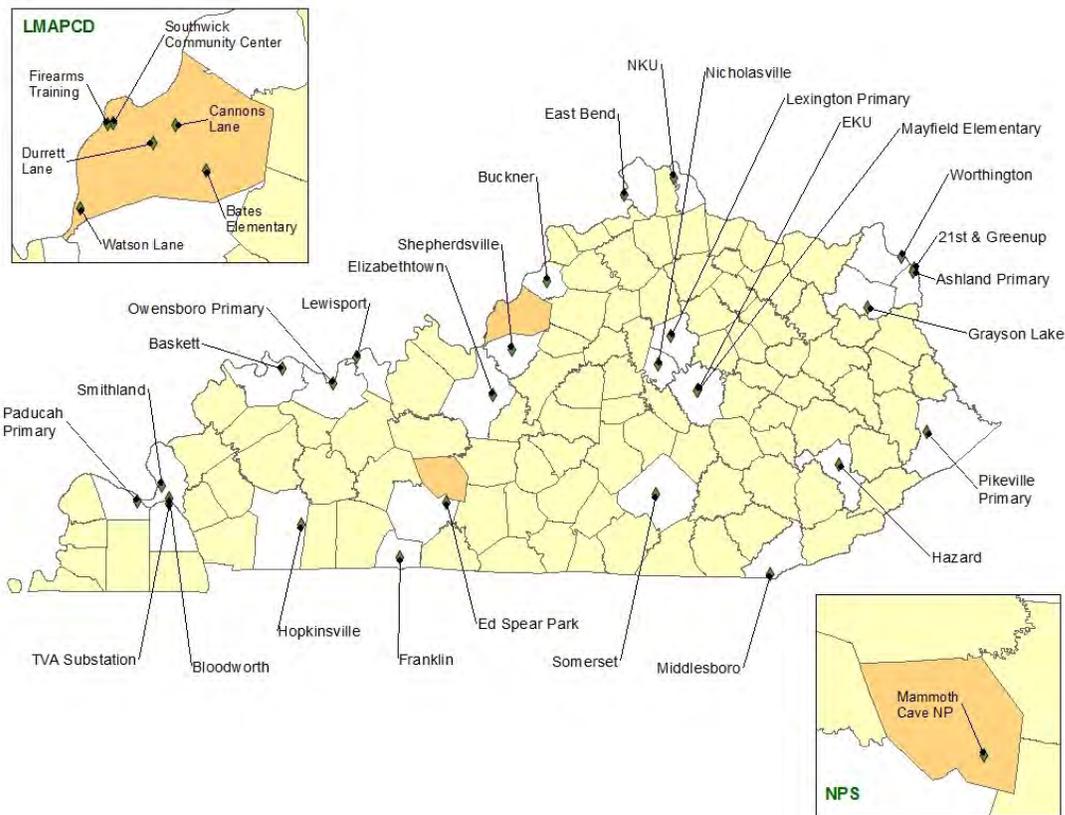


Kentucky Annual Ambient Air Monitoring Network Plan 2016



Commonwealth of Kentucky Energy & Environment Cabinet
Department for Environmental Protection
Division for Air Quality
300 Sower Boulevard
Frankfort, Kentucky 40601



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CERTIFICATION

By the signatures below, the Kentucky Division for Air Quality certifies that the information contained in this Surveillance Network document for sampling year 2016 is complete and accurate at the time of submittal to EPA Region 4. However, due to circumstances that may arise during the sampling year, some network information may change. A notification of change and a request for approval will be submitted to EPA Region 4 at that time, following a 30-day public comment period.

Print Name: Jennifer F. Miller
Signature: Jennifer F. Miller Date: 6/27/16
Environmental Scientist V

Print Name: John E. Gowins
Signature: John E. Gowins Date: 06/27/2016
Technical Services Branch Manager

Print Name: Sean O. Alteri
Signature: Sean O. Alteri Date: 6/27/16
Division Director

PUBLIC NOTIFICATION AND COMMENT PERIOD

In accordance with 40 C.F.R. 58.10(a)(1), the Kentucky Energy and Environment Cabinet shall make the annual monitoring network plan available for public inspection for at least 30 days prior to submission to the US EPA. The annual monitoring network plan details the operation and location of ambient air monitors operated by the Kentucky Division for Air Quality (KDAQ), Louisville Metro Air Pollution Control District (LMAPCD), and the National Park Service (NPS).

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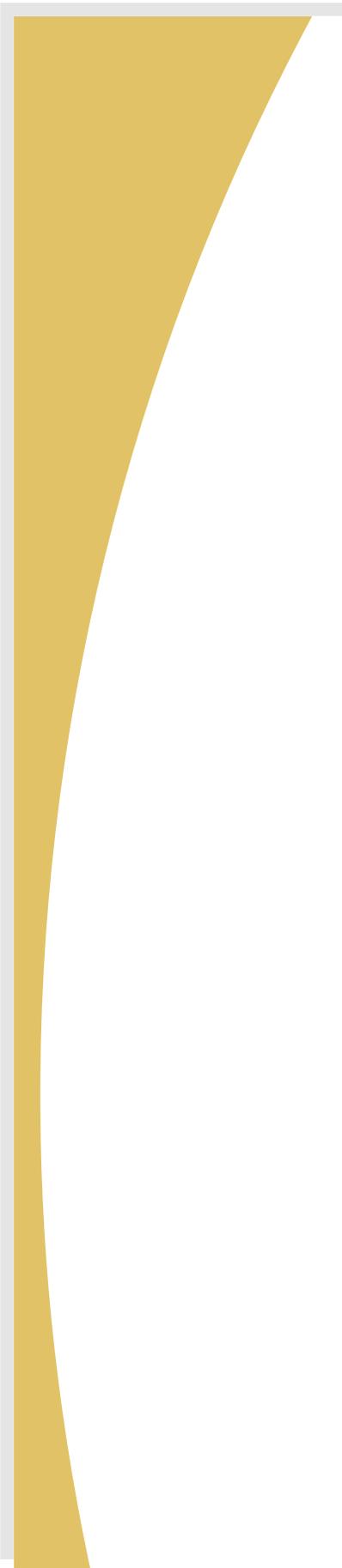
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ACRONYMS

| | |
|---------------|---------------------------------------------------|
| AEM | – Automated Equivalent Method |
| AQI | – Air Quality Index |
| AQS | – Air Quality System |
| ARM | – Automated Reference Method |
| BAM | – Beta Attenuation Monitor |
| CBSA | – Core-Based Statistical Area |
| CSA | – Combined Statistical Area |
| CO | – Carbon Monoxide |
| DRR | – Data Requirements Rule |
| FAM | – Federal Alternate Method |
| FEM | – Federal Equivalent Method |
| FRM | – Federal Reference Method |
| KDAQ | – Kentucky Division for Air Quality |
| LMAPCD | – Louisville Metro Air Pollution Control District |
| MSA | – Metropolitan Statistical Area |
| NAAQS | – National Ambient Air Quality Standards |
| NAMS | – National Air Monitoring Stations |

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| |
|--------------------------------------------------------------------------|
| NAREL – National Air and Radiation Environmental Laboratory |
| NATTS – National Air Toxics Trends Stations |
| NIST – National Institute of Standards and Technology |
| NO₂ – Nitrogen Dioxide |
| NPS – National Park Service |
| O₃ – Ozone |
| PAH – Polycyclic Aromatic Hydrocarbons |
| Pb – Lead |
| PM – Particulate Matter |
| PWEI – Population Weighted Emissions Index |
| RA-40 – Regional Administrator 40 |
| SAMWG – Standing Air Monitoring Working Group |
| SLAMS – State and Local Air Monitoring Stations |
| SO₂ – Sulfur Dioxide |
| SPM – Special Purpose Monitors |
| TBD – To Be Determined |
| TEOM – Tapered Elemental Oscillating Microbalance |
| U.S. EPA – United States Environmental Protection Agency |
| VOC – Volatile Organic Compounds |



INTRODUCTION

INTRODUCTION

The Kentucky Division for Air Quality (KDAQ) has operated an air quality monitoring network in the Commonwealth since July 1967. The Louisville Metro Air Pollution Control District (LMAPCD), a local agency, has maintained a sub-network in its area of jurisdiction since January 1956. Since that time, the networks have been expanded in accordance with United States Environmental Protection Agency's (US EPA) regulations.

In October 1975, the US EPA established a work group to critically review and evaluate current air monitoring activities at that time. This group was named the Standing Air Monitoring Working Group (SAMWG). The review by the SAMWG indicated several areas where deficiencies existed which needed correction. The principal areas needing correction were: an excess of monitoring sites in some areas to assess air quality; existing regulations that did not allow for flexibility to conduct special purpose monitoring studies; and data reporting that was untimely and incomplete. These deficiencies were primarily caused by a lack of uniformity in station locations and probe siting, sampling methodology, quality assurance practices, and data handling procedures.

In August 1978, recommendations developed by SAMWG, to remedy the deficiencies in the existing monitoring activities, were combined with the new requirements of Section 319 of the Clean Air Act. Section 319 provided for the development of uniform air quality monitoring criteria and methodology; reporting of a uniform air quality index in major urban areas; and the establishment of an air quality monitoring system nationwide which utilized uniform monitoring criteria and provides for monitoring stations in major urban areas that supplement State monitoring. The combination of the recommendations and requirements were included in a proposed revision to the air monitoring regulations.

In May 1979, air monitoring regulations were finalized by the US EPA requiring certain modifications and additions to be included in the State Implementation Plan for air quality surveillance. These regulations require each state to operate a network of monitoring stations designated as State and Local Air Monitoring Stations (SLAMS) that measure ambient concentrations of air pollutants for which standards have been established. The SLAMS designation contains provisions concerning the conformity to specific siting and monitoring criteria not previously required. The regulations also provide for an annual review of the monitoring network to insure objectives are being met and to identify needed modification.

The current overall network consists of 35 air monitoring stations, operated by KDAQ, LMAPCD, and the National Park Service (NPS). The Commonwealth's SLAMS air monitoring network monitors criteria pollutants for which the National Ambient Air Quality Standards (NAAQS) have been issued. In addition to a SLAMS network, KDAQ's air monitoring network includes special purpose monitors (SPM) for air toxics and meteorological data.

The annual monitoring network description, as provided for in 40 CFR Part 58.10, *Annual monitoring network plan and periodic network assessment*, must contain the following information for each monitoring station in the network:

1. The Air Quality System (AQS) site identification number for existing stations.
2. The location, including the street address and geographical coordinates, for each monitoring station.
3. The sampling and analysis method used for each measured parameter.

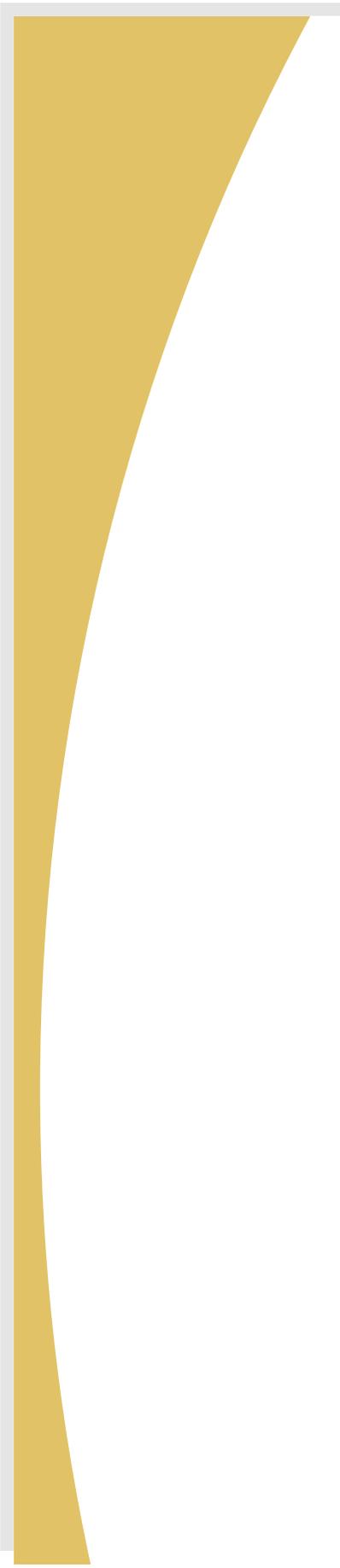
4. The operating schedule for each monitor.
5. Any proposal to remove or move a monitoring station within a period of eighteen months following the plan submittal.
6. The monitoring objective and spatial scale of representativeness for each monitor.
7. The identification of any site that is suitable for comparison against the PM_{2.5} NAAQS.
8. The Metropolitan Statistical Area (MSA), Core-Based Statistical Area (CBSA), Combined Statistical Area (CSA), or other area represented by the monitor.

The following document constitutes the Kentucky ambient air monitoring network description and is organized into main parts:

1. Station Description Format: An outline of the designations, parameters, monitoring methods, and the basis for site selection.
2. Network Summaries: Presenting the total number of sites and monitors in each region and for the state. Also included is a listing of all proposed changes to the current network.
3. Air Monitoring Station Description: Each air monitor station is described in detail as per the outline in (1) above.
4. Appendices: Additional information relating to the ambient air monitoring network.

Modification to the network as determined by an annual review process will be made each year to maintain a current network description document.

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AIR MONITORING NETWORK SUMMARY

SUMMARY OF KDAQ NETWORK CHANGES 2016

During the 2016-2017 monitoring year, KDAQ will operate 98 instruments, including 11 meteorological stations, located at 28 ambient air monitoring sites in 24 Kentucky counties. LMAPCD will operate an additional 32 instruments, including 5 meteorological stations, in Jefferson County. When combined with the air monitoring site operated by the NPS at Mammoth Cave National Park, the total ambient air monitoring network will consist of 136 instruments, including 17 meteorological stations, located at 35 sites across 26 counties of the Commonwealth.

KDAQ proposes to make the changes below to the ambient air monitoring network. As stated in Appendix E of this Annual Network Plan, LMAPCD currently does not plan to make any changes to the ambient air monitoring network in Jefferson County, KY.

METROPOLITAN STATISTICAL AREAS (MSAs):

- Bowling Green, KY:
 - The Mammoth Cave ozone monitor (21-061-0501), operated by the NPS, has been designated as the “Maximum O₃ Concentration” site for the MSA. This designation will be removed from KDAQ’s Ed Spear Park site (21-227-0009); effective July 1, 2016.
- Elizabethtown-Fort Knox, KY:
 - Designate the E-town ozone monitor (21-093-0006) as the “Maximum O₃ Concentration” site for the MSA; effective July 1, 2016.
- Evansville, IN-KY:
 - Change the “monitor type” of the Baskett ozone monitor (21-101-0014) from SPM to SLAMS. Designate the monitor as the “Maximum O₃ Concentration” site for the MSA. Both changes are effective July 1, 2016.
- Huntington-Ashland, WV-KY-OH:
 - Designate the Ashland Primary ozone monitor (21-019-0017) as the “Maximum O₃ Concentration” site for the MSA; effective July 1, 2016.
 - Change the scale of special-purpose metals parameters at the 21st & Greenup site (21-019-0002) from “Neighborhood” to “Middle,” which is the same scale used for PM₁₀ mass measurements; effective July 1, 2016.
- Lexington-Fayette, KY:
 - Designate the Lexington ozone monitor (21-067-0012) as the “Maximum O₃ Concentration” site for the MSA; effective July 1, 2016.

**SUMMARY OF KDAQ NETWORK CHANGES 2016
(Continued)**

MICROPOLITAN STATISTICAL AREAS:

- Middlesborough, KY:
 - Change the scale of the Middlesboro ozone monitor (21-013-0002) from “Regional” to “Neighborhood.” Effective July 1, 2016.

NOT IN A METROPOLITAN OR MICROPOLITAN STATISTICAL AREA:

- Grayson, KY:
 - Change the scale of the Grayson Lake ozone monitor (21-043-0500) from “Urban” to “Regional”; effective July 1, 2016.
- Calvert City, KY:
 - Discontinue the Atmos special-purpose VOC site (21-157-0016) as a cost-saving measure; effective December 31, 2016. VOC monitoring in the Calvert City area will continue at the TVA Substation (21-157-0014) and Bloodworth (21-139-0004) sites.

SO₂ DATA REQUIREMENTS RULE MONITORING:

- A SLAMS SO₂ monitoring site will be established near Sebree, KY (Evansville, IN-KY MSA) in order to characterize the air near the Big Rivers Electric Corporation & Century Aluminum Sebree, LLC facilities. While exact logistics have not been finalized, KDAQ has entered into negotiations to operate the site as a part of the Kentucky network. Available details about the site, and the process used for site selection, are included in Appendix H of this network plan. The monitor is to be operational by January 1, 2017.

INTERMITTENT PM_{2.5} SAMPLERS:

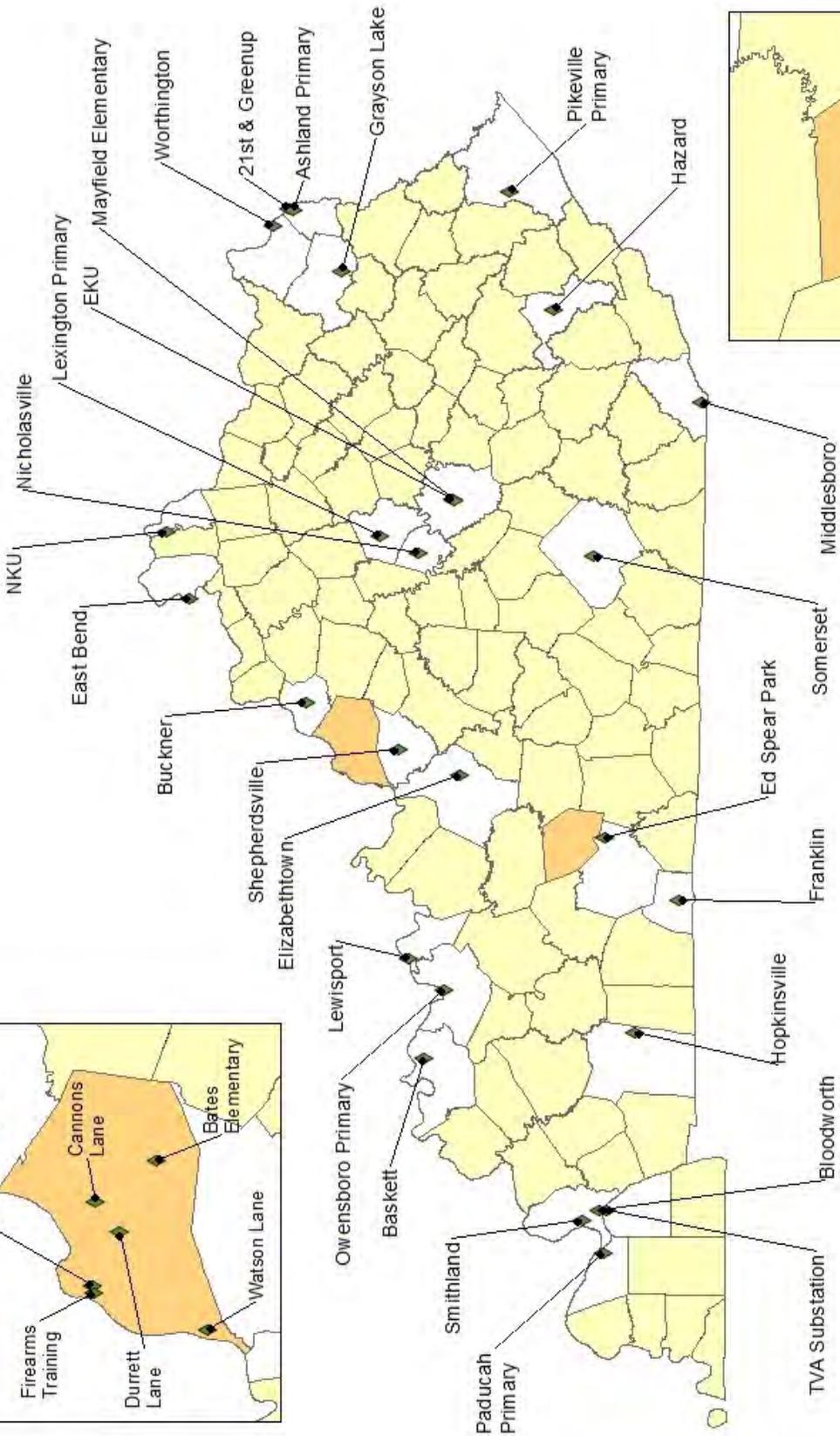
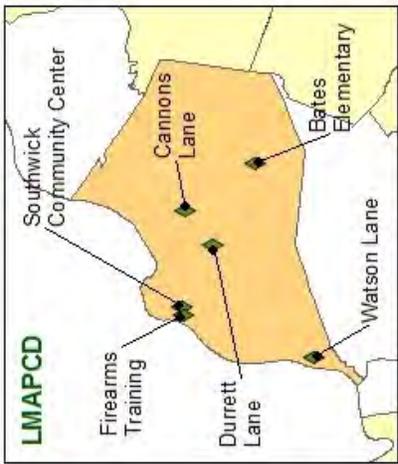
- As recommended by EPA Region 4, KDAQ plans to convert all intermittent PM_{2.5} samplers currently using a FRM impactor configuration to a FRM/FEM Very Sharp Cut Cyclone (VSCC) configuration; effective January 1, 2017.

AIR MONITORING STATIONS SUMMARY

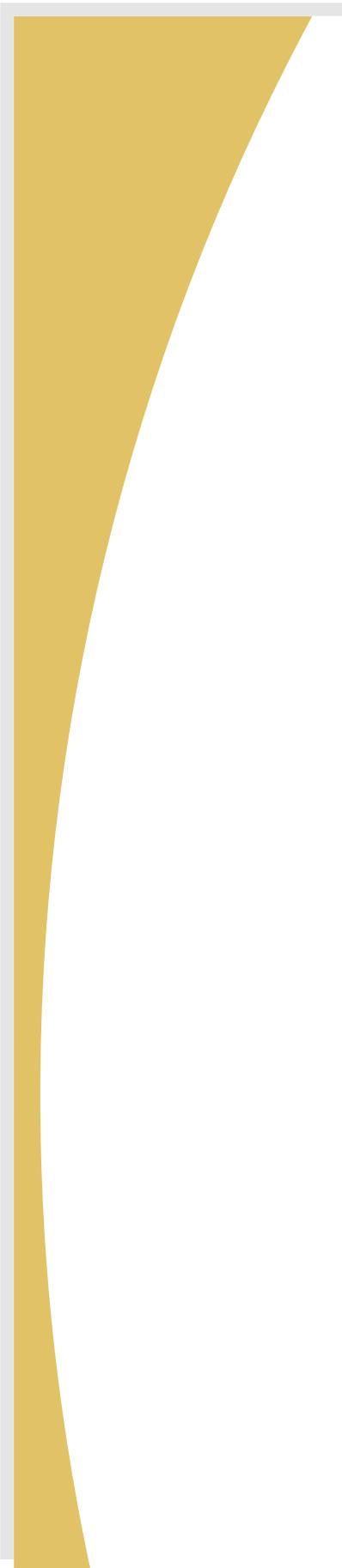
| Metropolitan Statistical Area | Site Count | PM2.5 | Continuous PM2.5 | PM10 | Continuous PM10 | SO2 | NO2 | NOy | CO | O3 | Pb | VOC | Carbonyl | PAH | PM2.5 Speciation | Carbon Speciation | RadNet | Met |
|-------------------------------------------------|------------|------------------|--------------------|--------------------|------------------|------------------|--------------------|----------|-----------------|---------------------|----------|----------------|----------------|----------|------------------|-------------------|----------|----------------|
| Bowling Green, KY | 2 | 2 ^C | 2 ⁱ | | | 1 | | 1 | 1 | 2 ^{i, Max} | | | | | | | | 1 |
| Cincinnati-Middletown, OH-KY-IN (AQB) (PWEI) | 2 | 1 | 1 ⁱ | | | 1 ⁱ | 1 ⁱ | | | 2 ⁱ | | | | | | | | 1 |
| Clarksville, TN-KY | 1 | 1 ^X | | | | | | | | 1 | | | | | | | | 1 |
| Elizabethtown, KY | 1 | 2 ^C | 1 | | | | | | | 1 ^{Max} | | | | | | | | |
| Evansville, IN-KY (PWEI) | 2 | 1 | 1 | 1 ^m | | 2 ^{DRR} | | | | 1 ^{Max} | | | | | | | | |
| Huntington-Ashland, WV-KY-OH (AQB) (PWEI) | 3 | 1 | 1 ⁱ | 2 ^{C,m} | | 2 ⁱ | 1 ⁱ | | | 2 ^{i, Max} | | 1 | | | | | | 1 |
| Lexington-Fayette, KY (AQB) (PWEI) | 2 | 1 | 1 ⁱ | 1 ^m | | 2 ⁱ | 1 ^{r40,i} | | | 2 ^{i, Max} | | 1 | | | | | 1 | 1 |
| Louisville-Jefferson County, KY-IN (AQB) (PWEI) | 8 | 5 ^{n,C} | 4 ^{i,B,*} | 1 ^{L,end} | 3 ^{i,B} | 3 ⁱ | 2 ^{n,i} | 1 | 2 ⁿⁱ | 5 ^{i, Max} | | | | | 1 ^U | 1 ^U | 1 | 6 ⁿ |
| Owensboro, KY | 2 | 1 | 1 ⁱ | | | 1 ⁱ | 1 ⁱ | | | 2 ^{i, Max} | | | | | | | | 1 |
| Metropolitan Statistical Area | | | | | | | | | | | | | | | | | | |
| Paducah, KY-IL (PWEI) | 3 | 1 | 1 ⁱ | 2 ^m | | 1 ⁱ | 1 ⁱ | | | 2 ⁱ | | 1 | | | | | 1 | 1 |
| Somerset, KY | 1 | 1 | | | | | | | | 1 | | | | | | | | |
| Middlesboro, KY | 1 | 1 | | | | | | | | 1 | | | | | | | | 1 |
| Richmond-Berea, KY | 2 | 1 | | | | | | | | | 3 | | | | | | | |
| Not in a CBSA | | | | | | | | | | | | | | | | | | |
| Carter County | 1 | 1 ^X | | 2 ^{C,m} | | | | | | 1 | | 2 ^D | 2 ^D | 1 | | | | 1 |
| Marshall County | 2 | | | | | | | | | | | 2 ^C | | | | | | |
| Perry County | 1 | 1 | 1 | | | | | | | 1 | | | | | | | | 1 |
| Pike County | 1 | 2 ^C | 1 ⁱ | | | | | | | 1 ⁱ | | | | | | | | |
| Simpson County | 1 | | | | | | | | | 1 | | | | | | | | 1 |
| KDAQ Totals | 28 | 18 | 10 | 8 | 0 | 9 | 5 | 0 | 0 | 22 | 3 | 7 | 2 | 1 | 0 | 0 | 2 | 11 |
| LMAPCD Totals | 6 | 5 | 4 | 1 | 3 | 3 | 2 | 1 | 2 | 3 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 5 |
| NPS Totals | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total 2015 Network | 35 | 23 | 15 | 9 | 3 | 13 | 7 | 2 | 3 | 26 | 3 | 7 | 2 | 1 | 1 | 1 | 3 | 17 |

Tallies are equal to the actual number of monitors present. Superscripts represent additional information about the network. PWEI= PWEI SO2 Monitoring Required in MSA; r40=RA-40 Monitor; Max= Maximum O3 Concentration Site; n=Near-Road Monitor; X= Regional PM2.5 Transport or Background Monitor; B=Continuous BAM; *=BAM Eligible for NAAQS Comparisons; AQI=AQI Monitoring Required in CBSA; i=AQI Reported; m= PM10 Filter Analyzed for Metals; Lead=PM10 Filter Analyzed for Lead; C=Collocated Monitors ; D= Duplicate Channels; U= Additional Monitor Used for Weekend and Holiday Sampling; DRR= SO2 Data Requirements Rule Monitor

2016 Ambient Air Monitoring Network



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STATION DESCRIPTION FORMAT

STATION DESCRIPTION FORMAT

AQS Site Identification Information

Pertinent, specific siting information for each site and monitor is stored in the US EPA's AQS data system. This information includes the exact location of the site, local and regional population, description of the site location, monitor types, and monitoring objectives. This site and monitor information is routinely updated whenever there is a change in site characteristics or pollutants monitored.

Network Station Description

The network station descriptions contained in this document include the following information:

1. Site Description

Specific information is provided to show the location of the monitoring equipment at the site, the CBSA in which the site is located, the AQS identification number, the GPS coordinates, and the conformance of monitors and monitor-probes to siting criteria.

2. Date Established

The date that each existing monitoring station was established is shown in the description. For proposed air monitoring stations, the date that the station is expected to be in operation is included in the annual Summary of Network Changes.

3. Site Approval Status

Each monitoring station in the existing network has been reviewed with the purpose of determining whether it meets all design criteria for inclusion in the SLAMS network. Stations that do not meet the criteria will either be relocated in the immediate area or, when possible, re-sited at the present location. KDAQ may also seek an exemption from certain criteria from the US EPA.

4. Monitoring Objectives

The monitoring network was designed to provide information to be used as a basis for the following actions:

- (a) To determine compliance with ambient air quality standards and to plan measures in order to attain these standards.
- (b) To activate emergency control procedures in the event of an impending air pollution episode.
- (c) To observe pollution trends throughout a region including rural areas and report progress made toward meeting ambient air quality standards.
- (d) To provide a database for the evaluation of the effects of air quality on population, land use, and transportation planning; to provide a database for the development and evaluation of air dispersion models.

5. Monitoring Station Designations, Monitor Types, and Network Affiliations

The Annual Network Surveillance document must describe the types of monitors that are used to collect ambient data. Most monitors described in the air quality surveillance network are designated as SLAMS, but some monitors fulfill other requirements. Additionally, monitors may be associated with additional networks beyond the state air program or may be used to fulfill multiple network design requirements.

State and Local Air Monitoring Stations (SLAMS): Requirements for air quality surveillance systems provide for the establishment of a network of monitoring stations designated as SLAMS that measure ambient concentrations of pollutants for which standards have been established. These stations must meet requirements that relate to four major areas: quality assurance, monitoring methodology, sampling interval, and siting of instruments.

Special Purpose (SPM and SPM-Other): Not all monitors and monitoring stations in the air quality surveillance network are included in the SLAMS network. In order to allow the capability of providing monitoring for complaint studies, modeling verification and compliance status, certain monitors are reserved for short-term studies and are designated as either Special Purpose Monitors (SPM) or Other Special Purpose Monitors (SPM-Other).

NCore: NCore is a multi pollutant network that integrates several advanced measurement systems for particulates, pollutant gases and meteorology.

Air Quality Index (AQI): The AQI is a method of reporting that converts pollutant concentrations to a simple number scale of 0-500. Intervals on the AQI scale are related to potential health effects of the daily measured concentrations of major pollutants. AQI reporting is required for all metropolitan statistical areas with a population exceeding 350,000. However, KDAQ provides this service to the general public for multiple areas within the state. KDAQ prepares the index twice daily for release to the public from the pollutant data reported from the Field Offices. The ambient air data establishing the AQI is subject to quality assurance procedures and is not considered official.

Emergency Episode Monitoring (Episode): Regulations provide for the operation of at least one continuous SLAMS monitor for each major pollutant in designated locations for emergency episode monitoring. These monitors are placed in areas of worst air quality and provide continual surveillance during episode conditions.

EPA: Monitor operated by the EPA or an EPA contractor. Monitors may be eligible for comparisons against the NAAQS and are typically apart of the CASTNET network.

Non-EPA Federal: Monitors operated by Federal agencies outside of the US EPA (such as the National Park Service) are designated as Non-EPA Federal monitors. These monitors are typically used for special studies, but the data may also be eligible for comparisons against the NAAQS.

Population Weighted Emissions Index (PWEI): On June 22, 2010, the US EPA released a new SO₂ Final Rule and a set of monitoring requirements. The requirements use a Population Weighted Emissions Index (PWEI) that is calculated for each Core-Based Statistical Area (CBSA). The PWEI is calculated by multiplying the population of each CBSA and the total amount of SO₂, in tons per year, that is emitted within the CBSA based upon county level data from the National Emissions Inventory (NEI). The result is then divided by one million to

provide the PWEI value, which is expressed in a unit of million persons-tons per year. PWEI requirements technically apply to the MSA and are not monitor specific. Any SO₂ used to fulfill MSA PWEI requirements must first and foremost be designated as SLAMS.

Regional Administrator 40 (RA-40): On February 9, 2010, the US EPA released a new NO₂ Final Rule and a new set of monitoring requirements. Under the new monitoring regulations, the EPA Regional Administrator must collaborate with agencies to establish or designate 40 NO₂ monitoring locations, with a primary focus on protecting susceptible and vulnerable populations. RA-40 NO₂ monitors are SLAMS monitors foremost.

Maximum Ozone Concentration: Each Metropolitan Statistical Area (MSA) must have at least one ozone monitor designed to record maximum expected ozone concentrations. These monitors are first and foremost SLAMS (or SLAMS-like) monitors.

6. Monitoring Methods

All sampling and analytical procedures used for NAAQS compliance in the air-monitoring network conform to Federal reference (FRM), alternate (FAM), or equivalent (FEM) methods. In case there is no federal method, procedures are described in the Kentucky Air Quality Monitoring and Quality Assurance Manuals.

(a) Particulate Matter 10 Microns in Size (PM₁₀)

All PM₁₀ samplers operated by KDAQ are certified as either FRM or FEM samplers and are operated according to the requirements set forth in 40 CFR 50 and 40 CFR 53. Intermittent samplers typically collect a 24-hour sample every sixth day on 46.2 mm PTFE filters. However, certain sites may collect samples more frequently to address local air quality concerns. Filters are weighed before and after a sample run. The gain in weight in relation to the volume of air sampled is calculated in micrograms per cubic meter (ug/m³). The PTFE filters are to be equilibrated before each weighing for a minimum of 24 hours at a 20-23 degrees C mean temperature and a 30-40% mean relative humidity.

LMAPCD operates continuous PM₁₀ samplers that provide 24-hour samples daily for SLAMS reporting. During sampling, ambient air passes through an inlet designed to pass only particles smaller than 10 microns in diameter. In PM₁₀ TEOMs, the sample stream passes through a Teflon-coated glass fiber filter. This filter is weighed every two seconds. The difference between the current filter weight and the initial or installed weight gives the total mass of the collected particulate. The data is transmitted by telemetry for entry into an automated central data acquisition system.

LMAPCD also operates PM₁₀ BAMs, which measure PM₁₀ through beta ray attenuation. After passing through an inlet designed to limit the size of particulate matter to 10 microns or less, the sample stream passes through filter tape, which is then placed in between a beta source and a scintillation detector causing an attenuation of the beta particle signal. The data is transmitted by telemetry for entry into an automated central data acquisition system.

(b) Particulate Matter 2.5 Microns in Size (PM_{2.5})

The Division currently operates continuous TEOM monitors and manual intermittent samplers for monitoring particulate matter 2.5 microns in size (PM_{2.5}). With the exception of continuous TEOM monitors, all PM_{2.5} samplers operated by the Division for Air Quality are certified as FRM samplers. All FRM manual intermittent samplers are operated per the requirements set

forth in 40 CFR 50, Appendix L. Samples are collected on 46.2 mm PTFE filters over a 24-hour sampling period, with airflow maintained at 16.7 liters per minute. The flow rate must not vary more than +/-5% for five minutes over a 24-hour sample period at actual ambient temperature and pressure. Samples must be retrieved within 177 hours of the end of the sample run and must be kept cool (4 degrees C or cooler) during transit to meet the thirty-day limit for re-weighing. The PTFE filters are to be equilibrated before each weighing for a minimum of 24 hours at a controlled atmosphere of 20-23 degrees C mean temperature and 30-40% mean relative humidity. Filters must be used within thirty days of initial weighing. Filters must be re-weighed within thirty days of the end of the sample run and must be kept at 4 degrees C or cooler. The gain in weight in relation to the volume of air sampled is calculated in micrograms per cubic meter ($\mu\text{g}/\text{m}^3$).

Continuous $\text{PM}_{2.5}$ TEOM monitors provide 24-hour samples daily for AQI reporting. During sampling, ambient air passes through an inlet and very sharp cut cyclone designed to pass only particles smaller than 2.5 microns in diameter. After exiting the inlet, the sample stream is sent to a mass transducer. Inside the transducer the sample stream passes through a Teflon-coated glass fiber filter. This filter is weighed every two seconds. The difference between the current filter weight and the initial or installed weight gives the total mass of the collected particulate. The mass concentration is computed by dividing the total mass by the flow rate. Data is transmitted by telemetry for entry into the automated central data acquisition system. While usable for the AQI, $\text{PM}_{2.5}$ TEOMs are not classified as either FRM or FEM monitors; and thus, are not eligible for comparison to the NAAQS.

LMAPCD operates continuous $\text{PM}_{2.5}$ BAM monitors, which measure $\text{PM}_{2.5}$ through beta ray attenuation. During sampling, ambient air passes through an inlet and a cyclone designed to pass only particles smaller than 2.5 microns in diameter. The sample is collected on filter tape as the air passes through the tape. The filter tape is then placed in between a beta source and a scintillation detector causing an attenuation of the beta particle signal. Data is transmitted by telemetry for entry into the automated central data acquisition system.

Continuous $\text{PM}_{2.5}$ BAMs provide 24-hour daily reporting for the AQI. The data obtained from $\text{PM}_{2.5}$ BAMs may or may not be used for comparison to the NAAQS. $\text{PM}_{2.5}$ BAMS that are operated as FEMs, and demonstrate comparability to the data obtained from manual FRM samplers, are eligible for comparisons to the NAAQS. A statement on the use of continuous FEM $\text{PM}_{2.5}$ monitors is included in the appendices of this document.

(c) **$\text{PM}_{2.5}$ Speciation and Carbon Speciation Sampling and Analysis**

In addition to operating $\text{PM}_{2.5}$ samplers that determine only $\text{PM}_{2.5}$ mass values, LMAPCD also operates $\text{PM}_{2.5}$ speciation samplers that collect samples that are analyzed to determine the chemical makeup of $\text{PM}_{2.5}$. Samples are collected on a set of two filters, one comprised of Teflon and a one comprised of nylon, over a 24-hour sampling period. The filters are composed of either Teflon or nylon in order to collect specific types of toxic pollutants. A second instrument collects a sample on a quartz filter over a 24-hour sampling period. The quartz filter is used to collect a speciated carbon sample.

After collection, the samples are shipped in ice chests to an EPA contract laboratory for analysis. At the laboratory, the samples are analyzed using optical and electron microscopy, thermal-optical analysis, ion chromatography, and x-ray fluorescence to determine the presence and level of specific toxic compounds. Sample results are entered in the AQS data system.

(d) **Sulfur Dioxide (SO₂)**

Instruments used to continuously monitor sulfur dioxide levels in the atmosphere employ the UV fluorescence method. The continuous data output from the instrument is transmitted by telemetry for entry into an automated central data system.

Calibration of these instruments is done dynamically using certified gas mixtures containing a known concentration of sulfur dioxide gas. This gas is then diluted in a specially designed apparatus to give varying known concentrations of sulfur dioxide. These known concentrations are supplied to the instruments, which are adjusted so that instrument output corresponds with the specific concentrations. Calibration curves are prepared for each instrument and each data point is automatically compared to this curve before entry into the data acquisition system.

(e) **Carbon Monoxide (CO)**

Continuous monitoring for carbon monoxide is performed by use of the non-dispersive infrared correlation method. Data is transmitted by telemetry for entry in an automated central data acquisition system.

Calibration of the instrument is performed periodically by using nitrogen or zero air to establish the zero baseline and NIST or NIST traceable gas mixtures of carbon monoxide in air. The span is checked daily using a certified mixture of compressed gas containing approximately 45 parts per million carbon monoxide.

(f) **Ozone (O₃)**

Ozone is monitored using the UV photometry methods. The continuous data output from the instrument is transmitted by telemetry for entry into an automated central data acquisition system.

Monitors are calibrated routinely using an ozone generator, which is calibrated using the ultra violet photometry reference method. Calibration curves are prepared for each instrument and each data point is automatically compared to this curve before entry into the data acquisition system.

(g) **Nitrogen Dioxide (NO₂)**

KDAQ uses the chemiluminescence method for monitoring the nitrogen dioxide level in the ambient air. The continuous data output from the instrument is transmitted by telemetry for entry into an automated central data acquisition system.

LMAPCD utilizes the photolysis method at its near-road site. In this method, an ambient sample stream passes through a cell and is exposed to light from an LED array at a specific wavelength. The process causes nitrogen dioxide to be converted to nitrogen oxide.

Calibration of these instruments is done dynamically using NIST certified gas mixtures of nitric oxide. Through the use of dilution apparatus, varying concentrations are produced and supplied to the monitors, thus producing a specific calibration curve for each instrument. Each data point is automatically compared to this curve before entry into the data acquisition system.

(h) **Lead (Pb)**

To determine lead concentrations, KDAQ uses high volume particulate samplers, which collect samples of suspended particulates onto 8 x 10 glass fiber filters. The samplers use a brushless motor and a critical flow orifice in order to achieve a sampling flow rate between 1.10 and 1.70 cubic meters per minute (m³/min) over the course of 24 hours. Upon collection, the filters are sent to an US EPA certified laboratory for analysis. The sample filters are cut into strips, acid digested according to 40 CFR Part 50, Appendix G, and analyzed by Inductively Coupled Plasma with Mass Spectroscopy Detection (ICP-MS).

LMAPCD sends 46.2 mm PTFE filters, collected via the FRM/FEM intermittent PM₁₀ low volume methodology, to an US EPA certified laboratory for analysis. Filters are analyzed via x-ray fluorescence to determine lead concentrations.

(i) **Air Toxics**

Air toxics samples are classified into four categories: metals, volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH), and carbonyls.

Metal samples are collected on 46.2 mm PTFE filter over a 24-hour period from the PM₁₀ monitoring method. The filter is weighed before and after the sample run. The gain in weight in relation to the volume of air sampled is used to calculate the concentration in micrograms per cubic meter (ug/m³). The PTFE filter is to be equilibrated before each weighing for a minimum of 24 hours at a 20-23 degrees C mean temperature and a 30-40% mean relative humidity. The filter is then delivered to an US EPA contract laboratory for analysis by inductively coupled plasma/mass spectrometer analysis.

VOC samples are collected in a passivated vacuum canister. Ambient air is pulled into the canister over a 24-hour sampling period. The sample is shipped to an US EPA contract laboratory for analysis via gas chromatography.

PAH samples are collected by a hi-volume air sampler over a 24-hour period. The sample is collected on a polyurethane foam filter cartridge. After sampling, the filter cartridge is packed on ice and shipped to an US EPA contract laboratory for analysis via gas chromatography/mass spectrometry.

Carbonyl samples are collected on a DPNH cartridge. An ambient air stream flows through the cartridge at a one-liter per minute flow rate for a 24-hour sampling period. The cartridge is packed on ice and shipped to an US EPA contract laboratory for high-pressure liquid chromatography analysis.

(j) **RadNet**

The US EPA RadNet fixed air station consists of a high-volume sampler that pulls ambient air through a 4-inch diameter filter at a rate of 1,000 liters per minute. Filters are collected twice each week. The instrument also consists of two radiation detectors that continuously measure gamma and beta radiation from particulates collected on the air filter. Data is recorded to the monitor's CPU and is sent hourly to the National Air and Radiation Environmental Laboratory (NAREL) for evaluation.

The RadNet network, which has stations in each State, has been used to track environmental

releases of radioactivity from nuclear weapons tests and nuclear accidents. RadNet also documents the status and trends of environmental radioactivity. In general, data generated from RadNet provides the information base for making decisions necessary to ensure the protection of public health. The system helps the EPA determine whether additional sampling or other actions are needed in response to particular releases of radioactivity to the environment. RadNet can also provide supplementary information on population exposure, radiation trends, and other aspects of releases. Data is published by NAREL in a quarterly report entitled *Environmental Radiation Data*. While the Division operates the monitors, all other aspects, including maintenance and data responsibility, are handled by the US EPA. For more information, please visit the US EPA's RadNet website: <http://www.epa.gov/narel/radnet/>.

7. Quality Assurance Status

The Division for Air Quality has an extensive quality assurance program to ensure that all air monitoring data collected is accurate and precise. Staff members audit air monitors on a scheduled basis, including those operated by the Louisville Metro Air Pollution Control District and the National Park Service, to ensure that each instrument is calibrated and operating properly. Agencies audit their data monthly and verify that the data reported by each instrument is recorded accurately in the computerized database.

8. Scale of Representativeness

Each station in the monitoring network must be described in terms of the physical dimensions of the air parcel nearest the monitoring station throughout which actual pollutant concentrations are reasonably similar. Area dimensions or scales of representativeness used in the network description are:

- (a) Microscale - defines the concentration in air volumes associated with area dimensions ranging from several meters up to about 100 meters.
- (b) Middle scale - defines the concentration typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometers.
- (c) Neighborhood scale - defines the concentrations within an extended area of a city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers.
- (d) Urban scale - defines an overall city-sized condition with dimensions on the order of 4 to 50 kilometers.
- (e) Regional Scale - defines air quality levels over areas having dimensions of 50 to hundreds of kilometers.

The scale of representativeness is closely related to the type of air monitoring site and the objectives of that site. There are six basic types of sites supported by the ambient air monitoring network:

- (a) To determine the highest concentrations expected to occur in the area covered by the network.
- (b) To determine representative concentrations in areas of high population density.
- (c) To determine the impact on ambient pollution levels of significant sources or source categories.

- (d) To determine the extent of regional transport of pollutants.
- (e) To determine general background concentration levels.
- (f) To determine impacts on visibility, vegetation damage, or other welfare-based concerns.

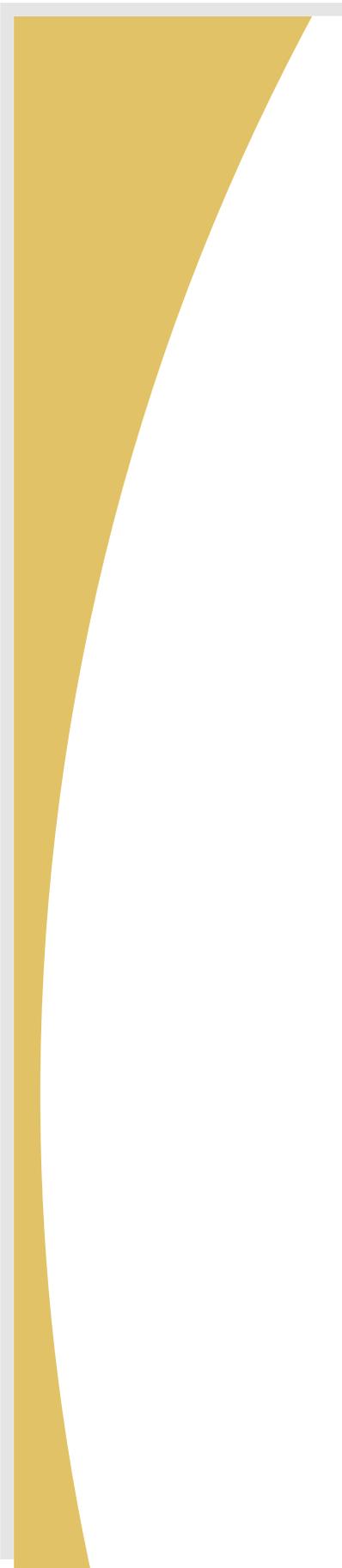
The design intent in siting stations is to correctly match the area dimensions represented by the sample of monitored air with the area dimensions most appropriate for the monitoring objective of the station. The following relationship of these six basic site type and the scale of representativeness are appropriate when siting monitoring stations:

| <u>Monitoring Site Type</u> | <u>Scale of Representativeness</u> |
|-----------------------------------------|------------------------------------|
| Highest Concentration | Micro, Middle, Neighborhood |
| Population Oriented | Neighborhood, Urban |
| Source Impact | Micro, Middle, Neighborhood |
| Regional Transport & General Background | Neighborhood, Regional |
| Welfare-based Impacts | Urban, Regional |

Data Processing and Reporting

All ambient air quality data are stored in a centralized server located at the 14th floor of the Capital Plaza Tower, the Energy and Environment Cabinet (EEC) headquarters in Frankfort, Kentucky. The server is backed up on tape nightly, weekly, and monthly. The backup tape of the server is stored off site of the EEC headquarters and is cycled through use on a monthly schedule. After each month of data has passed all quality assurance checks, the data is transmitted via telemetry to the US EPA's national data storage system known as AQS. Statistical data summaries are generated from this database and compiled to produce the Ambient Air Quality Annual Report. This report may be accessed at the KDAQ website: <http://air.ky.gov>. The report is located under Resources.

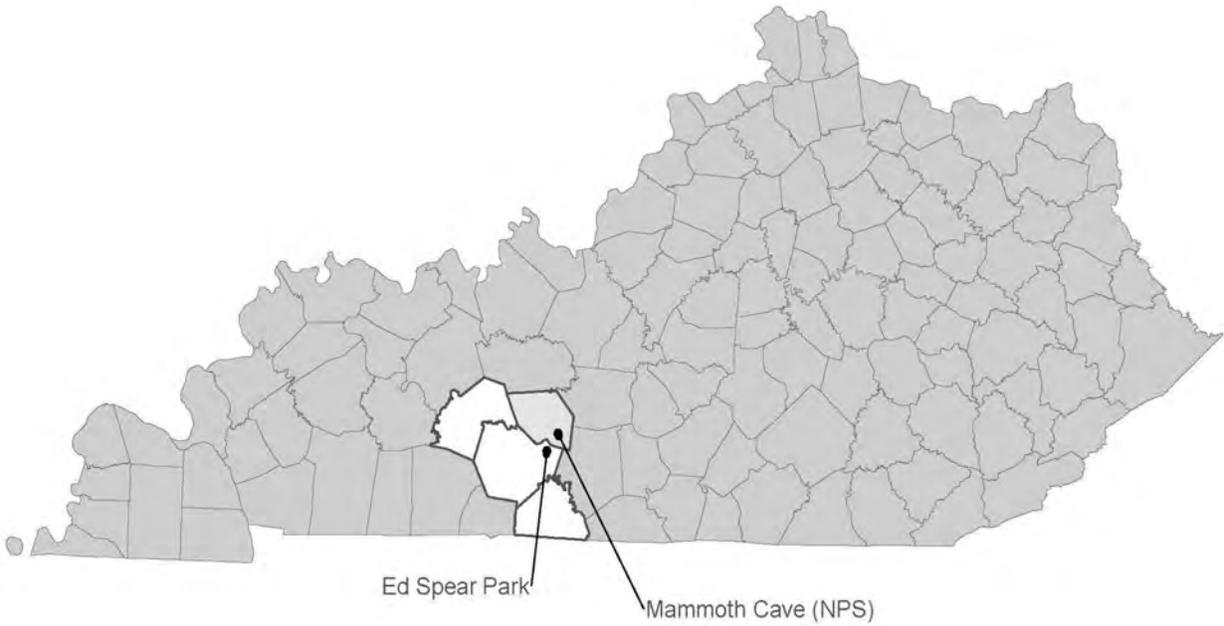
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**AIR MONITORING STATION
DESCRIPTIONS**

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Bowling Green, KY



| AQS ID / County | Site Address | PM2.5 | Cont. PM2.5 | PM10 | Cont. PM10 | SO2 | NO2 | NOy | CO | O3 | Pb | VOC | Carbonyl | PAH | PM2.5 Spec. | Carbon Spec. | RadNet | Met |
|-------------------------|----------------------------------------|----------------|-----------------|------|------------|----------------|-----|----------------|----------------|-------------------|----|-----|----------|-----|-------------|--------------|--------|----------------|
| 21-061-0501 Edmonson | Alfred Cook Road Mammoth Cave (NPS) | | 1 ^{tF} | | | 1 ^F | | 1 ^F | 1 ^F | 1 ^{F, M} | | | | | | | | 1 ^F |
| 21-227-0009 Warren | 226 Sunset Street Smiths Grove | 2 ^C | 1 ^t | | | | | | | 1 ⁱ | | | | | | | | |
| Totals | 2 | 2 | 2 | | | 1 | | 1 | 1 | 2 | | | | | | | | 1 |

Tallies are equal to the actual number of monitors present. Superscripts represent additional information about the network.

F=Non-EPA Federal Monitor

t=Continuous TEOM Monitor

C=Collocated

i=AQI Reported

M=Maximum Ozone Concentration Site for MSA

CSA/MSA: Bowling Green-Glasgow, KY CSA; Bowling Green, KY MSA
401 KAR 50:020 Air Quality Region: South Central Kentucky Intrastate (105)
Site Name: Mammoth Cave National Park, Houchin Meadow
AQS Site ID: 21-061-0501
Location: Alfred Cook Road, Park City, KY 42160
County: Edmonson
GPS Coordinates: 37.131944, -86.14778 (NAD83)
Date Established: August 1, 1997
Inspection Date: October 21, 2015
Inspection By: Ashley Bedel



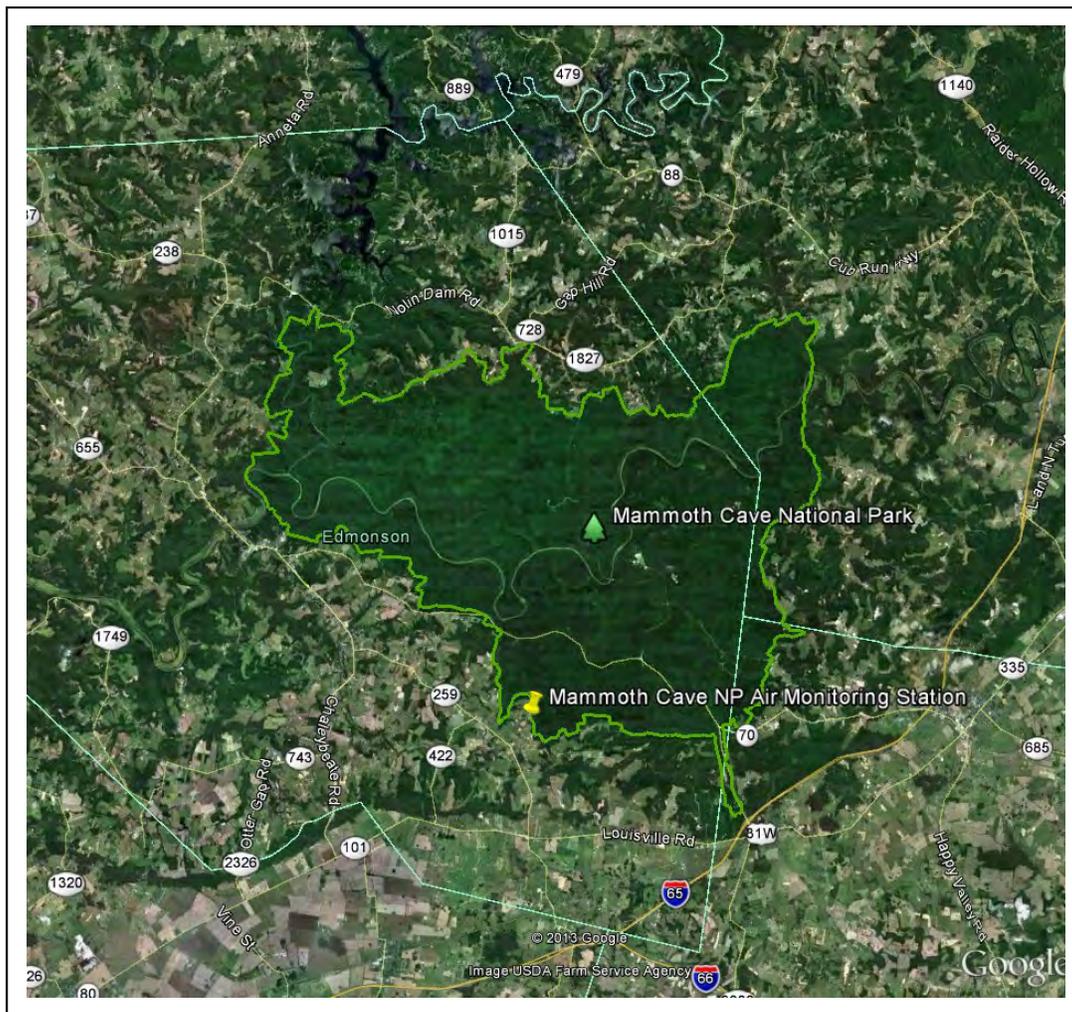
Mammoth Cave National Park was established as one of 156 mandatory Federal Class I Areas nationwide under the Clean Air Act Amendments of 1977. Class I Areas are imparted with the highest level of air quality protections, especially regarding visibility degradation (haze). The Division maintains a cooperative relationship with Mammoth Cave National Park and frequently includes the site's data in air quality analyses. Additionally, the ozone monitor is designated as the "Maximum Ozone Concentration" monitor for the Bowling Green, KY MSA. However, the Division does not operate the site nor certify the annual data. While the park conducts a variety of air quality studies, only certain data is reported to the EPA's AQS database.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|-----------------------------------------------|-----------------------|---------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------|
| AEM Ozone | 11.0 | CASTNET Maximum O ₃ Non-EPA Federal | Automated Equivalent Method utilizing UV photometry analysis | Continuously |
| Sulfur Dioxide | 10.0 | Non-EPA Federal | Automated Equivalent Method utilizing trace level UV fluorescence analysis | Continuously |
| Total Reactive Nitrogen (NO/NO _y) | 10.0 | Non-EPA Federal | Automated method utilizing trace level chemiluminescence analysis | Continuously |
| Carbon Monoxide | 10.0 | Non-EPA Federal | Automated Reference Method utilizing trace level non-dispersive infrared analysis | Continuously |

Monitors (Continued):

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|------------------------|-----------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| PM _{2.5} TEOM | 2.5 | Non-EPA Federal | Tapered element oscillating microbalance, gravimetric. | Continuously |
| Meteorological | 15.0 | Non-EPA Federal | AQM grade instruments for wind speed, wind direction, solar radiation, precipitation, humidity, barometric pressure, and temperature | Continuously |



CSA/MSA: Bowling Green-Glasgow, KY CSA; Bowling Green, KY MSA
401 KAR 50:020 Air Quality Region: South Central Kentucky Intrastate (105)
Site Name: Ed Spear Park
AQS Site ID: 21-227-0009
Location: 226 Sunset Street, Smiths Grove, KY 42171
County: Warren
GPS Coordinates: 37.04926, -86.21487 (NAD83)
Date Established: May 3, 2012
Inspection Date: October 21, 2015
Inspection By: Ashley Bedel
Site Approval Status: Siting and monitor design has been approved by the EPA.



This monitoring site was established as a replacement for the Oakland (Warren County) air monitoring station (21-227-0008). In October 2010, the Oakland site was found to be sitting within the doline of a sinkhole and was discontinued. Monitoring was established at the new Ed Spear Park site in May 2012. Inspections found the sample lines and equipment to be in good condition. The sample inlets are 42 meters from the nearest road. The site meets the requirements of 40 CFR 58, Appendices A, C, D and E.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards. While not required for the CBSA, the site also provides levels of ozone and particulate matter for daily index reporting.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|----------------------------------|-----------------------|--------------|-------------------------------------------------------|--------------------------------------|
| AEM Ozone | 4.5 | SLAMS AQI | UV photometry | Continuously March 1 – October 31 |
| PM _{2.5} TEOM | 4.6 | SPM AQI | Tapered element oscillating microbalance, gravimetric | Continuously |
| FRM PM _{2.5} | 2.4 | SLAMS | Gravimetric | 24-hours every third day |
| Collocated FRM PM _{2.5} | 2.4 | SLAMS | Gravimetric | 24-hours every sixth day |

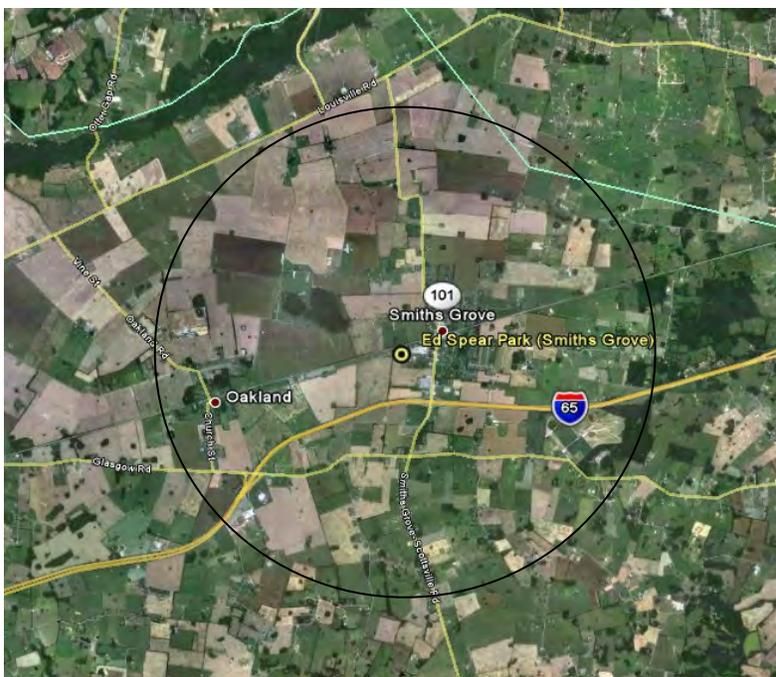
Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

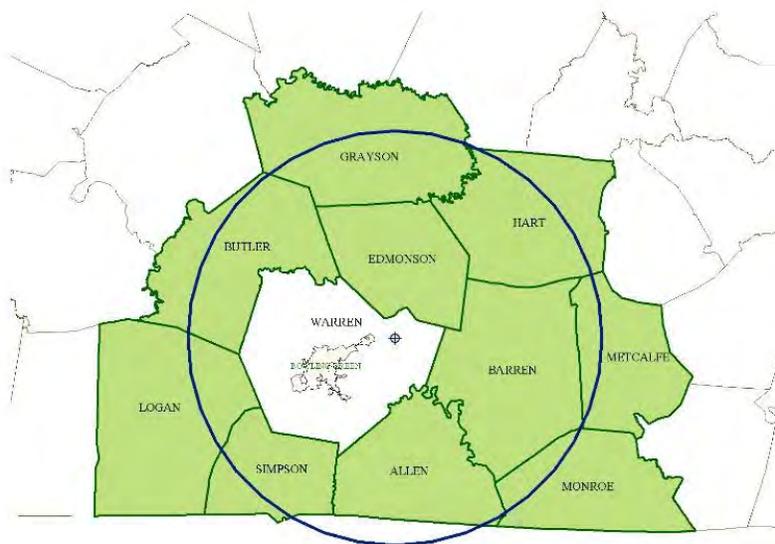
Area Representativeness:

This site represents population exposure on a neighborhood scale for particulates. This site also represents maximum concentrations on an urban scale for ozone.

Neighborhood Scale: Particulates

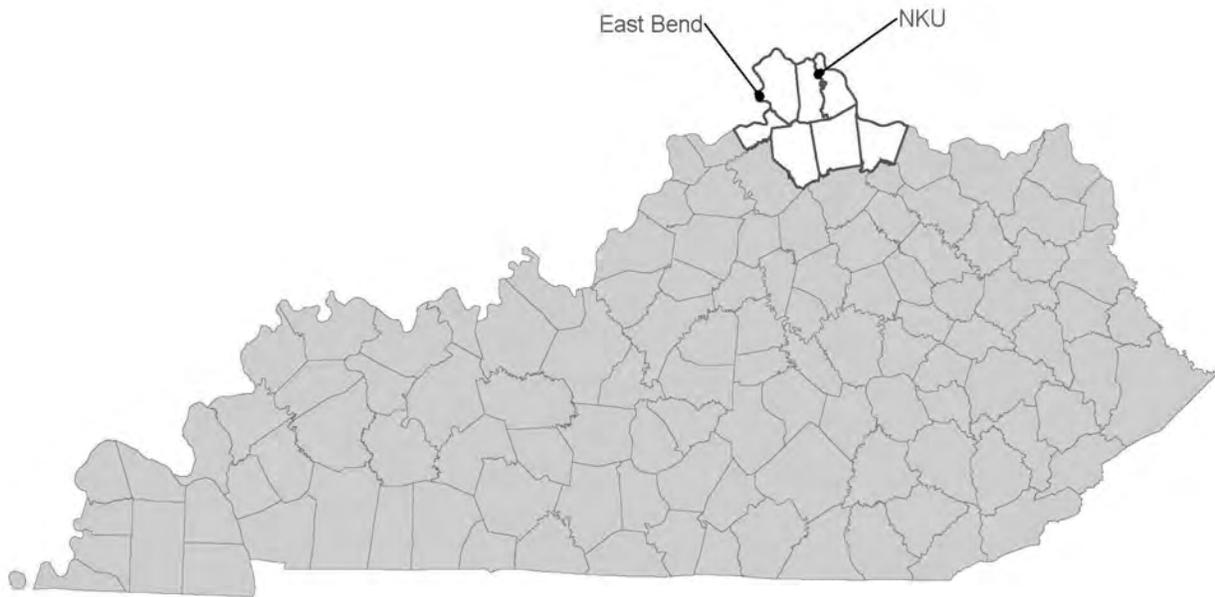


Urban Scale: Ozone



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Cincinnati, OH-KY-IN



| AQS ID / County | Site Address | PM2.5 | Cont. PM2.5 | PM10 | Cont. PM10 | SO2 | NO2 | NOy | CO | O3 | Pb | VOC | Carbonyl | PAH | PM2.5 Spec. | Carbon Spec. | RadNet | Met |
|-------------------------|-----------------------------------------|----------|-----------------|------|------------|----------------|----------------|-----|----|-----------------|----|-----|----------|-----|-------------|--------------|--------|----------|
| 21-015-0003 Boone | KY338 & Lower River Union | | | | | | | | | 1 | | | | | | | | 1 |
| 21-037-3002 Campbell | 524A John's Hill Rd Highland Heights | 1 | 1 ^{ti} | | | 1 ⁱ | 1 ⁱ | | | 1 ^{ci} | | | | | | | | |
| Totals | 2 | 1 | 1 | | | 1 | 1 | | | 2 | | | | | | | | 1 |

Tallies are equal to the actual number of monitors present. Superscripts represent additional information about the network.

PWEI SO2 monitors required in CBSA..

i=AQI Reported

e=Emergency Episode Monitor

t=Continuous TEOM Monitor

CSA/MSA: Cincinnati-Wilmington-Maysville, OH-KY-IN CSA; Cincinnati, OH-KY-IN MSA

401 KAR 50:020 Air Quality Region: Metropolitan Cincinnati (Ohio) Interstate (079)

Site Name: East Bend

AQS Site ID: 21-015-0003

Location: KY 338 and Lower River Road, Union, KY 41091

County: Boone

GPS Coordinates: 38.918330, -84.852637 (NAD 83)

Date Established: July 1, 1977

Inspection Date: December 18, 2015

Inspection By: Jennifer F. Miller

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located at the intersection of KY 338 and Lower River Road near East Bend, Kentucky. The sample inlet is 15 meters from the nearest road. Upon inspection, the sample line and monitor were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices C, D and E.

Monitoring Objective:

The monitoring objective is to determine compliance with National Ambient Air Quality Standards.

Monitors:

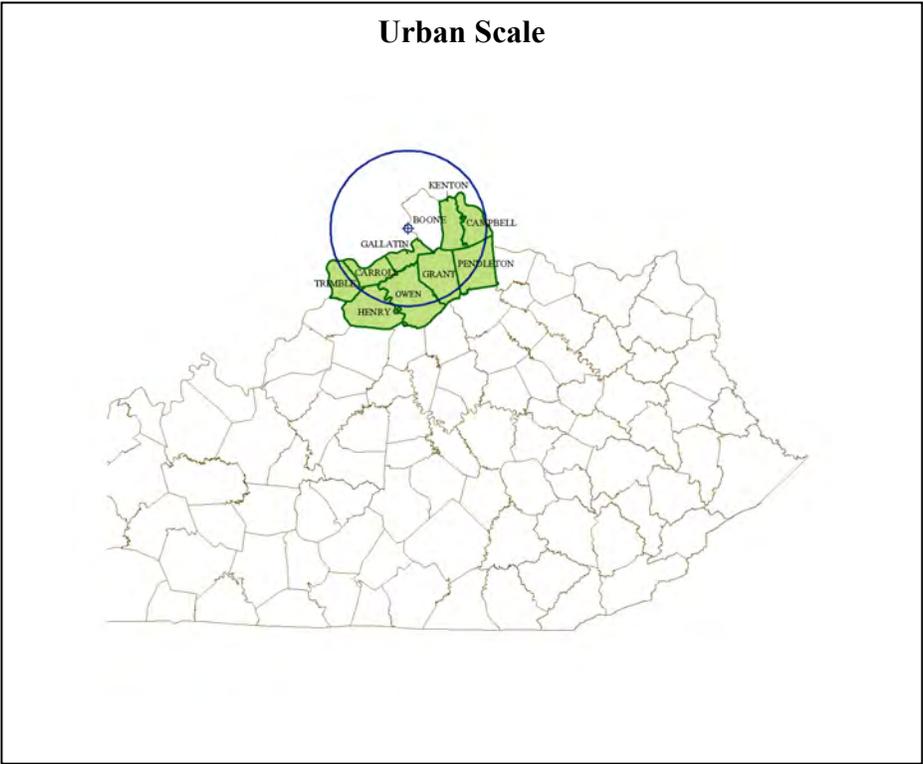
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|----------------|-----------------------|-------------|-----------------------------------------------------------------------------------------------------|--------------------------------------|
| AEM Ozone | 3.5 | SLAMS | UV photometry | Continuously March 1 – October 31 |
| Meteorological | 7.1 | Other | AQM grade instruments for wind speed, wind direction, humidity, barometric pressure and temperature | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

This site represents the upwind background levels on an urban scale for ozone.



CSA/MSA: Cincinnati-Wilmington-Maysville, OH-KY-IN CSA; Cincinnati, OH-KY-IN MSA

401 KAR 50:020 Air Quality Region: Metropolitan Cincinnati (Ohio) Interstate (079)

Site Name: Northern Kentucky University (NKU)

AQS Site ID: 21-037-3002

Location: 524A John's Hill Road, Highland Heights, KY 41076

County: Campbell

GPS Coordinates: 39.02181, -84.47445 (NAD 83)

Date Established: August 1, 2007

Inspection Date: December 18, 2015

Inspection By: Jennifer F. Miller

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on farmland owned by Northern Kentucky University in Highland Heights, Kentucky. The sample inlets are 23 meters from the nearest road, which is a gravel service-drive for a radio tower. Upon inspection, the sample lines and monitors were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices A, C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards; to provide ozone, particulate, nitrogen dioxide, and sulfur dioxide levels for daily index reporting; and to detect elevated pollutant levels for activation of emergency control procedures for ozone.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|------------------------|-----------------------|-------------------------|----------------------------------------------------------|--------------------------------------|
| AEM Nitrogen Dioxide | 3.8 | SLAMS AQI | Chemiluminescence | Continuously |
| AEM Ozone | 3.8 | SLAMS AQI EPISODE | UV photometry | Continuously March 1 – October 31 |
| FRM PM _{2.5} | 4.6 | SLAMS | Gravimetric | 24-hours every third day |
| PM _{2.5} TEOM | 4.6 | SPM AQI | Tapered element oscillating microbalance, gravimetric | Continuously |
| AEM Sulfur Dioxide | 3.9 | SLAMS AQI | UV fluorescence | Continuously |

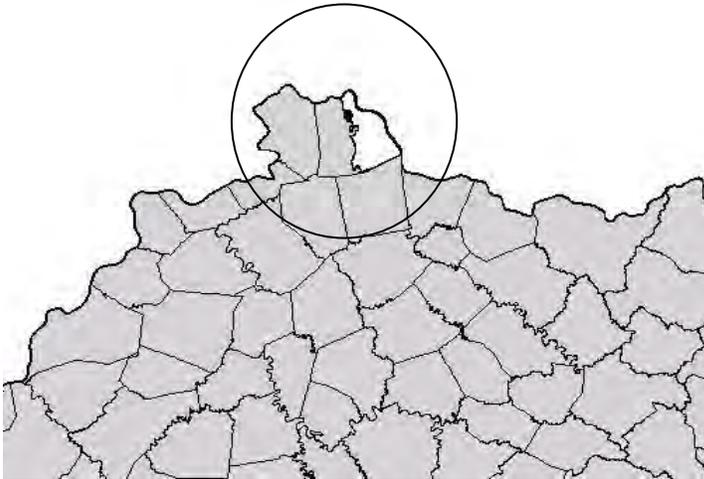
Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

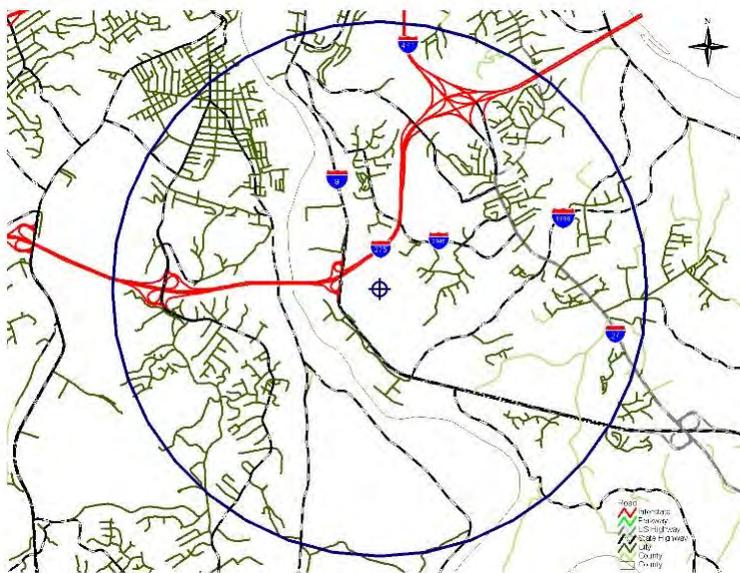
Area Representativeness:

This site represents population exposure for nitrogen dioxide, ozone, and sulfur dioxide on an urban scale. This site also represents population exposure on a neighborhood scale for particulate matter.

Urban Scale: Nitrogen Dioxide, Ozone, Sulfur Dioxide

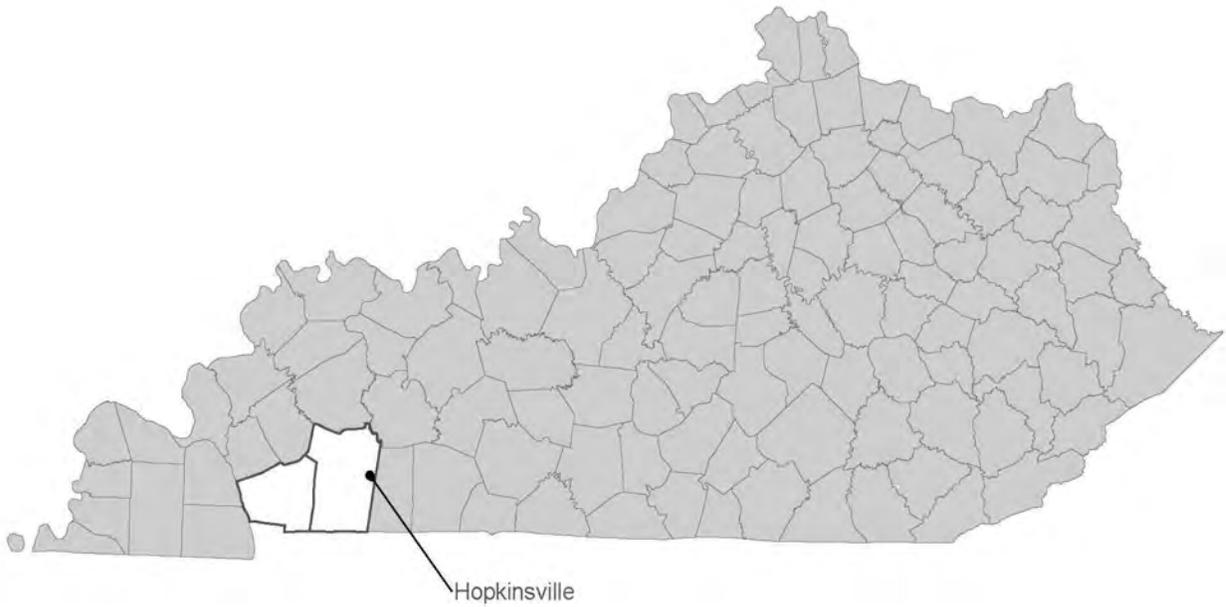


Neighborhood Scale: Particulates



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Clarksville, TN-KY



| AQS ID / County | Site Address | PM2.5 | Cont. PM2.5 | PM10 | Cont. PM10 | SO2 | NO2 | NOy | CO | O3 | Pb | VOC | Carbonyl | PAH | PM2.5 Spec. | Carbon Spec. | RadNet | Met |
|--------------------------|-------------------------------------|----------------|-------------|------|------------|-----|-----|-----|----|----------|----|-----|----------|-----|-------------|--------------|--------|----------|
| 21-047-0006 Christian | 10800 Pilot Rock Rd Hopkinsville | 1 ^X | | | | | | | | 1 | | | | | | | | 1 |
| Totals | 1 | 1 | | | | | | | | 1 | | | | | | | | 1 |

Tallies are equal to the actual number of monitors present. Superscripts represent additional information about the network.

X=Regional Transport PM2.5 Monitor

CSA/MSA: Clarksville, TN- KY MSA

401 KAR 50:020 Air Quality Region: Paducah - Cairo Interstate (072)

Site Name: Hopkinsville

AQS Site ID: 21-047-0006

Location: 10800 Pilot Rock Road, Hopkinsville, KY 42240

County: Christian

GPS Coordinates: 36.91171, -87.32337 (NAD 83)

Date Established: January 1, 1999

Inspection Date: December 10, 2015

Inspection By: Jennifer F. Miller

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site consists of a PM_{2.5} monitoring platform and an adjacent stationary equipment shelter. The site is located in a field on the property of a private residence, located at 10800 Pilot Rock Road in Hopkinsville, Kentucky. The sample inlets are 108 meters from the nearest road. Upon inspection, the sample inlets and monitors were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices C, D and E.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards and to determine levels of interstate regional transport of fine particulate matter and ozone.

Monitors:

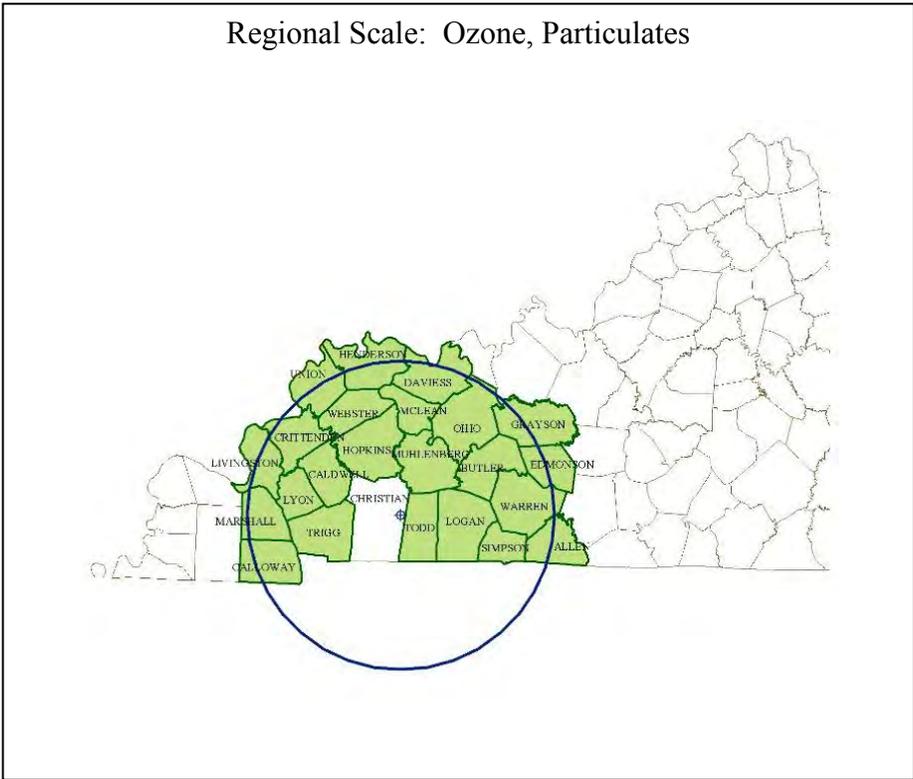
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|-----------------------|-----------------------|-------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------|
| AEM Ozone | 3.4 | SLAMS | UV photometry | Continuously March 1 – October 31 |
| FRM PM _{2.5} | 2.3 | SLAMS | Gravimetric | 24-hours every third day |
| Meteorological | 6.4 | Other | AQM grade instruments for wind speed, wind direction, relative humidity, barometric pressure, and temperature | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

This site represents population exposure on a regional scale for ozone and PM_{2.5}.



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Elizabethtown-Fort Knox, KY



| AQS ID / County | Site Address | PM2.5 | Cont. PM2.5 | PM10 | Cont. PM10 | SO2 | NO2 | NOy | CO | O3 | Pb | VOC | Carbonyl | PAH | PM2.5 Spec. | Carbon Spec. | RadNet | Met |
|-----------------------|--------------------------------------|----------------|----------------|------|------------|-----|-----|-----|----|----------------|----|-----|----------|-----|-------------|--------------|--------|-----|
| 21-093-0006 Hardin | 801 North Miles St. Elizabethtown | 2 ^C | 1 ^t | | | | | | | 1 ^M | | | | | | | | |
| Totals | 1 | 2 | 1 | | | | | | | 1 | | | | | | | | |

Tallies are equal to the actual number of monitors present. Superscripts represent additional information about the network.

C=Collocated

t=Continuous TEOM Monitor

M=Maximum Ozone Concentration Site for MSA

CSA/MSA: Louisville/Jefferson County-Elizabethtown-Madison, KY-IN CSA; Elizabethtown-Fort Knox, KY MSA

401 KAR 50:020 Air Quality Region: North Central Kentucky Intrastate (104)

Site Name: Elizabethtown

AQS Site ID: 21-093-0006

Location: American Legion Park, 801 North Miles Street, Elizabethtown, KY 42701

County: Hardin

GPS Coordinates: 37.705635, -85.852656 (NAD 83)

Date Established: February 24, 2000

Inspection Date: November 5, 2015

Inspection By: Jennifer F. Miller

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located near the tennis courts on the grounds of the American Legion Park in Elizabethtown, Kentucky. In 2012, the site was moved approximately 23 meters due to potential expansion of a nearby park building. From the new location, the sample inlets are approximately 35 meters from the nearest road. Upon inspection, the sample lines and monitors were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices A, C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards.

Monitors:

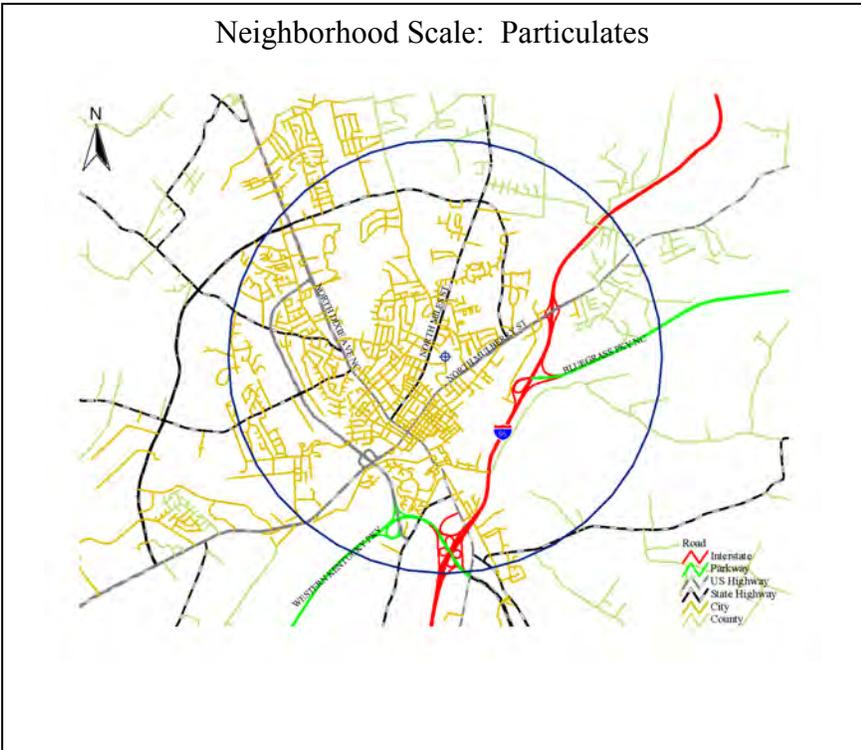
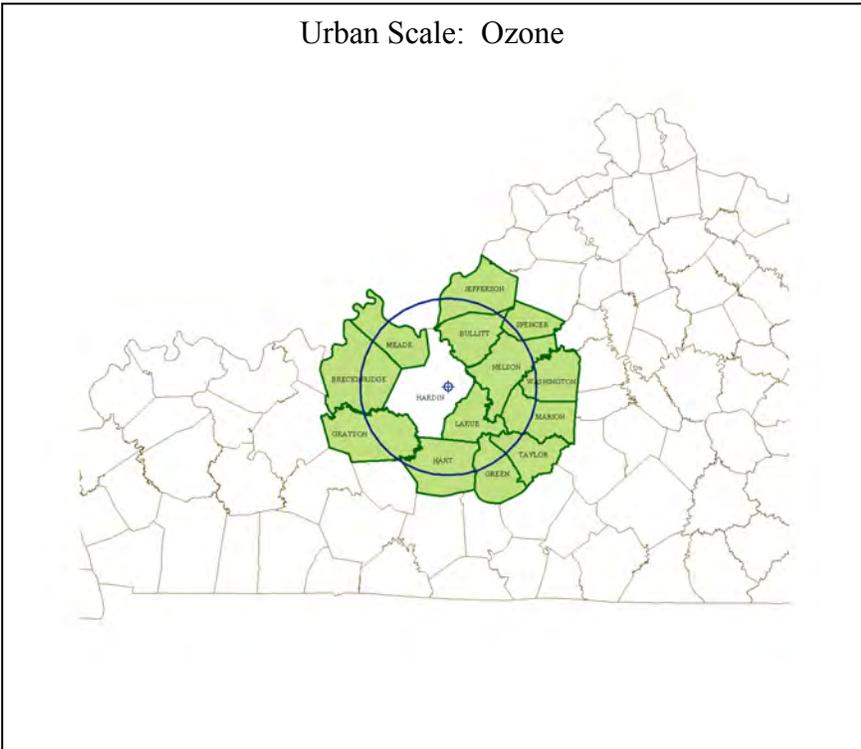
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|----------------------------------|-----------------------|---------------------------------|---------------------------------------------------------|--------------------------------------|
| AEM Ozone | 3.4 | SLAMS Maximum O ₃ | UV photometry | Continuously March 1 – October 31 |
| FRM PM _{2.5} | 4.6 | SLAMS | Gravimetric | 24-hours every third day |
| Collocated FRM PM _{2.5} | 4.6 | SLAMS | Gravimetric | 24-hours every sixth day |
| PM _{2.5} TEOM | 4.4 | SPM | Tapered elemental oscillating microbalance, gravimetric | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

This site represents population exposure on a neighborhood scale for particulates and population exposure on an urban scale for ozone.



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Evansville, IN-KY



| AQS ID / County | Site Address | PM2.5 | Cont. PM2.5 | PM10 | Cont. PM10 | SO2 | NO2 | NOy | CO | O3 | Pb | VOC | Carbonyl | PAH | PM2.5 Spec. | Carbon Spec. | RadNet | Met |
|----------------------------|-----------------------------------------|----------|----------------|----------------|------------|------------------|-----|-----|----|----------------|----|-----|----------|-----|-------------|--------------|--------|-----|
| 21-101-0014 Henderson | 7492 Dr. Hodge Rd. Baskett | 1 | 1 ^t | 1 ^m | | 1 | | | | 1 ^M | | | | | | | | |
| 21-101-1011 Appendix H* | Alcan Aluminum Rd. Robards, KY 42452 | | | | | 1 ^{DRR} | | | | | | | | | | | | |
| Totals | 2 | 1 | 1 | 1 | | 2 | | | | 1 | | | | | | | | |

Tallies are equal to the actual number of monitors present. Superscripts represent additional information about the network.

PWEI SO₂ monitor required in CBSA.

* See Appendix H for site details

t=Continuous TEOM Monitor

m=PM10 Filter Analyzed for Metals

M=Maximum Ozone Concentration Site for MSA

DRR = SO2 Data Requirements Rule Monitor

CSA/MSA: Evansville, IN-KY MSA
401 KAR 50:020 Air Quality Region: Evansville-Owensboro-Henderson Interstate (077)
Site Name: Baskett
AQS Site ID: 21-101-0014
Location: Baskett Fire Department, 7492 Dr. Hodge Road, Henderson, KY 42420
County: Henderson
GPS Coordinates: 37.87120, -87.46375 (NAD 83)
Date Established: February 27, 1992
Inspection Date: October 20, 2015
Inspection By: Ashley Bedel
Site Approval Status: Site and monitors meet design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of the Baskett Fire Department in Baskett, Kentucky. Upon inspection, the sample lines and monitors were found to be in good condition. The sample inlets are 6.5 meters from the nearest road, which is closer than the allowable-distances stated by CFR. Due to the small traffic count of the street and the unlikely influence of vehicles on data, KDAQ has received EPA-approval for a waiver from the required road-distances stated by 40 CFR 58, Appendix E. Otherwise, the site meets the requirements of 40 CFR 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards.

Monitors:

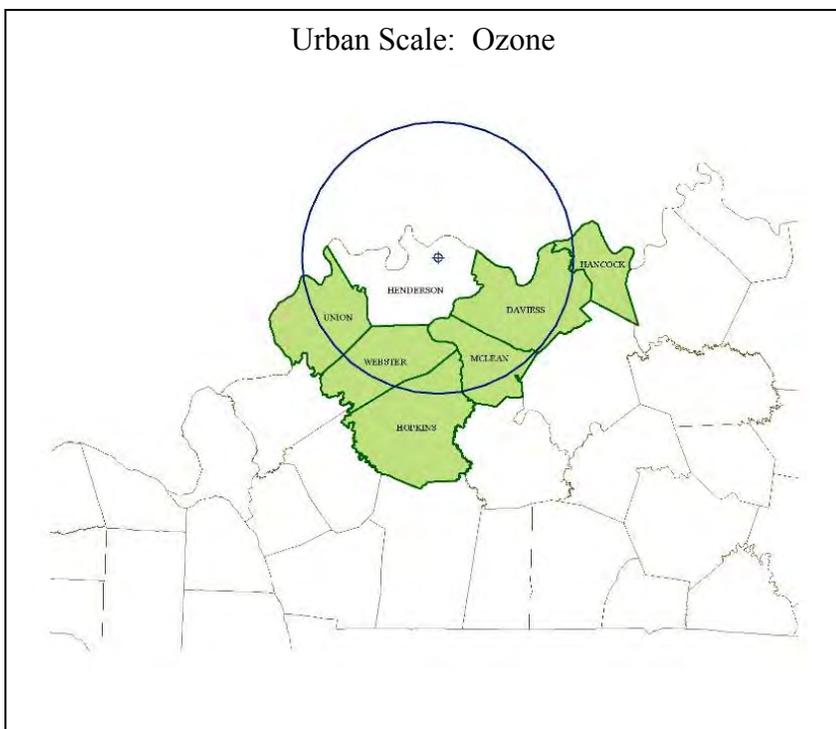
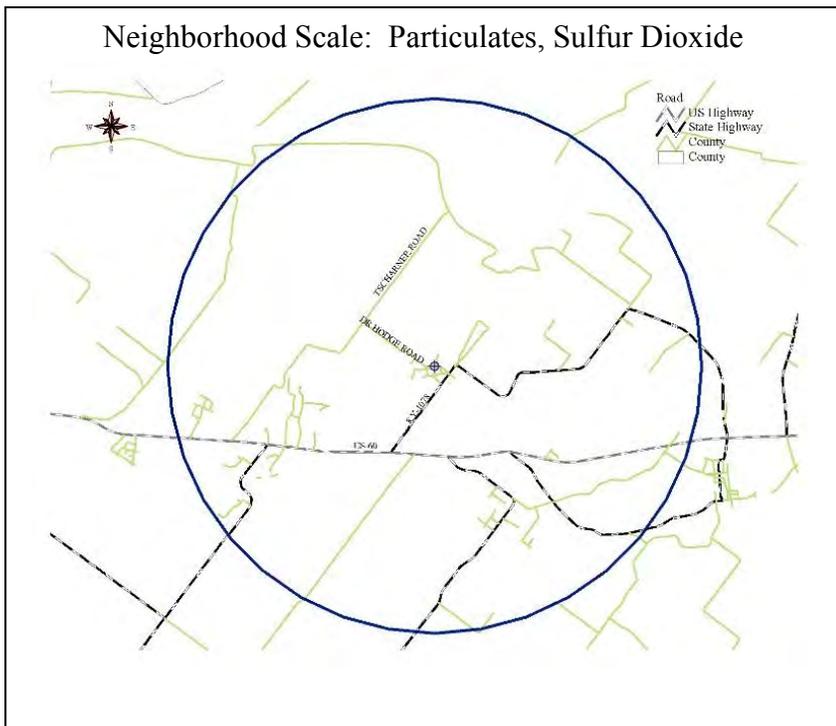
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|---------------------------|-----------------------|---------------------------------|---------------------------------------------------------------------|--------------------------------------|
| AEM Ozone | 3.9 | SLAMS Maximum O ₃ | UV photometry | Continuously March 1 – October 31 |
| FRM PM _{2.5} | 4.7 | SLAMS | Gravimetric | 24-hours every third day |
| PM _{2.5} TEOM | 4.5 | SPM | Tapered element oscillating microbalance, gravimetric | Continuously |
| FRM PM ₁₀ | 4.5 | SLAMS | Gravimetric | 24-hours every sixth day |
| - PM ₁₀ Metals | | SPM-Other | Determined from the PM ₁₀ sample using EPA method IO 3.5 | Same as PM ₁₀ |
| AEM Sulfur Dioxide | 3.5 | SLAMS | UV fluorescence | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

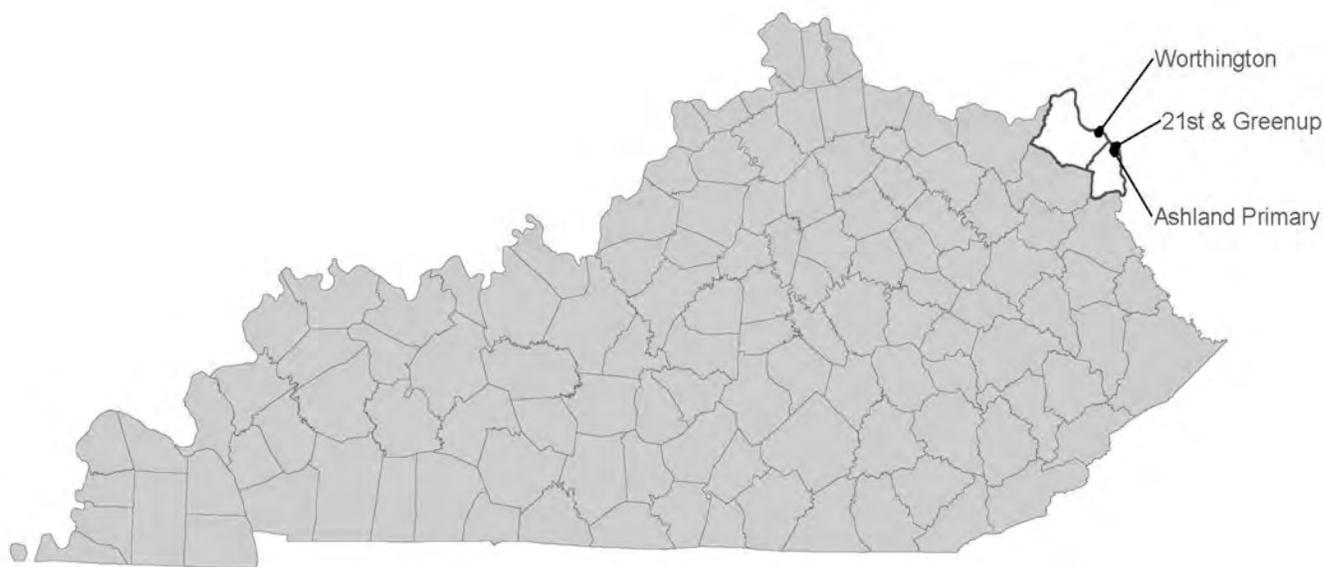
Area Representativeness:

This site represents maximum concentrations on an urban scale for ozone. This site also represents population exposure on a neighborhood scale for particulates and sulfur dioxide.



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Huntington-Ashland, WV-KY-OH



| AQS ID / County | Site Address | PM2.5 | Cont. PM2.5 | PM10 | Cont. PM10 | SO2 | NO2 | NOy | CO | O3 | Pb | VOC | Carbonyl | PAH | PM2.5 Spec. | Carbon Spec. | RadNet | Met |
|-----------------|-------------------------|----------|-----------------|-----------------|------------|-----------------|-----------------|-----|----|------------------|----|----------|----------|-----|-------------|--------------|--------|----------|
| 21-019-0002 | 122 22nd Street | | | 2 ^{Cm} | | | | | | | | | | | | | | |
| Boyd | Ashland | | | | | | | | | | | | | | | | | |
| 21-019-0017 | 2924 Holt Street | 1 | 1 ^{ti} | | | 1 ^{ei} | 1 ^{ei} | | | 1 ^{eiM} | | 1 | | | | | | 1 |
| Boyd | Ashland | | | | | | | | | | | | | | | | | |
| 21-089-0007 | Scott St. & Center Ave. | | | | | 1 ^e | | | | 1 ^e | | | | | | | | |
| Greenup | Worthington | | | | | | | | | | | | | | | | | |
| Totals | 3 | 1 | 1 | 2 | | 2 | 1 | | | 2 | | 1 | | | | | | 1 |

Tallies are equal to the actual number of monitors present. Superscripts represent additional information about the network.

i=AQI Reported

m=PM10 Filter Analyzed for Metals

C=Collocated

e=Emergency Episode Monitor

t=Continuous TEOM Monitor

M=Maximum Ozone Concentration Site for MSA

CSA/MSA: Charleston-Huntington-Ashland, WV-OH-KY CSA; Huntington-Ashland, WV-KY-OH MSA

401 KAR 50:020 Air Quality Region: Huntington (WV)-Ashland (KY)-Portsmouth-Ironton (OH) Interstate (103)

Site Name: 21st and Greenup

AQS Site ID: 21-019-0002

Location: 122 22nd Street, Ashland, KY 41101

County: Boyd

GPS Coordinates: 38.47676, -82.63137 (NAD 83)

Date Established: April 2, 1978

Inspection Date: November 23, 2015

Inspection By: Jennifer F. Miller & James Mullins

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is located on the west end of the roof of the Valvoline Oil complex building in Ashland, Kentucky. The building is one story tall. The sample inlets are 71.3 meters from the nearest road. Upon inspection, the sample inlets and monitors were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices A, C, D and E.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards and to measure concentrations of a sub-group of air toxics.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|--------------------------------------|-----------------------|-------------|---------------------------------------------------------------------|--------------------------------|
| FEM PM ₁₀ | 7.7 | SLAMS | Gravimetric | 24-hours every sixth day |
| - Metals PM ₁₀ | | SPM-Other | Determined from the PM ₁₀ sample using EPA method IO 3.5 | Same as PM ₁₀ |
| Collocated FEM PM ₁₀ | 7.6 | SLAMS | Gravimetric | 24-hours every twelfth day |
| - Collocated Metals PM ₁₀ | | SPM-Other | Determined from the PM ₁₀ sample using EPA method IO 3.5 | 24-hours; six samples per year |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

The site represents maximum concentration on a middle scale for particulates and metals.

Middle Scale: Particulates and Metals



CSA/MSA: Charleston-Huntington-Ashland, WV-OH-KY CSA; Huntington-Ashland, WV-KY-OH MSA

401 KAR 50:020 Air Quality Region: Huntington (WV)-Ashland (KY)-Portsmouth-Ironton (OH) Interstate (103)

Site Name: Ashland Primary (FIVCO)

AQS Site ID: 21-019-0017

Location: FIVCO Health Department, 2924 Holt Street, Ashland, KY 41101

County: Boyd

GPS Coordinates: 38.45934, -82.64041 (NAD 83)

Date Established: January 1, 1999

Inspection Date: November 23, 2015

Inspection By: Jennifer F. Miller & James Mullins

Site Approval Status: Site is partially obstructed by trees.



The monitoring site is a stationary equipment shelter located on the grounds of the health department building in Ashland, Kentucky. The sample inlets are 70 meters from the nearest road. Upon inspection, the sample lines and monitors were found to be in good condition.

Airflow at the site is partially obstructed by tall trees; as such, the site does not meet certain requirements of 40 CFR 58, Appendix E. KDAQ expects to either move the site or invest in significant tree removal at the current site within the upcoming year. If required, KDAQ will submit a site proposal to the EPA, following a public comment period. The site is operated in accordance with all other criteria required by 40 CFR 58, Appendices A, C, D, and E.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards; to detect elevated pollutant levels for activation of emergency control procedures for nitrogen dioxide, ozone, and sulfur dioxide; and to provide pollutant levels for daily air quality index reporting.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|------------------------|-----------------------|---------------------------------------------------|-------------------------------------------------------|--------------------------------------|
| AEM Nitrogen Dioxide | 4.3 | SLAMS AQI EPISODE | Chemiluminescence | Continuously |
| AEM Sulfur Dioxide | 4.3 | SLAMS AQI EPISODE | UV fluorescence | Continuously |
| AEM Ozone | 4.3 | SLAMS AQI EPISODE Maximum O ³ | UV photometry | Continuously March 1 – October 31 |
| FRM PM _{2.5} | 4.8 | SLAMS | Gravimetric | 24-hours every third day |
| PM _{2.5} TEOM | 4.7 | SPM AQI | Tapered element oscillating microbalance, gravimetric | Continuously |

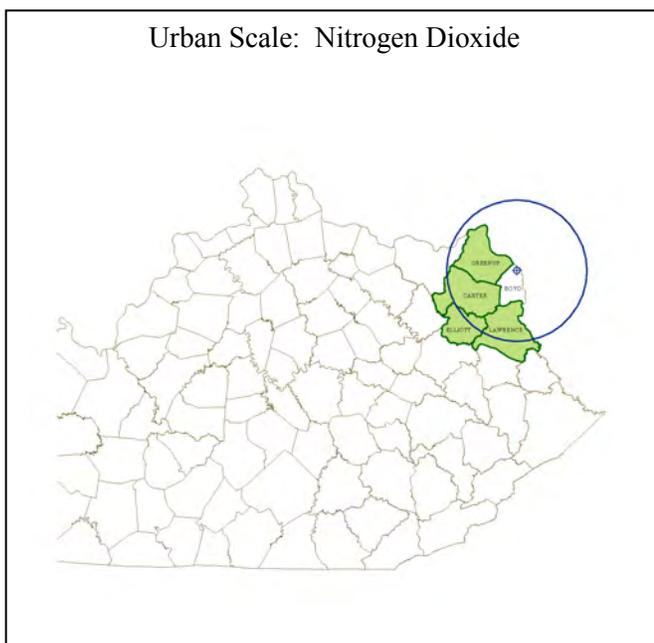
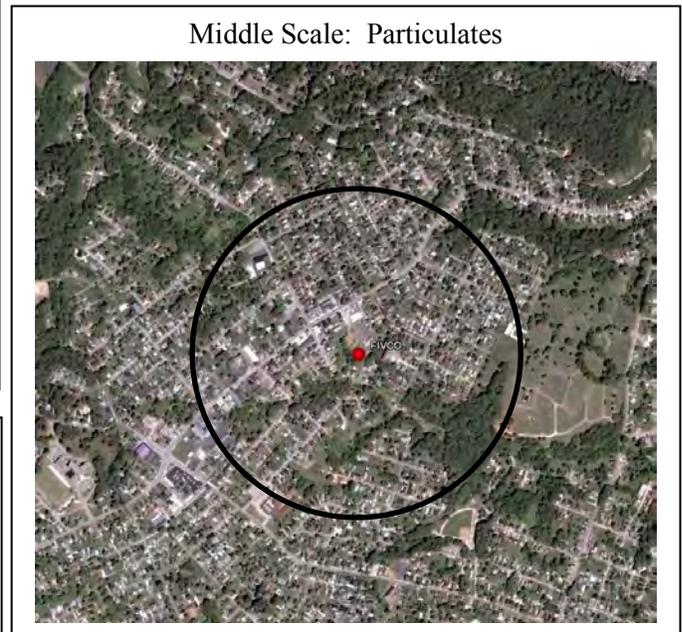
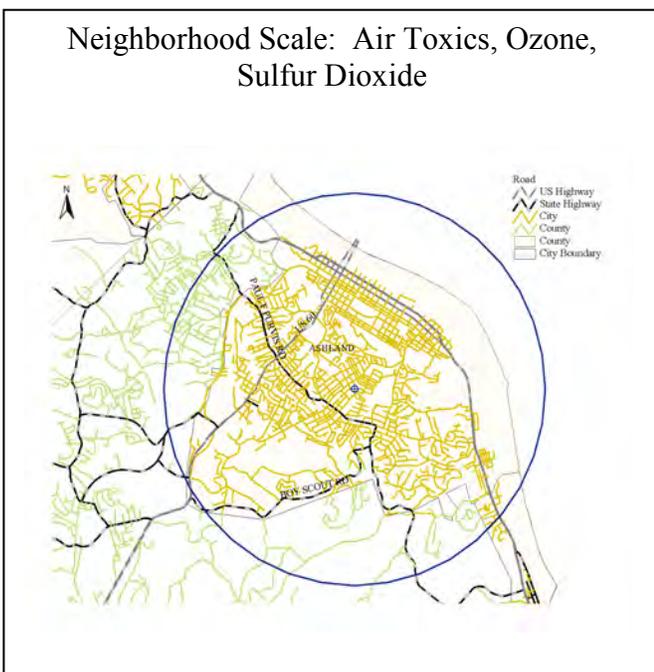
| | | | | |
|----------------------------|-----|-----------|------------------------------------------------------------------------------------------------------|--------------------------|
| Volatile Organic Compounds | 3.8 | SPM-Other | EPA method TO-15 | 24-hours every sixth day |
| Meteorological | 5.9 | Other | AQM grade instruments for wind speed, wind direction, humidity, barometric pressure, and temperature | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

This site represents population exposure on a neighborhood scale for air toxics, ozone, and sulfur dioxide. This site also represents maximum concentrations on a middle scale for particulates, as well as an urban scale for nitrogen dioxide.



CSA/MSA: Charleston-Huntington-Ashland, WV-OH-KY CSA; Huntington-Ashland, WV-KY-OH MSA

401 KAR 50:020 Air Quality Region: Huntington (WV)-Ashland (KY)-Portsmouth-Ironton (OH) Interstate (103)

Site Name: Worthington

AQS Site ID: 21-089-0007

Location: Scott Street & Center Avenue, Worthington, KY 41183

County: Greenup

GPS Coordinates: 38.548136, -82.731163 (NAD 83)

Date Established: October 12, 1980

Inspection Date: November 23, 2015

Inspection By: Jennifer F. Miller & James Mullins

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of a water tower near the intersection of Scott Street and Center Avenue in Worthington, Kentucky. The sample inlets are 18 meters from the nearest road. Upon inspection, the sample lines and monitors were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards; to detect elevated pollutant levels for activation of emergency control procedures for ozone and sulfur dioxide.

Monitors:

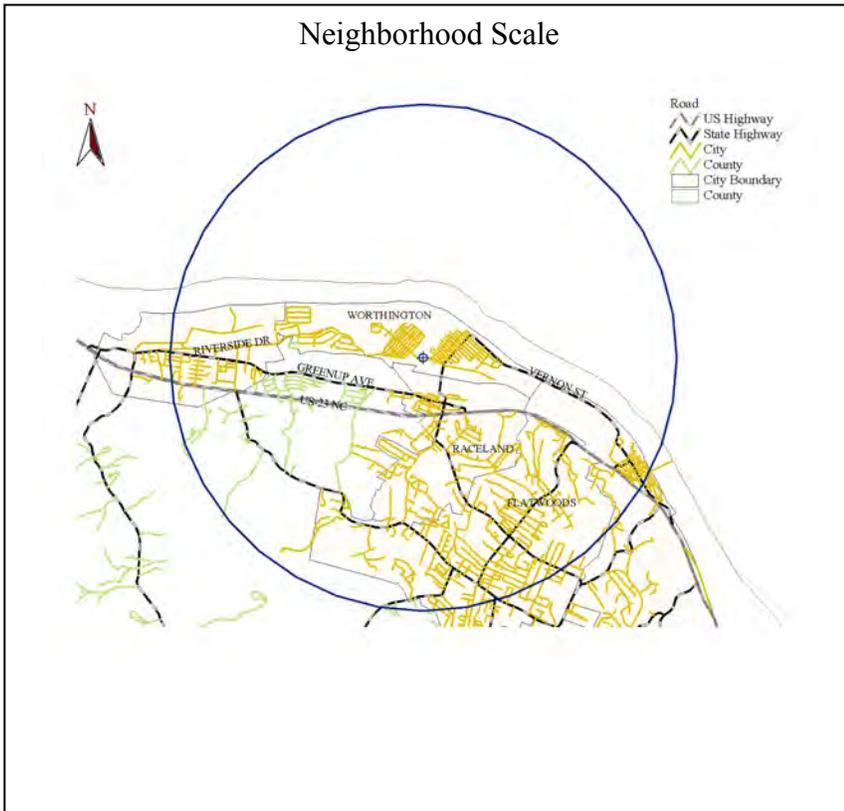
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|--------------------|-----------------------|------------------|-----------------|--------------------------------------|
| AEM Ozone | 4.2 | SLAMS EPISODE | UV photometry | Continuously March 1 – October 31 |
| AEM Sulfur Dioxide | 4.2 | SPM EPISODE | UV fluorescence | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

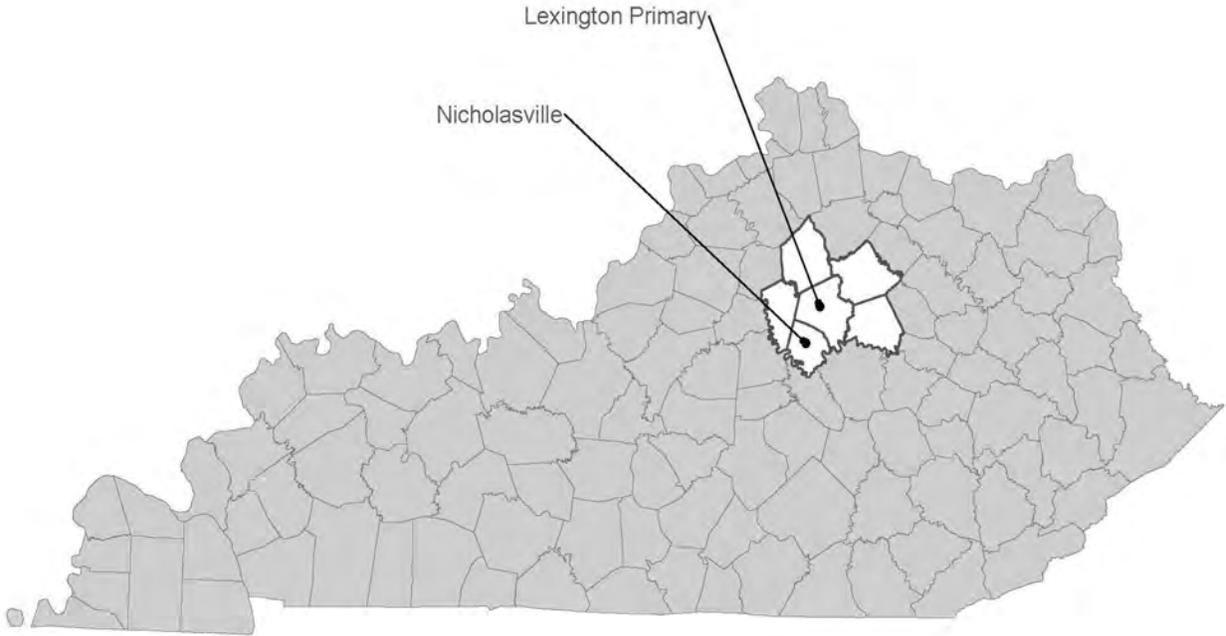
Area Representativeness:

This site represents population exposure on a neighborhood scale for ozone and sulfur dioxide.



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Lexington-Fayette, KY



| AQS ID / County | Site Address | PM2.5 | Cont. PM2.5 | PM10 | Cont. PM10 | SO2 | NO2 | NOy | CO | O3 | Pb | VOC | Carbonyl | PAH | PM2.5 Spec. | Carbon Spec. | RadNet | Met |
|--------------------------|-----------------------------------|----------|-----------------|----------------|------------|------------------|------------------|-----|----|------------------|----|----------|----------|-----|-------------|--------------|----------|----------|
| 21-067-0012 Fayette | 650 Newtown Pike Lexington | 1 | 1 ^{ti} | 1 ^m | | 1 ^{ieP} | 1 ^{ier} | | | 1 ^{ieM} | | 1 | | | | | 1 | |
| 21-113-0001 Jessamine | 260 Wilson Drive Nicholasville | | | | | 1 | | | | 1 | | | | | | | | 1 |
| Totals | 2 | 1 | 1 | 1 | | 2 | 1 | | | 2 | | 1 | | | | | 1 | 1 |

Tallies are equal to the actual number of monitors present. Superscripts represent additional information about the network.

PWEI SO₂ monitor required in CBSA.

- i =AQI
- m =PM10 Filter Analyzed for Metals
- r =RA-40 Monitor
- e =Emergency Episode Monitor
- t =Continuous TEOM Monitor
- M =Maximum Ozone Concentration Site for MSA

CSA/MSA: Lexington-Fayette-Richmond-Frankfort, KY CSA; Lexington-Fayette, KY MSA

401 KAR 50:020 Air Quality Region: Bluegrass Intrastate (102)

Site Name: Lexington Primary

AQS Site ID: 21-067-0012

Location: Fayette County Health Department, 650 Newtown Pike, Lexington, KY 40508

County: Fayette

GPS Coordinates: 38.06503, -84.49761 (NAD 83)

Date Established: November 8, 1979

Inspection Date: November 6, 2015

Inspection By: Jennifer F. Miller

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of the Fayette County Health Department building in Lexington, Kentucky. The sample inlets are 122 meters from the nearest road. Upon inspection, the sample lines and monitors were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices A, C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards; to detect elevated pollutant levels for activation of emergency control procedures for nitrogen dioxide, ozone, particulates, and sulfur dioxide; and to provide pollutant levels for daily air quality index reporting.

Additionally, the nitrogen dioxide monitor has been approved as a RA-40 monitor. According to CFR, each EPA Regional Administrator is required to collaborate with agencies to establish or designate 40 NO₂ monitoring locations, with a primary focus on protecting susceptible and vulnerable populations.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|------------------------|-----------------------|---------------------------------------------------|-------------------------------------------------------|------------------------------------------|
| AEM Ozone | 3.8 | SLAMS AQI EPISODE Maximum O ³ | UV photometry | Continuously March 1 – October 31 |
| ARM Nitrogen Dioxide | 4.1 | SLAMS (RA-40) AQI EPISODE | Chemiluminescence | Continuously |
| AEM Sulfur Dioxide | 3.6 | SLAMS AQI EPISODE | UV fluorescence | Continuously |
| PM _{2.5} TEOM | 4.6 | SPM AQI | Tapered element oscillating microbalance, gravimetric | Continuously |

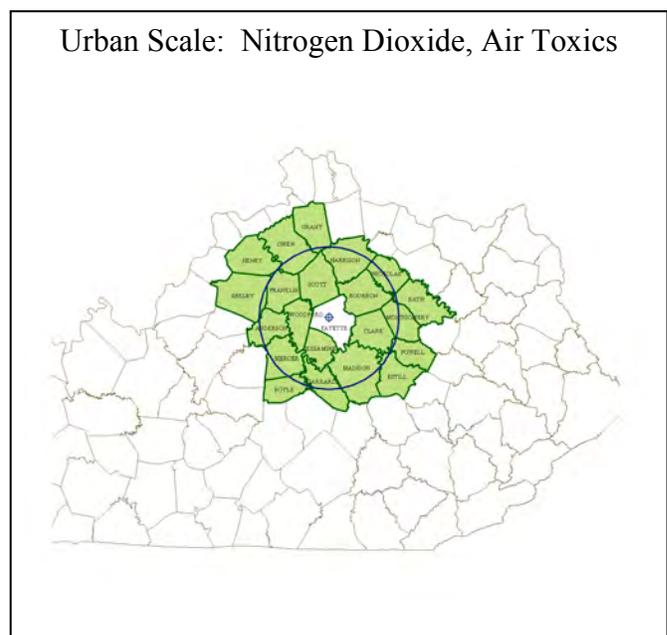
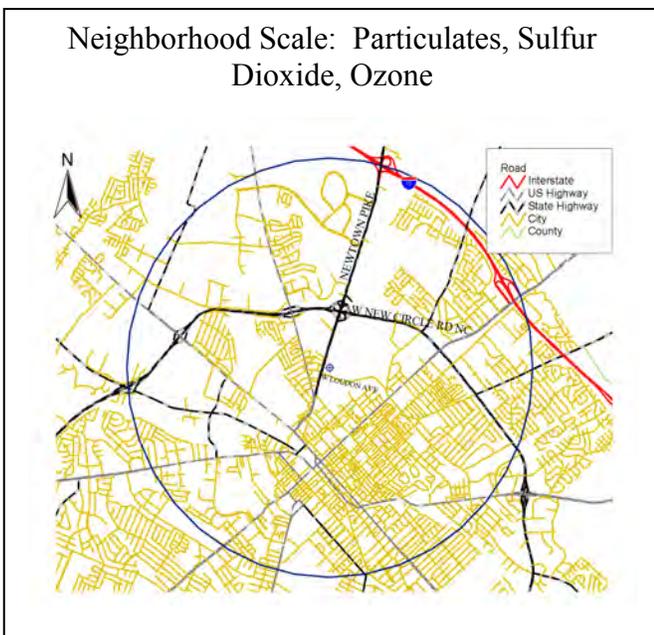
| | | | | |
|----------------------------|-----|-----------|---------------------------------------------------------------------|---------------------------------|
| FRM PM _{2.5} | 4.7 | SLAMS | Gravimetric | 24-hours every third day |
| PM ₁₀ | 4.5 | SLAMS | Gravimetric | 24-hours every sixth day |
| - PM ₁₀ Metals | | SPM-Other | Determined from the PM ₁₀ sample using EPA method IO 3.5 | Same as PM ₁₀ |
| Volatile Organics Compound | 3.4 | SPM-Other | EPA method TO-15 | 24-hours every sixth day |
| Radiation | 2.0 | RadNet | RadNet fixed stationary monitor, manual and automated methods | Continuously & 2 weekly filters |

Quality Assurance Status:

All quality assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

This site represents population exposure on a neighborhood scale for particulates, sulfur dioxide and ozone. This site also represents population exposure on an urban scale for nitrogen dioxide and air toxics.



CSA/MSA: Lexington-Fayette-Richmond-Frankfort, KY CSA; Lexington-Fayette, KY MSA

401 KAR 50:020 Air Quality Region: Bluegrass Intrastate (102)

Site Name: Nicholasville

AQS Site ID: 21-113-0001

Location: KYTC Maintenance Garage, 260 Wilson Drive, Nicholasville, KY 40356

County: Jessamine

GPS Coordinates: 37.89147, -84.58825 (NAD 83)

Date Established: August 1, 1991

Inspection Date: October 9, 2015

Inspection By: Jennifer F. Miller

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of the Kentucky Transportation Cabinet garage in Nicholasville, Kentucky. The sample inlets are 110 meters from the nearest road. Upon inspection, the sample inlets and monitors were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards and to provide ozone data upwind of the Lexington area.

Monitors:

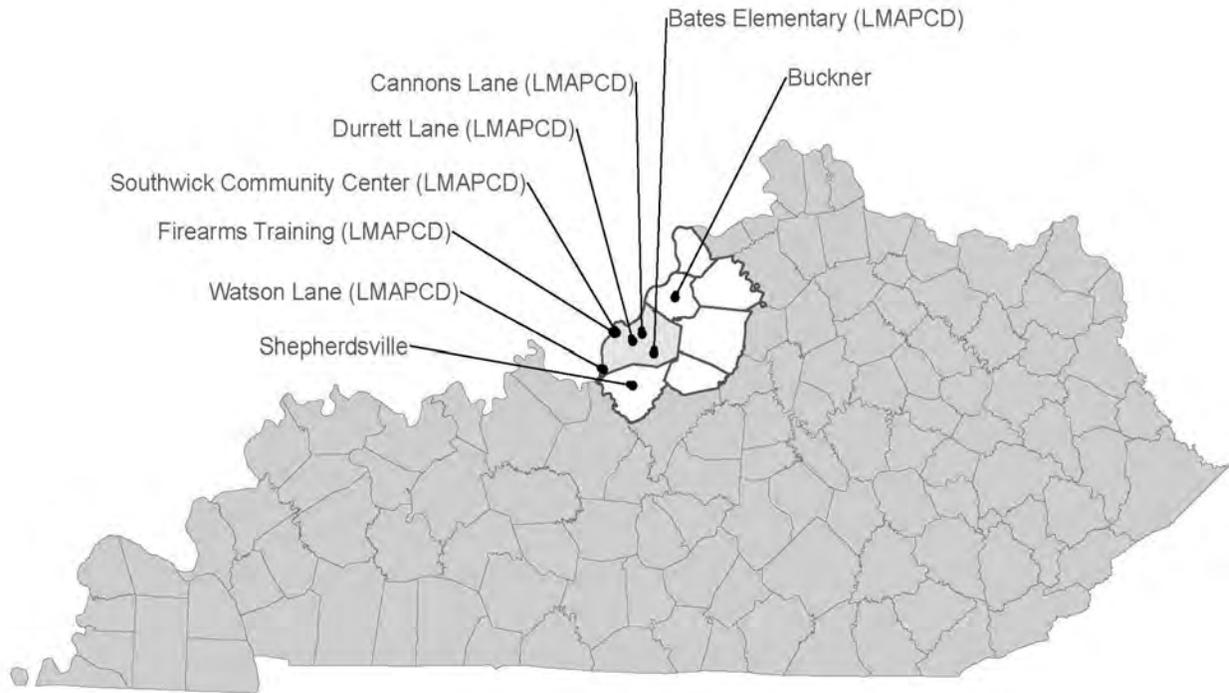
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|--------------------|-----------------------|-------------|--------------------------------------------------------------------------------------------|--------------------------------------|
| AEM Ozone | 3.9 | SLAMS | UV photometry | Continuously March 1 – October 31 |
| AEM Sulfur Dioxide | 3.9 | SPM | UV fluorescence | Continuously |
| Meteorological | 5.9 | Other | AQM grade instruments for wind speed, wind direction, temperature, and barometric pressure | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

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Louisville/Jefferson County, KY-IN



| AQS ID / County | Site Address | PM2.5 | Cont. PM2.5 | PM10 | Cont. PM10 | SO2 | NO2 | NOy | CO | O3 | Pb | VOC | Carbonyl | PAH | PM2.5 Spec. | Carbon Spec. | RadNet | Met |
|--------------------------|--------------------------------------------|----------------|------------------|----------------|-----------------|-----------------|----------------|----------|----------------|----------------|----|-----|----------|-----|----------------|----------------|----------|----------------|
| 21-029-0006 Bullitt | 2nd & Carpenter St Shepherdsville | | | | | | | | | 1 | | | | | | | | |
| 21-185-0004 Oldham | 1601 South Hwy 393 LaGrange | | | | | | | | | 1 ^M | | | | | | | | 1 |
| 21-111-0027 Jefferson | 7601 Bardstown Rd Louisville (LMAPCD) | | 1 ^{iB} | | | | | | | 1 ⁱ | | | | | | | | 1 |
| 21-111-0043 Jefferson | 3621 Southern Ave Louisville (LMAPCD) | 2 ^C | 1 ^{iB*} | | 1 ^{iB} | | | | | | | | | | | | | 1 |
| 21-111-0051 Jefferson | 7201 Watson Ln Louisville (LMAPCD) | 1 | 1 ^{iB*} | | 1 ^{iB} | 1 ^{Pi} | | | | 1 ⁱ | | | | | | | | 1 |
| 21-111-0067 Jefferson | 2730 Cannons Ln Louisville (LMAPCD) | 1 | 1 ^{iB*} | 1 ^L | 1 ^{iB} | 1 ^{iP} | 1 ⁱ | 1 | 1 ⁱ | 1 ⁱ | | | | | 1 ^U | 1 ^U | 1 | 1 |
| 21-111-0075 Jefferson | 1517 Durrett Ln Louisville (LMAPCD) | | 1 ⁿ | | | | 1 ⁿ | | 1 ⁿ | | | | | | | | | 1 ⁿ |
| 21-111-1041 Jefferson | 4201 Algonquin Pkwy Louisville (LMAPCD) | | | | | 1 ^c | | | | | | | | | | | | |
| Totals | 8 | 5 | 4 | 1 | 3 | 3 | 2 | 1 | 2 | 5 | | | | | 1 | 1 | 1 | 6 |

Tallies are equal to the actual number of monitors present. Superscripts represent additional information about the network.

PWEI SO2 monitors required in CBSA.

C=Collocated

U=Auxiliary Monitor On Site

B=Continuous BAM Monitor

*=BAM Eligible for PM2.5 NAAQS Comparisons

L=PM10 Filter Analyzed for Lead

i=AQI Reported

n=Near-Road Monitor

e=Emergency Episode Monitor

M=Maximum Ozone Concentration Site for MSA

CSA/MSA: Louisville/Jefferson County-Elizabethtown-Madison, KY-IN CSA; Louisville/Jefferson County, KY-IN MSA

401 KAR 50:020 Air Quality Region: North Central Kentucky Intrastate (104)

Site Name: Shepherdsville

AQS Site ID: 21-029-0006

Location: East Joe B. Hall Avenue & Carpenter Streets, Shepherdsville, KY 40165

County: Bullitt

GPS Coordinates: 37.98629, -85.71192 (NAD 83)

Date Established: January 30, 1992

Inspection Date: November 5, 2015

Inspection By: Jennifer F. Miller

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located in a fenced-in area near the intersection of Second and Carpenter Streets in Shepherdsville, Kentucky. The sample inlets are 56 meters from the nearest road. Upon inspection, the sample lines and monitors were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards.

Monitors:

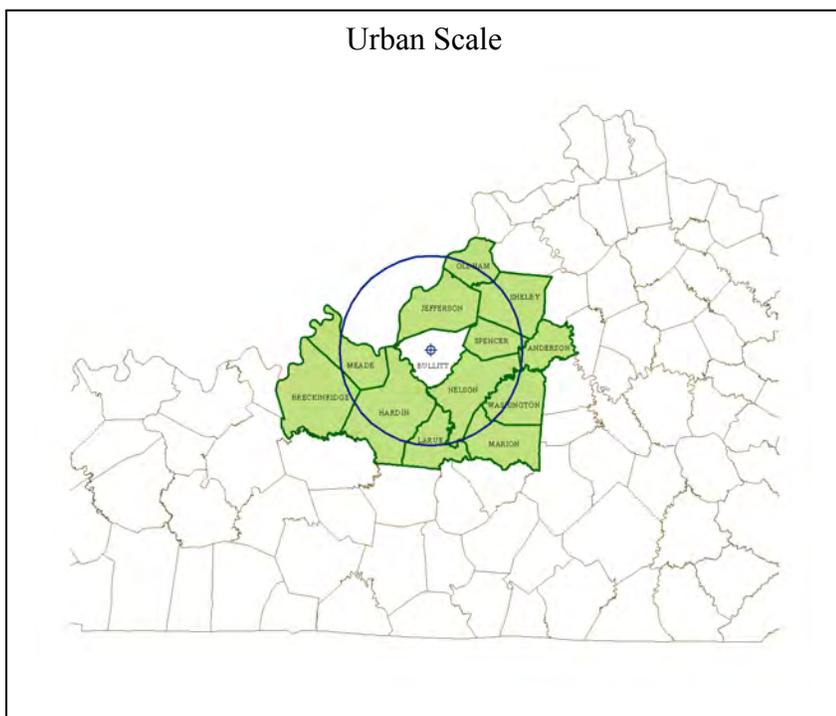
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|--------------|-----------------------|-------------|-----------------|--------------------------------------|
| AEM Ozone | 4.0 | SLAMS | UV photometry | Continuously March 1 – October 31 |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

This site represents population exposure on an urban scale for ozone.



CSA/MSA: Louisville/Jefferson County-Elizabethtown-Madison, KY-IN CSA; Louisville/Jefferson County, KY-IN MSA

401 KAR 50:020 Air Quality Region: North Central Kentucky Intrastate (104)

Site Name: Buckner

AQS Site ID: 21-185-0004

Location: KYTC Maintenance Facility, 1601 South Hwy 393, LaGrange, KY 40031

County: Oldham

GPS Coordinates: 38.40020, -85.44428 (NAD 83)

Date Established: May 1, 1981

Inspection Date: November 5, 2015

Inspection By: Jennifer F. Miller

Site Approval Status: Site and monitor meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of the Kentucky Transportation Cabinet Highway garage in Buckner, Kentucky. The sample inlet is 51 meters from the nearest road. Upon inspection, the sample line and monitor were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|----------------|-----------------------|---------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------|
| AEM Ozone | 3.8 | SLAMS Maximum O ³ | UV photometry | Continuously March 1 – October 31 |
| Meteorological | 6.2 | Other | AQM grad instruments for wind speed, wind direction, humidity, barometric pressure, and temperature | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

CSA/MSA: Louisville/Jefferson County-Elizabethtown-Madison, KY-IN CSA; Louisville/Jefferson County, KY-IN MSA

401 KAR 50:020 Air Quality Region: Louisville Interstate (078)

Site Name: Bates Elementary

AQS Site ID: 21-111-0027

Location: 7601 Bardstown Road, Louisville, KY 40291

County: Jefferson

GPS Coordinates: 38.13784, -85.57648 (NAD 83)

Date Established: January 4, 1973

Inspection Date: December 4, 2015

Inspection By: Jennifer F. Miller & Wayne Bray

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of the Bates Elementary School in Louisville, Kentucky. The sample inlets are 4.0 meters above ground level and 115 meters from the nearest road. Upon inspection, the sample inlets and monitors were found to be in good condition. The air monitoring site meets the criteria established in 40 CFR Part 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards and to provide pollution levels for daily index reporting.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|-----------------------|-----------------------|--------------|--------------------------------------------------------------------------------------------------------------|--------------------------------------|
| AEM Ozone | 4.0 | SLAMS AQI | UV photometry | Continuously March 1 – October 31 |
| PM _{2.5} BAM | 5.6 | SPM AQI | Automated non-equivalent Beta Attenuation method. | Continuously |
| Meteorological | 6.5 | Other | AQM grade instruments for wind speed and wind direction. Not reported to AQS; thus, there is no designation. | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

This site represents population exposure on an urban scale for ozone. This site also represents population exposure on a neighborhood scale for fine particulates.

Urban Scale: Ozone



Neighborhood Scale: Particulates



CSA/MSA: Louisville/Jefferson County-Elizabethtown-Madison, KY-IN CSA; Louisville/Jefferson County, KY-IN MSA

401 KAR 50:020 Air Quality Region: Louisville Interstate (078)

Site Name: Southwick Community Center

AQS Site ID: 21-111-0043

Location: 3621 Southern Avenue, Louisville, KY 40211

County: Jefferson

GPS Coordinates: 38.23319, -85.81566 (NAD 83)

Date Established: July 1, 1983

Inspection Date: December 4, 2015

Inspection By: Jennifer F. Miller & Wayne Bray

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is located on the roof of the Southwick Community Center in Louisville, Kentucky. The sample inlets are 6 meters above ground level and 45 meters from the nearest road. Upon inspection, the sample inlets and monitors were found to be in good condition. The air monitoring site meets the criteria established in 40 CFR Part 58, Appendices A, C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards and to provide pollution levels for daily index reporting.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|----------------------------------|-----------------------|-------------|------------------------------------------------------------------------------------------------------|--------------------------|
| PM ₁₀ BAM | 5.9 | SLAMS AQI | Automated Equivalent Method utilizing Beta Attenuation. | Continuously |
| FRM PM _{2.5} | 6.0 | SLAMS | Gravimetric | 24-hours every third day |
| Collocated FRM PM _{2.5} | 6.0 | SLAMS | Gravimetric | 24-hours every sixth day |
| PM _{2.5} BAM | 6.0 | SLAMS AQI | Automated Equivalent Method utilizing Beta Attenuation. | Continuously |
| Meteorological | 11.4 | Other | AQM grade instruments for wind speed, wind direction, humidity, barometric pressure, and temperature | Continuously |
| -Rain Gauge | 5.0 | Other | AQM grade instrument for precipitation. | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

This site represents population exposure on a neighborhood scale for particulates.



CSA/MSA: Louisville/Jefferson County-Elizabethtown-Madison, KY-IN CSA; Louisville/Jefferson County, KY-IN MSA

401 KAR 50:020 Air Quality Region: Louisville Interstate (078)

Site Name: Watson Lane

AQS Site ID: 21-111-0051

Location: 7201 Watson Lane, Louisville, KY 40272

County: Jefferson

GPS Coordinates: 38.06091, -85.89804 (NAD 83)

Date Established: July 16, 1992

Inspection Date: December 4, 2015

Inspection By: Jennifer F. Miller & Wayne Bray

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of the Watson Lane Elementary School in Louisville, Kentucky. The sample inlets are 4 meters above ground level and 34 meters from the nearest road. Upon inspection, the sample lines and monitors were found to be in good condition. The air monitoring site meets the criteria established by 40 CFR Part 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards and to provide pollution levels for daily index reporting.

Monitors:

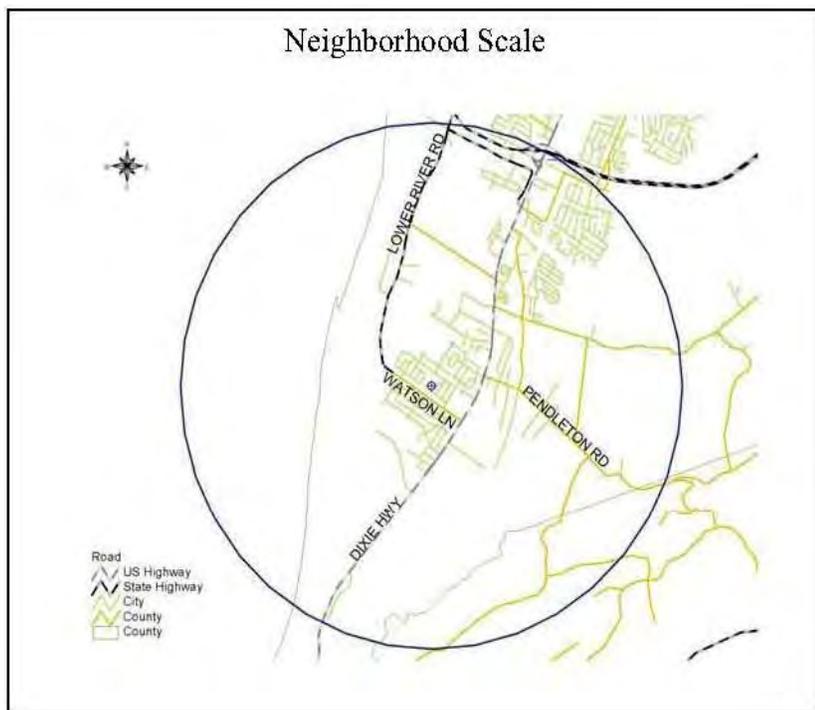
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|-----------------------|-----------------------|--------------|-------------------------------------------------------------------------------|--------------------------------------|
| AEM Ozone | 4.3 | SLAMS AQI | UV photometry | Continuously March 1 – October 31 |
| FRM PM _{2.5} | 4.8 | SLAMS | Gravimetric | 24-hours every third day |
| PM _{2.5} BAM | 4.6 | SLAMS AQI | Automated Equivalent Method utilizing Beta Attenuation. | Continuously |
| PM ₁₀ BAM | 4.6 | SLAMS AQI | Automated Equivalent Method utilizing Beta Attenuation. | Continuously |
| AEM Sulfur Dioxide | 4.3 | SLAMS | UV fluorescence | Continuously |
| Meteorological | 6.0 | Other | AQM grade instruments for wind speed and wind direction. Not reported to AQS. | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

This site represents population exposure on a neighborhood scale for ozone and particulates. This site also represents maximum concentrations on a neighborhood scale for SO₂.



CSA/MSA: Louisville/Jefferson County-Elizabethtown-Madison, KY-IN CSA; Louisville/Jefferson County, KY-IN MSA

401 KAR 50:020 Air Quality Region: Louisville Interstate (078)

Site Name: Cannons Lane

AQS Site ID: 21-111-0067

Location: Bowman Field, 2730 Cannons Lane, Louisville, KY 40204

County: Jefferson

GPS Coordinates: 38.2288760, -85.654520 (NAD 83)

Date Established: July 1, 2008

Inspection Date: December 4, 2015

Inspection By: Jennifer F. Miller & Wayne Bray

Site Approval Status: EPA SLAMS approval on December 22, 2008; EPA NCore approval on October 30, 2009.



The station is located on property leased by LMAPCD. The site is located in the NE quadrant of Jefferson County and is approximately 9 km from the urban core of Metro Louisville. The site was originally established as a SLAMS site in 2008 and became a NCore site in 2009. In December 2010, a solar electric array designed to produce approximately 6,336 kWh per year was installed. The array provides over 50% of the power used by the air monitoring station. Upon inspection, the sample lines and monitors were found to be in good condition. The air monitoring site meets the criteria of 40 CFR Part 58, Appendices A, C, D, E and G.

Monitoring Objective:

The NCore Network addresses the following monitoring objectives:

- timely reporting of data to the public through AIRNow, air quality forecasting, and other public reporting mechanisms
- support development of emission strategies through air quality model evaluation and other observational methods
- accountability of emission strategy progress through tracking long-term trends of criteria and non-criteria pollutants and their precursors
- support long-term health assessments that contribute to ongoing reviews of the National Ambient Air Quality Standards (NAAQS)
- compliance through establishing nonattainment/attainment areas by comparison with the NAAQS
- support multiple disciplines of scientific research, including public health, atmospheric, and ecological.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|-------------------------------------------------------------------------|-----------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Carbon Monoxide | 4.6 | NCORE SLAMS AQI | Automated Reference Method utilizing trace level non-dispersive infrared analysis. | Continuously |
| Nitrogen Oxide | 4.6 | NCORE SLAMS AQI | Automated Reference Method utilizing chemiluminescence analysis. | Continuously |
| Nitrogen Dioxide | 4.6 | NCORE SLAMS AQI | Automated Reference Method utilizing chemiluminescence analysis | Continuously |
| Total Reactive Nitrogen (NO/NO _y) | 8.8 | NCORE | Automated method utilizing trace level chemiluminescence analysis. | Continuously |
| Ozone | 4.6 | NCORE SLAMS AQI | Automated Equivalent Method utilizing UV photometry analysis. | Continuously |
| Sulfur Dioxide | 4.6 | NCORE SLAMS AQI | Automated Equivalent Method utilizing trace level UV fluorescence analysis. | Continuously |
| PM _{2.5} BAM | 4.6 | NCORE SLAMS AQI | Automated Equivalent Method utilizing Beta Attenuation. | Continuously |
| PM ₁₀ BAM | 4.6 | NCORE SPM AQI | Automated Equivalent Method utilizing Beta Attenuation. | Continuously |
| - PM _{Coarse} (PM ₁₀ -PM _{2.5}) BAM | | | Differential Automated Equivalent Method utilizing Beta Attenuation. | Continuously |
| PM _{2.5} Speciation | 2.2 | NCORE SLAMS | Multi-Species manual collection method utilizing thermal optical ion chromatography, gravimetric, and X-ray fluorescence. | 1/3 days |
| -Auxiliary PM _{2.5} Speciation | 2.2 | NCORE SLAMS | Multi-Species manual collection method utilizing thermal optical ion chromatography, gravimetric, and X-ray fluorescence. Data is reported to POC2, but is not used for precision. Sampler provides 1/3 day sampling coverage for weekends and holidays. | Supplements the primary monitor's 1/3 sampling schedule on weekends and holidays |
| PM _{2.5} Carbon Speciation | 2.4 | NCORE SLAMS | Multi-species manual collection method utilizing thermal optical and gravimetric analyses. | 1/3 days |
| -Auxiliary PM _{2.5} Carbon Speciation | 2.4 | NCORE SLAMS | Multi-species manual collection method utilizing thermal optical and gravimetric analyses. Data is reported to POC2, but is not used for precision. Sampler provides 1/3 day sampling coverage for weekends and holidays. | Supplements the primary monitor's 1/3 sampling schedule on weekends and holidays |

Monitors (Continued):

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|--------------------------|-----------------------|-------------|-------------------------------------------------------------------------------------------------------------|---------------------------------|
| FRM PM _{2.5} | 2.4 | NCore SLAMS | Manual reference method utilizing differential gravimetric analysis | 1/3 days |
| PM _{10c} Filter | 2.4 | NCore SLAMS | Manual reference method PM _{10c} utilizing differential gravimetric analysis. | 1/3 days |
| - Lead | 2.4 | NCore SLAMS | Every other PM _{10c} Manual reference method filter analyzed via X-ray fluorescence. | 1/6 days |
| Meteorological | 9.3 | NCore Other | Air Quality Measurements approved instrumentation for wind speed, wind direction, humidity, and temperature | Continuously |
| -Solar Radiation | 5.0 | NCore Other | Air Quality Measurements approved instrumentation for solar radiation | Continuously |
| -Rain Gauge | 1.8 | NCore Other | Air Quality Measurements approved instrumentation for precipitation | Continuously |
| Radiation | 1.5 | RadNet | RadNet fixed station air monitor, manual and automated methods | Continuously + 2 weekly filters |

Quality Assurance Status:

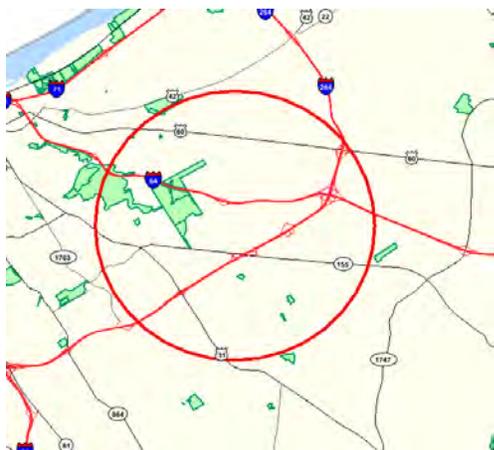
All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A. The District’s current Quality Assurance Project Plan covers trace-level O₃, NO_x, SO₂, and CO, as well as PM_{2.5} speciation, lead, and meteorological measurements. Standard operating procedures for trace-level CO, NO_x, NO_y, SO₂, O₃, PM_{2.5} BAM, and meteorological measurements have been developed. Additional standard operating procedures manuals will be adopted or developed for new instrumentation.

Area Representativeness:

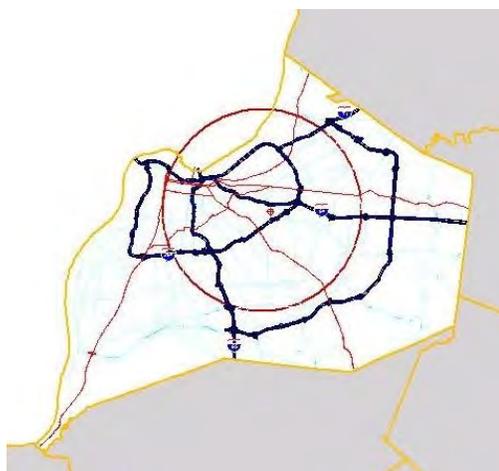
The air monitoring equipment at the Cannon’s Lane NCore station is specifically located at the urban and neighborhood scales. These scales are generally the most representative of the expected population exposures that occur throughout metropolitan areas.

| Pollutant | Spatial Scale | Comments |
|----------------------------------|------------------------------|---------------------------------------------|
| Ozone | Neighborhood and Urban Scale | 10 km radius |
| NO _x /NO _y | Neighborhood and Urban Scale | 10 km radius |
| Carbon Monoxide | Neighborhood Scale | There is no urban scale for CO |
| SO ₂ | Neighborhood Scale | There is no urban scale for SO ₂ |
| Particulates | Urban | |
| Radiation | Urban | |

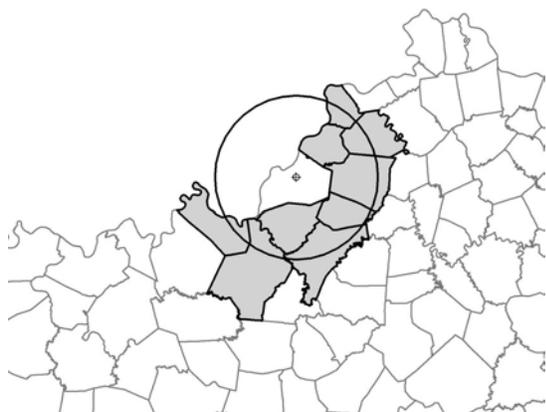
Neighborhood Scale (4 km): Carbon Monoxide, Sulfur Dioxide, and VOCs



Neighborhood and Urban Scales (10 km): Nitrogen Oxides and Ozone



Urban Scale (50 km): Particulates and Radiation



CSA/MSA: Louisville/Jefferson County-Elizabethtown-Madison, KY-IN CSA; Louisville/Jefferson County, KY-IN MSA

401 KAR 50:020 Air Quality Region: Louisville Interstate (078)

Site Name: Durrett Lane (Near-Road Site)

AQS Site ID: 21-111-0075

Location: 1517 Durrett Lane, Louisville, KY 40213

County: Jefferson

GPS Coordinates: 38.193632, -85.711950 (NAD 83)

Date Established: January 1, 2014

Inspection Date: December 4, 2015

Inspection By: Jennifer F. Miller & Wayne Bray

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



On February 9, 2010, the EPA released a new NO₂ Final Rule and a new set of monitoring requirements. Under the new monitoring requirements, State and Local agencies are required to establish near-road monitoring stations based upon core based statistical area (CBSA) populations and traffic metrics. The Louisville/Jefferson County, KY-IN MSA is required to establish not only a near-road nitrogen dioxide monitor, but also near-road PM_{2.5} and carbon monoxide monitors. In response, LMAPCD has established a multi-pollutant near-road site that includes instrumentation to measure nitrogen dioxide, PM_{2.5}, carbon monoxide, and meteorology. The specific site was chosen following the development of a formal site proposal and a 30-day comment public period in April 2013. Data collection at the site began in January 2014. More information regarding near-road monitoring can be found in the appendices of the this Annual Network Plan.

Monitoring Objective:

The monitoring objective will be to determine compliance with National Ambient Air Quality Standards for nitrogen dioxide, carbon monoxide, and particulate matter.

Monitors:

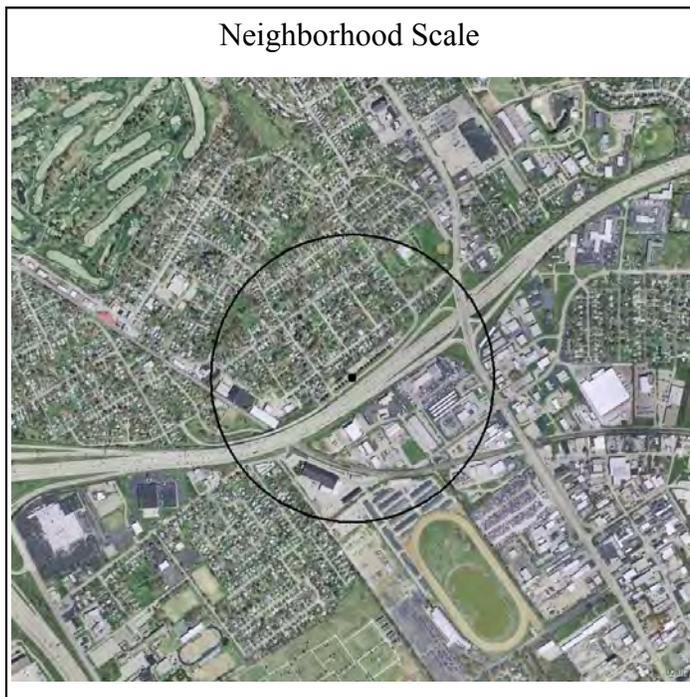
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|-----------------------|-----------------------|-------------|------------------------------------------------------------------------------------------------------|----------------------------|
| Nitrogen Dioxide | 4.6 | SLAMS | Automated Equivalent Method utilizing photolysis | Continuously |
| Carbon Monoxide | 4.6 | SLAMS | Automated Reference Method utilizing non-dispersive infrared analysis | Continuously |
| FRM PM _{2.5} | 4.7 | SLAMS | Manual Reference Method utilizing differential gravimetric analysis | One sample every third day |
| Meteorological | 10.0 | Other | AQM grade instruments for wind speed, wind direction, humidity, barometric pressure, and temperature | Continuously |

Quality Assurance Status:

All Quality Assurance procedures will be implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

The site represents maximum concentrations on a neighborhood scale.



CSA/MSA: Louisville/Jefferson County-Elizabethtown-Madison, KY-IN CSA; Louisville/Jefferson County, KY-IN MSA

401 KAR 50:020 Air Quality Region: Louisville Interstate (078)

Site Name: Firearms Training

AQS Site ID: 21-111-1041

Location: 4201 Algonquin Parkway, Louisville, KY 40211

County: Jefferson

GPS Coordinates: 38.23158, -85.82675 (NAD 83)

Date Established: April 13, 1978

Inspection Date: December 4, 2015

Inspection By: Jennifer F. Miller & Wayne Bray

Site Approval Status: Site and monitor meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of the Firearms Training Center in Louisville, Kentucky. The sample inlet is 4.5 meters above ground level and 52 meters from the nearest road. Upon inspection, the sample lines and monitors were found to be in good condition. The air monitoring site meets the criteria established by 40 CFR Part 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards and to detect episode levels for the activation of emergency control procedures.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|--------------------|-----------------------|---------------|-----------------|-----------------------|
| AEM Sulfur Dioxide | 4.5 | SLAMS EPISODE | UV fluorescence | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

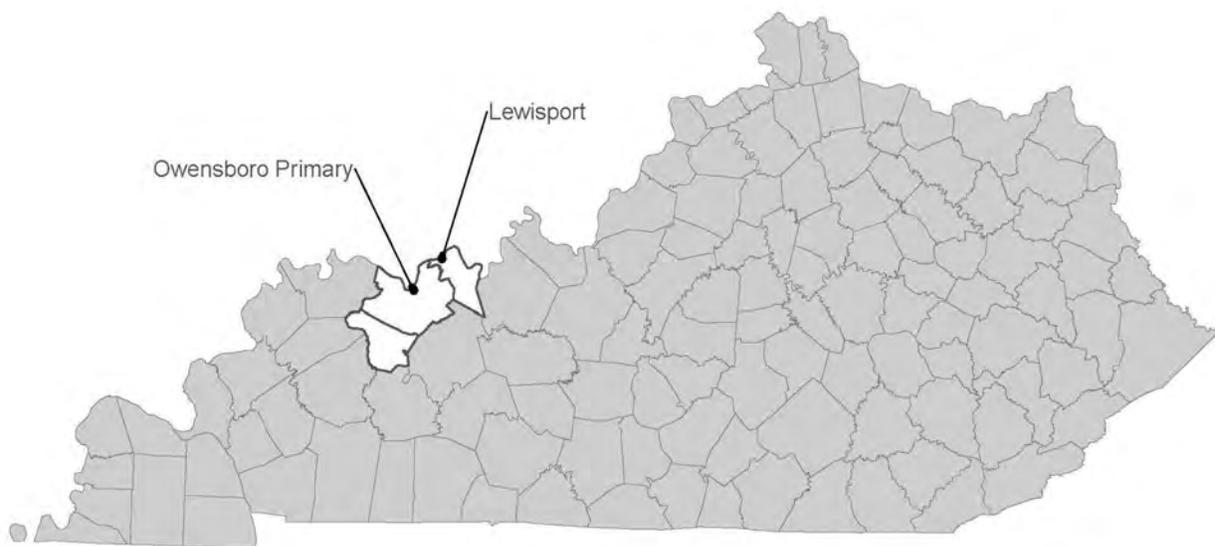
Area Representativeness:

This site represents population exposure on a neighborhood scale.



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Owensboro, KY



| AQS ID / County | Site Address | PM2.5 | Cont. PM2.5 | PM10 | Cont. PM10 | SO2 | NO2 | NOy | CO | O3 | Pb | VOC | Carbonyl | PAH | PM2.5 Spec. | Carbon Spec. | RadNet | Met |
|------------------------|--------------------------------------|----------|-----------------|------|------------|-----------------|-----------------|-----|----|-----------------|----|-----|----------|-----|-------------|--------------|--------|----------|
| 21-059-0005 Daviess | 716 Pleasant Valley Rd. Owensboro | 1 | 1 ^{te} | | | 1 ^{ei} | 1 ^{ei} | | | 1 ^{ei} | | | | | | | | 1 |
| 21-091-0012 Hancock | Second & Caroline St. Lewisport | | | | | | | | | 1 ^M | | | | | | | | |
| Totals | 2 | 1 | 1 | | | 1 | 1 | | | 2 | | | | | | | | 1 |

Tallies are equal to the actual number of monitors present. Superscripts represent additional information about the network.

e=Emergency Episode Monitor

t=Continuous TEOM Monitor

i=AQI Reported

M=Maximum Ozone Concentration Site for MSA

CSA/MSA: Owensboro, KY MSA

401 KAR 50:020 Air Quality Region: Evansville-Owensboro-Henderson Interstate (077)

Site Name: Owensboro Primary

AQS Site ID: 21-059-0005

Location: 716 Pleasant Valley Road, Owensboro, KY 42303

County: Daviess

GPS Coordinates: 37.780776, -87.075307 (NAD 83)

Date Established: December 1, 1970

Inspection Date: October 20, 2015

Inspection By: Ashley Bedel

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds behind the Wyndall's Shopping Center in Owensboro, Kentucky. The sample inlets are 48 meters from the nearest road. Upon inspection, the sample lines and monitors were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards; to detect emergency pollution levels of criteria pollutants for activation of emergency control procedures. While not required for the CBSA, the site also provide levels of pollutants for daily index reporting.

Monitors:

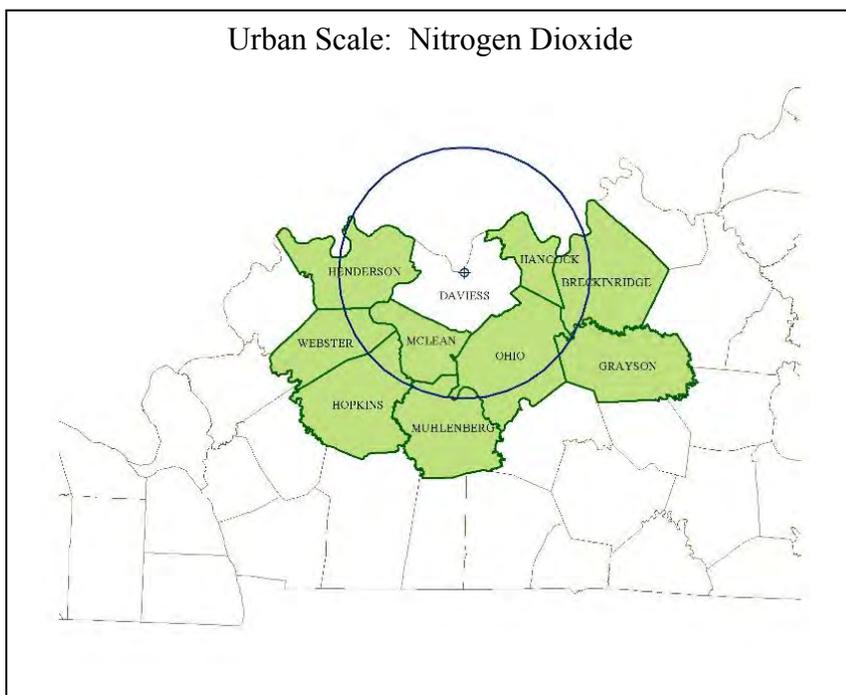
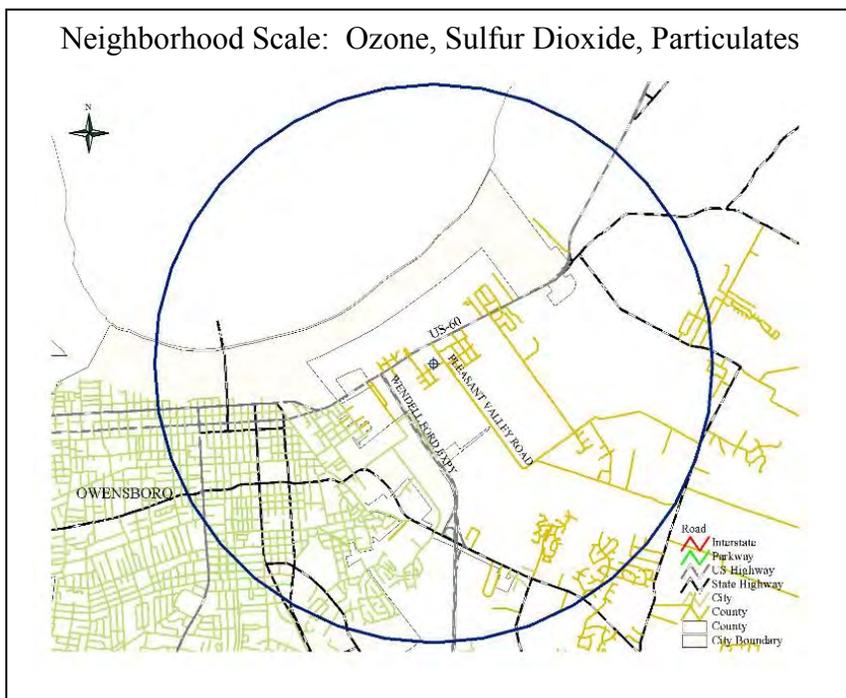
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|------------------------|-----------------------|-------------------------|-----------------------------------------------------------------------------------------------------------|--------------------------------------|
| AEM Nitrogen Dioxide | 3.5 | SLAMS EPISODE AQI | Chemiluminescence | Continuously |
| AEM Ozone | 3.5 | SLAMS EPISODE AQI | UV photometry | Continuously March 1 – October 31 |
| FRM PM _{2.5} | 2.2 | SLAMS | Gravimetric | 24-hours every third day |
| PM _{2.5} TEOM | 4.6 | SPM EPISODE AQI | Tapered element oscillating microbalance, gravimetric | Continuously |
| AEM Sulfur Dioxide | 3.5 | SLAMS EPISODE AQI | UV fluorescence | Continuously |
| Meteorological | 7.5 | Other | AQM grade instruments for wind speed, wind direction, humidity, barometric pressure and temperature | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

This site represents population exposure on a neighborhood scale for particulates, ozone, and sulfur dioxide. This site also represents population exposure on an urban scale for nitrogen dioxide.



CSA/MSA: Owensboro, KY MSA

401 KAR 50:020 Air Quality Region: Evansville-Owensboro-Henderson Interstate (077)

Site Name: Lewisport

AQS Site ID: 21-091-0012

Location: Community Center Drive & First Street, Lewisport, KY 42351

County: Hancock

GPS Coordinates: 37.93829, -86.89719 (NAD 83)

Date Established: September 5, 1980

Inspection Date: October 20, 2015

Inspection By: Ashley Bedel

Site Approval Status: Site and monitor meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the athletic fields of the former Lewisport Consolidated Elementary School in Lewisport, Kentucky. The sample inlet is 57 meters from the nearest road. Upon inspection, the sample line and monitor were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards.

Monitors:

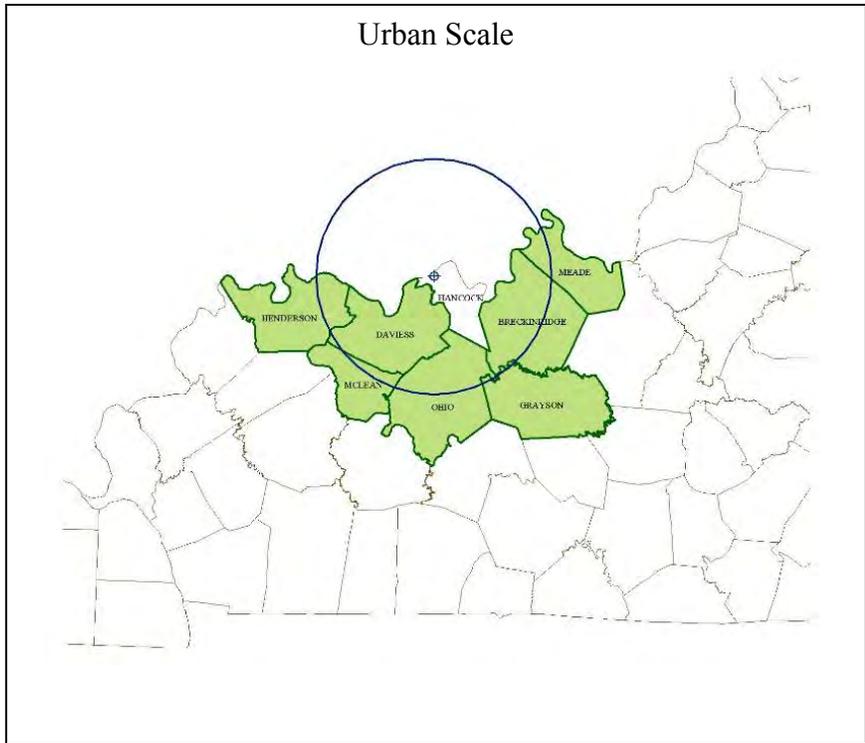
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|--------------|-----------------------|---------------------------------|-----------------|--------------------------------------|
| AEM Ozone | 3.5 | SLAMS Maximum O ₃ | UV photometry | Continuously March 1 – October 31 |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

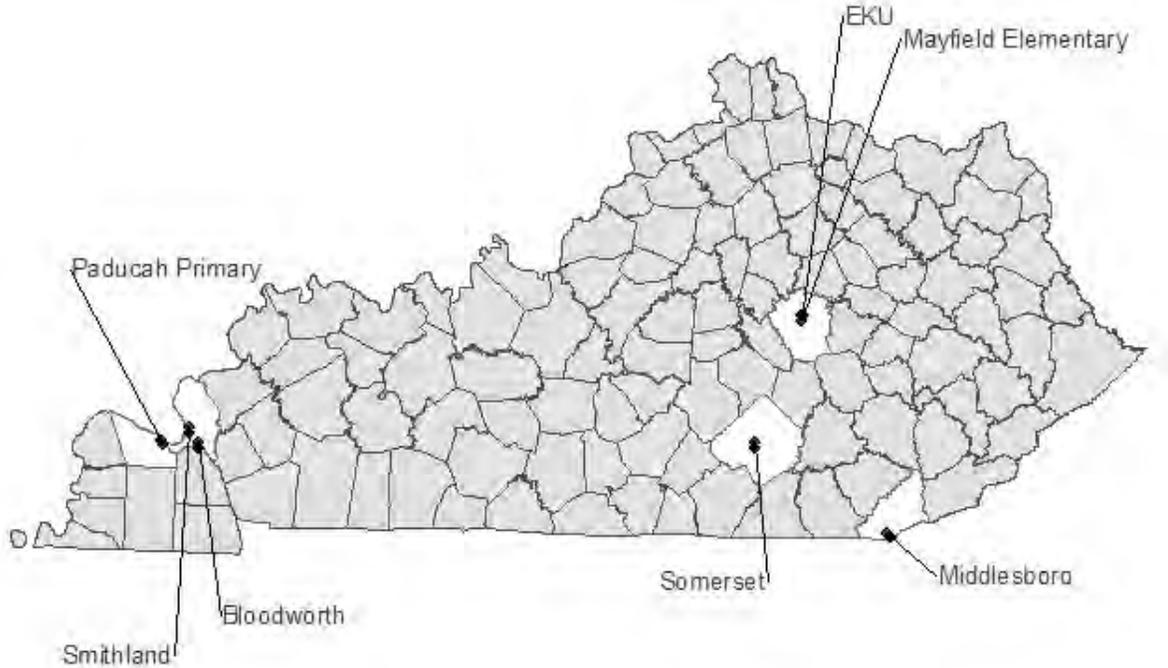
Area Representativeness:

This site represents maximum concentrations on an urban scale.



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Micropolitan Statistical Areas



| AQS ID / County | Site Address | PM2.5 | Cont. PM2.5 | PM10 | Cont. PM10 | SO2 | NO2 | NOy | CO | O3 | Pb | VOC | Carbonyl | PAH | PM2.5 Spec. | Carbon Spec. | RadNet | Met |
|---------------------------|-------------------------------------|----------|-----------------|----------------|------------|------------------|-----------------|-----|----|-----------------|----------------|----------|----------|-----|-------------|--------------|----------|----------|
| 21-013-0002 Bell | 1420 Dorchester Ave. Middlesboro | 1 | | | | | | | | 1 | | | | | | | | 1 |
| 21-139-0003 Livingston | 706 State Drive Smithland | | | | | | | | | 1 | | | | | | | 1 | |
| 21-139-0004 Livingston | 763 Bloodworth Road Smithland | | | 1 ^m | | | | | | | | 1 | | | | | | 1 |
| 21-145-1024 McCracken | 2901 Powell Street Paducah | 1 | 1 ^{ti} | 1 | | 1 ^{Pei} | 1 ^{ei} | | | 1 ^{ei} | | | | | | | | |
| 21-151-0003 Madison | 300 Bond Street Richmond | 1 | | | | | | | | | 1 | | | | | | | |
| 21-151-0005 Madison | Van Hoose Drive Richmond | | | | | | | | | | 2 ^C | | | | | | | |
| 21-199-0003 Pulaski | 305 Clifty Street Somerset | 1 | | | | | | | | 1 | | | | | | | | |
| Totals | 7 | 4 | 1 | 2 | | 1 | 1 | | | 4 | 3 | 1 | | | | | 1 | 2 |

Tallies are equal to the actual number of monitors present. Superscripts represent additional information about the network.

P= PWEI SO2 monitor required in CBSA.

C=Collocated

P=PWEI Monitor

t=Continuous TEOM Monitor

m=PM10 Filter Analyzed for Metals

e=Emergency Episode Monitor

i=AQI Reported

CSA/MSA: Middlesborough, KY Micropolitan Statistical Area
401 KAR 50:020 Air Quality Region: Appalachian Intrastate (101)
Site Name: Middlesboro
AQS Site ID: 21-013-0002
Location: Middlesboro Airport, 1420 Dorchester Avenue, Middlesboro, KY 40965
County: Bell
GPS Coordinates: 36.60843, -83.73694 (NAD 83)
Date Established: February 14, 1992
Inspection Date: September 9, 2015
Inspection By: Ashley Bedel
Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of the Middlesboro Airport in Middlesboro, Kentucky. The sample inlets are 92 meters from the nearest road. Upon inspection the sample lines and monitors were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards and to provide information on the transport of ozone into the region.

Monitors:

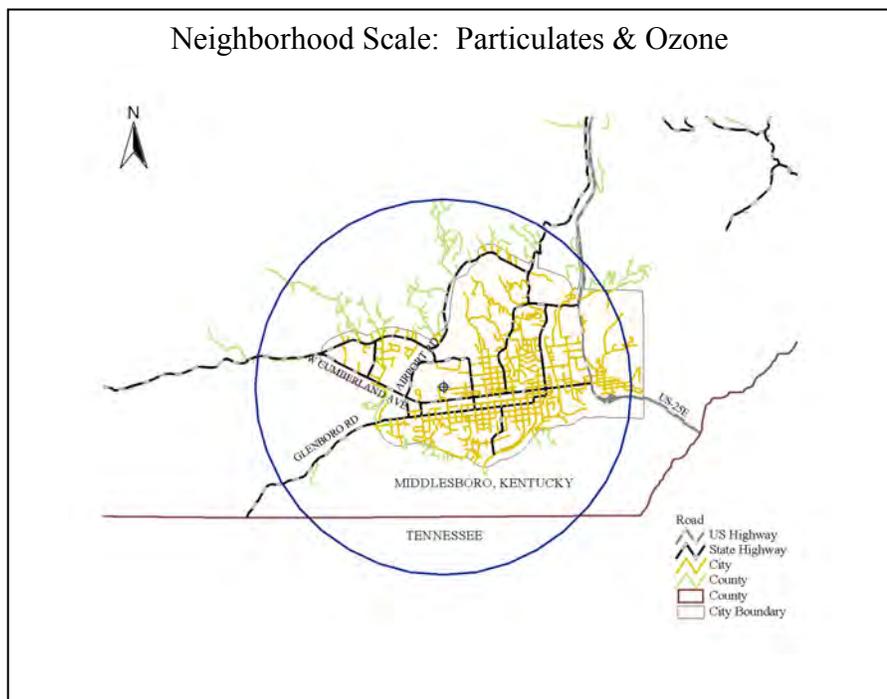
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|-----------------------|-----------------------|-------------|-----------------------------------------------------------------------------------------------------|--------------------------------------|
| AEM Ozone | 4.1 | SPM | UV photometry | Continuously March 1 – October 31 |
| FRM PM _{2.5} | 4.6 | SPM | Gravimetric | 24-hours every sixth day |
| Meteorological | 5.7 | Other | AQM grade instruments for wind speed, wind direction, humidity, barometric pressure and temperature | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

The site represents population exposure on a neighborhood scale for particulates and ozone.



CSA/MSA: Paducah-Mayfield, KY-IL CSA; Paducah, KY-IL Micropolitan Statistical Area
401 KAR 50:020 Air Quality Region: Paducah-Cairo Interstate (072)
Site Name: Smithland
AQS Site ID: 21-139-0003
Location: Livingston County Road Dept., 730 State Drive, Smithland, KY 42081
County: Livingston
GPS Coordinates: 37.155392, -88.394024 (NAD 83)
Date Established: April 1, 1988
Inspection Date: December 9, 2015
Inspection By: Jennifer F. Miller
Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of the Livingston County Road Dept. facility in Smithland, Kentucky. The sample inlets are 139 meters from the nearest road. Upon inspection, the sample lines and monitors were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objective is to determine compliance with National Ambient Air Quality Standards.

Monitors:

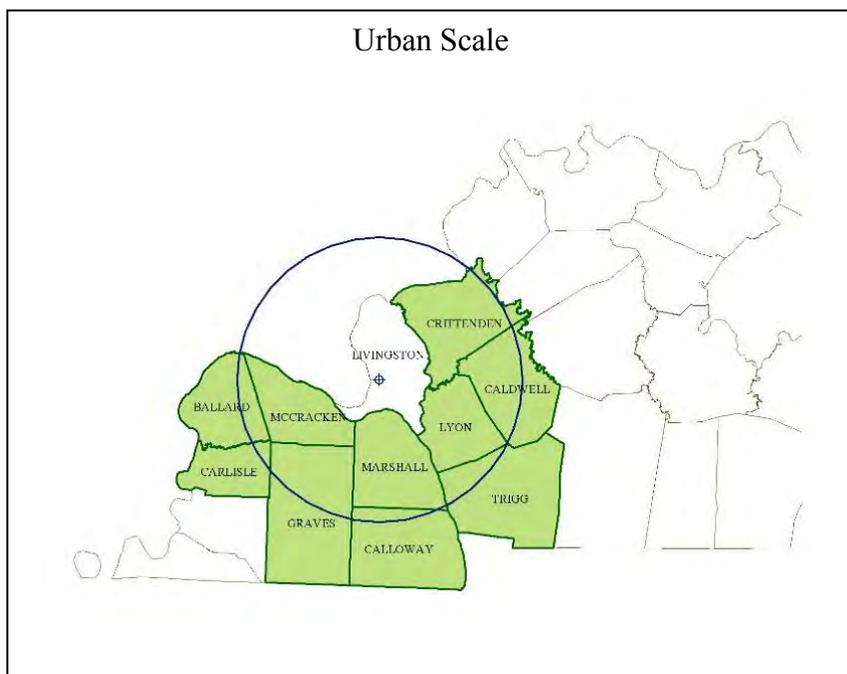
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|--------------|-----------------------|-------------|---------------------------------------------------------------|---------------------------------|
| AEM Ozone | 3.3 | SLAMS | UV photometry | Continuously |
| Radiation | 2.0 | RadNet | RadNet fixed stationary monitor, manual and automated methods | Continuously & 2 weekly filters |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

This site represents maximum concentrations on an urban scale.



CSA/MSA: Paducah-Mayfield, KY-IL CSA; Paducah, KY-IL Micropolitan Statistical Area
401 KAR 50:020 Air Quality Region: Paducah-Cairo Interstate (072)
Site Name: Bloodworth
AQS Site ID: 21-139-0004
Location: 763 Bloodworth Road, Smithland, KY 42081
County: Livingston
GPS Coordinates: 37.07151, -88.33389 (NAD 83)
Date Established: September 15, 1986
Inspection Date: December 9, 2015
Inspection By: Jennifer F. Miller
Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located at the residence of 763 Bloodworth Road in Livingston County, Kentucky. The sample inlets are 8 meters from the nearest road, which is an access road for a residence. Upon inspection, the inlet and sampler were found to be in good condition.

Monitoring Objective:

The monitoring objective is to determine compliance with National Ambient Air Quality Standards for PM₁₀ and to detect and quantify air toxics in ambient air.

Monitors:

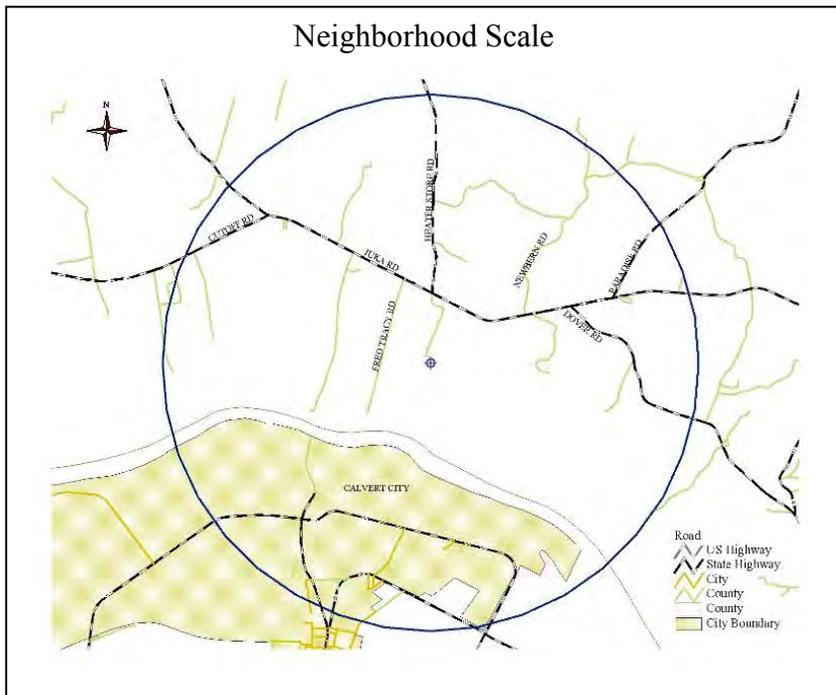
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|----------------------------|-----------------------|-------------|-----------------------------------------------------------------------------------------------------|--------------------------|
| Volatile Organic Compounds | 4.6 | SPM-Other | EPA method TO-15 | 24-hours every sixth day |
| FRM PM ₁₀ | 4.5 | SPM | Gravimetric | 24-hours every sixth day |
| - Metals PM ₁₀ | | SPM-Other | Determined from the PM ₁₀ sample using EPA method IO 3.5 | Same as PM ₁₀ |
| Meteorological | 7.5 | Other | AQM grade instruments for wind speed, wind direction, humidity, barometric pressure and temperature | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

The site represents source impacts on a neighborhood scale.



CSA/MSA: Paducah-Mayfield, KY-IL CSA; Paducah, KY-IL Micropolitan Statistical Area
401 KAR 50:020 Air Quality Region: Paducah-Cairo Interstate (072)
Site Name: Jackson Purchase-Paducah Primary
AQS Site ID: 21-145-1024
Location: Jackson Purchase RECC, 2901 Powell Street, Paducah, KY 42003
County: McCracken
GPS Coordinates: 37.05822, -88.57251 (NAD 83)
Date Established: August 15, 1980
Inspection Date: December 10, 2015
Inspection By: Jennifer F. Miller
Site Approval Status: Site and monitors meet design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of the Jackson Purchase RECC in Paducah, Kentucky. While the site meets most of the requirements established by 40 CFR 58, Appendices C, D, E and G, the sample inlets are only 9 meters from the nearest road, which is closer than the distances allowed by 40 CFR 58, Appendix E. Due to the small traffic count of the street and the unlikely influence of vehicle-exhaust on data, KDAQ has received EPA-approval for a waiver from the minimum allowable road-distances for all monitors at the site.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards and to detect elevated pollutant levels for activation of emergency control procedures for nitrogen dioxide, ozone, and sulfur dioxide. While not required for the CBSA, the site also provides pollutant levels for daily air quality index reporting.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|----------------------|-----------------------|-------------------------|-------------------|--------------------------------------|
| AEM Nitrogen Dioxide | 3.7 | SLAMS EPISODE AQI | Chemiluminescence | Continuously |
| AEM Sulfur Dioxide | 3.7 | SLAMS AQI EPISODE | UV fluorescence | Continuously |
| AEM Ozone | 3.7 | SLAMS AQI EPISODE | UV photometry | Continuously March 1 – October 31 |

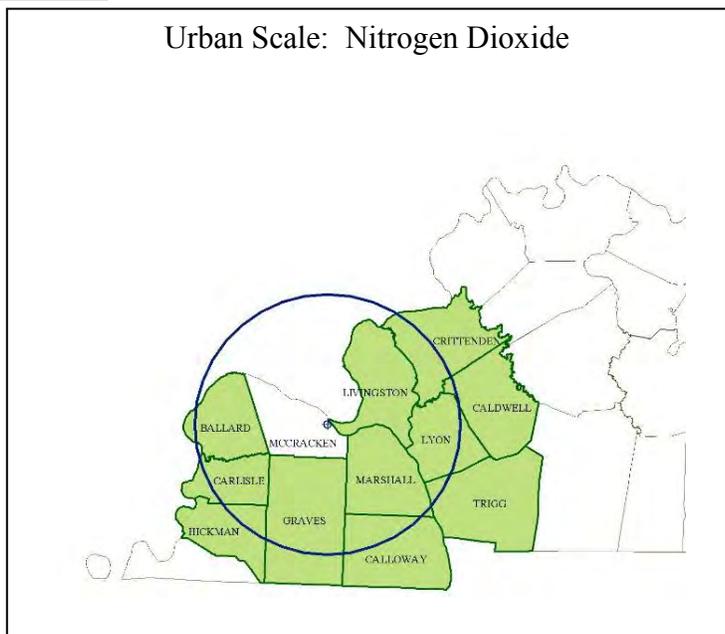
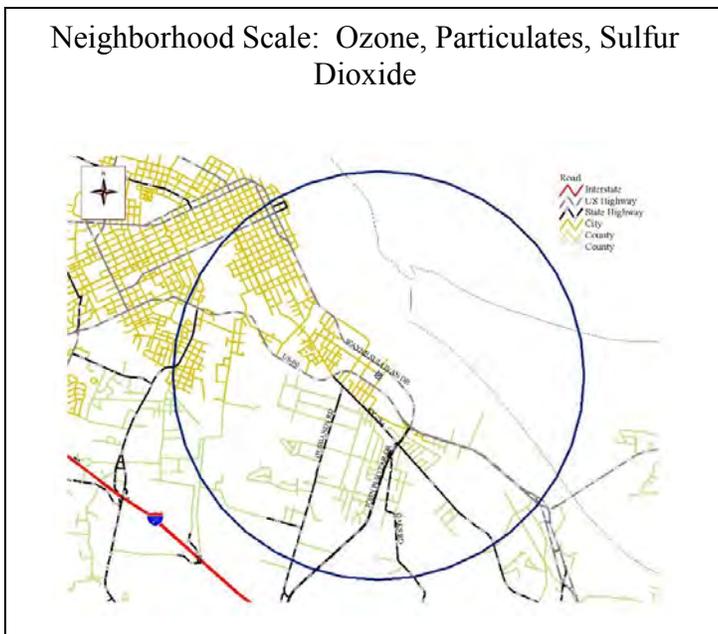
| | | | | |
|------------------------|-----|------------|----------------------------------------------------------|--------------------------|
| PM _{2.5} TEOM | 4.8 | SPM AQI | Tapered element oscillating microbalance, gravimetric | Continuously |
| FRM PM _{2.5} | 4.7 | SLAMS | Gravimetric | 24-hours every third day |
| FEM PM ₁₀ | 4.6 | SLAMS | Gravimetric | 24-hours every sixth day |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

This site represents population exposure on a neighborhood scale for ozone, particulates, and sulfur dioxide. This site also represents population exposure on an urban scale for nitrogen dioxide.



CSA/MSA: Lexington-Fayette-Richmond-Frankfort KY CSA; Richmond-Berea, KY Micropolitan Statistical Area

401 KAR 50:020 Air Quality Region: Bluegrass Intrastate (102)

Site Name: Mayfield Elementary (Madison Kindergarten Academy-MKA)

AQS Site ID: 21-151-0003

Location: Madison Kindergarten Academy at Mayfield, 300 Bond Street, Richmond, KY 40475

County: Madison

GPS Coordinates: 37.738458, -84.284952 (NAD 83)

Date Established: January 1, 1999

Inspection Date: November 6, 2015

Inspection By: Jennifer F. Miller

Site Approval Status: Site and PM_{2.5} monitor meet all design criteria for the monitoring network. Siting criteria for the lead sampler have not been approved by the EPA.



The monitoring site is located on the roof of the Madison Kindergarten Academy (formerly Mayfield Elementary) in Richmond, Kentucky. The sample inlets are 65 meters from the nearest road. Upon inspection, the sample inlet and monitor were found to be in good condition. The lead sampler is not located within the expected area of maximum deposition, as is required by 40 CFR 58, Appendix D. Otherwise, the site meets the requirements of 40 CFR 58, Appendices A, C, D and E.

Monitoring Objective:

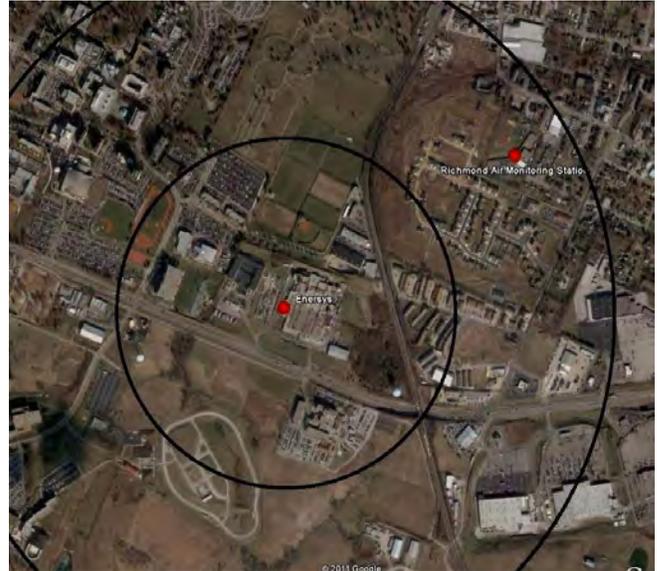
The monitoring objectives are to determine compliance with National Ambient Air Quality Standards.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|-----------------------|-----------------------|-------------|-----------------------------------------------|--------------------------|
| FRM PM _{2.5} | 5.5 | SLAMS | Gravimetric | 24-hours every third day |
| FRM Lead | 4.5 | SLAMS | High volume air sampler. Analysis via ICP-MS. | 24-hours every sixth day |

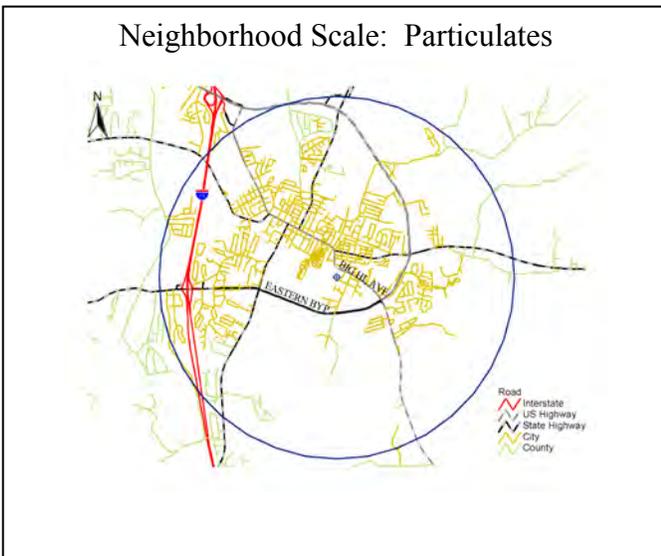
Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.



Area Representativeness:

This site represents population exposure on a neighborhood scale for particulates. This site also represents source impacts on a neighborhood scale for lead.



CSA/MSA: Lexington-Fayette-Richmond-Frankfort KY CSA; Richmond-Berea, KY Metropolitan Statistical Area

401 KAR 50:020 Air Quality Region: Bluegrass Intrastate (102)

Site Name: EKU

AQS Site ID: 21-151-0005

Location: Eastern Kentucky University, Van Hoose Drive, Richmond, KY 40475

County: Madison

GPS Coordinates: 37.73635, -84.29169 (NAD 83)

Date Established: March 10, 2012

Inspection Date: November 6, 2015

Inspection By: Jennifer F. Miller

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The EKU site was originally established as a temporary lead monitoring location to evaluate the adequacy of the Mayfield Elementary (21-151-0003) lead site, which is 0.64 km away. Modeling had demonstrated that the EKU site is located within the expected area of maximum concentration, while Mayfield Elementary was not within the area of maximum concentration. Sample results obtained from both sites have confirmed the modeling; thus, KDAQ has established permanent lead monitoring at the EKU site. A collocated lead monitor has also been established.

The site is located behind the Gentry Facilities Services building and is adjacent to Eastern Kentucky University's athletic fields. The sample inlets are 2.9 meters from the nearest road. Upon inspection, the sample inlet and monitor were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices A, C, D and E.

Monitoring Objective:

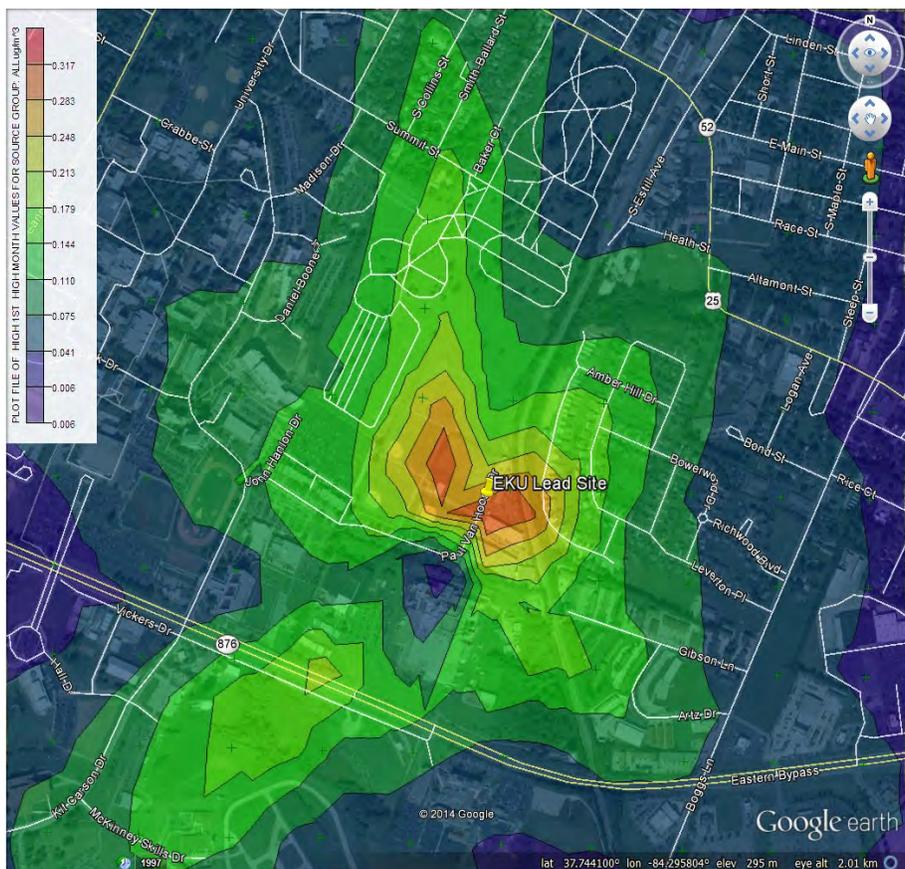
The monitoring objectives are to determine compliance with National Ambient Air Quality Standards.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|---------------------|-----------------------|-------------|-----------------------------------------------|----------------------------|
| FRM Lead | 2.3 | SLAMS | High volume air sampler. Analysis via ICP-MS. | 24-hours every sixth day |
| Collocated FRM Lead | 2.3 | SLAMS | High volume air sampler. Analysis via ICP-MS. | 24-hours every twelfth day |

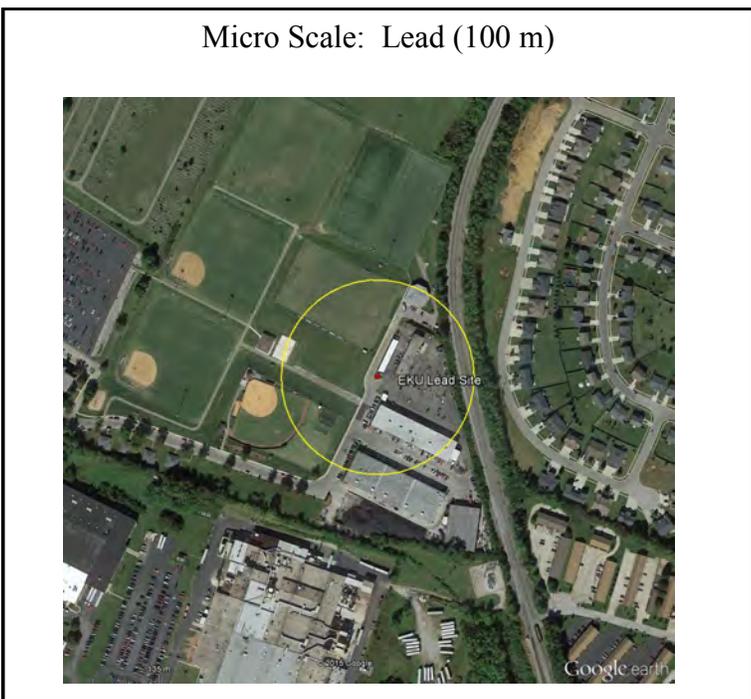
Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.



Area Representativeness:

This site represents source impacts on a micro scale for lead.



CSA/MSA: Somerset, KY Micropolitan Statistical Area
401 KAR 50:020 Air Quality Control Region: South Central Kentucky Intrastate (105)
Site Name: Somerset
AQS Site ID: 21-199-0003
Location: Somerset Gas Company Warehouse, 305 Clifty Street, Somerset, KY 42501
County: Pulaski
GPS Coordinates: 37.09798, -84.61152 (NAD 83)
Date Established: February 14, 1992
Inspection Date: September 9, 2015
Inspection By: Ashley Bedel
Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of the Somerset Gas Company Warehouse on Clifty Street in Somerset, KY. The sample inlets are 10 meters from the nearest road, which is a dead-end street with little traffic. Upon inspection the sample line and monitors were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices C, D, and E.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards.

Monitors:

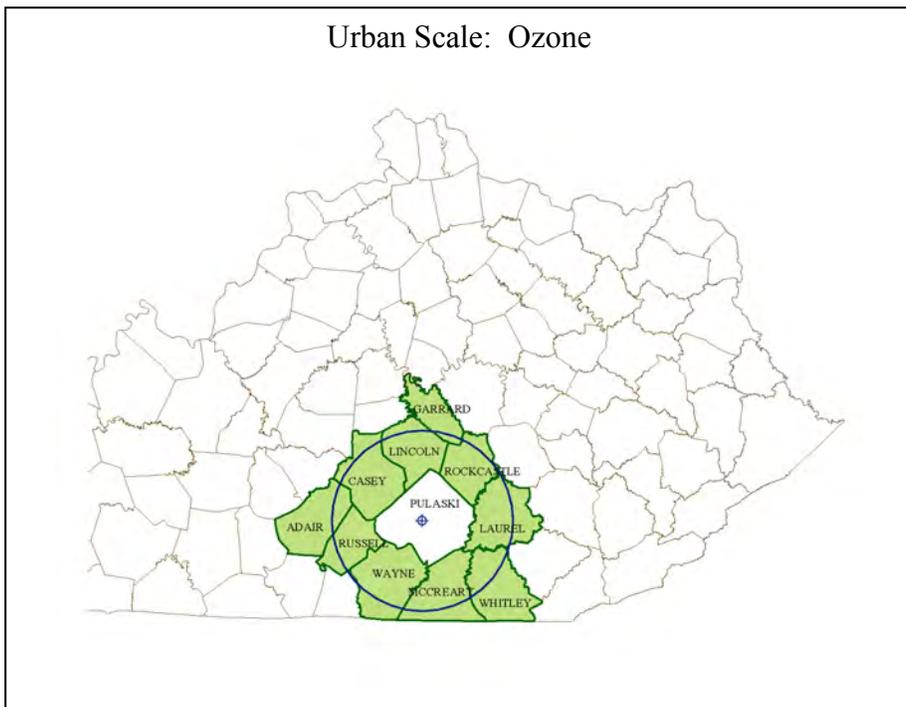
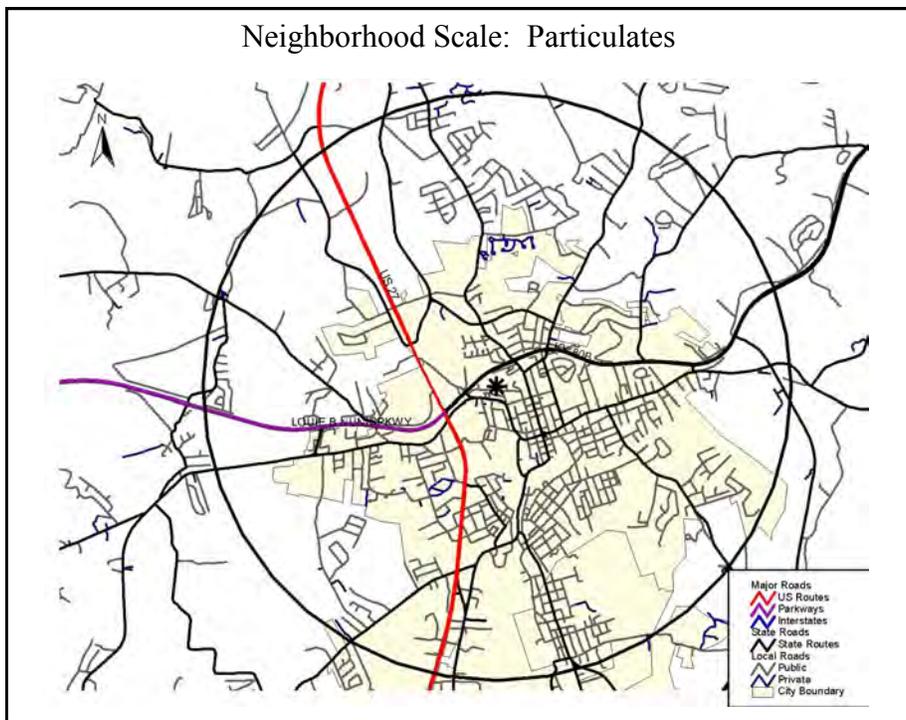
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|-----------------------|-----------------------|-------------|-----------------|--------------------------------------|
| AEM Ozone | 4.4 | SPM | UV photometry | Continuously March 1 – October 31 |
| FRM PM _{2.5} | 4.6 | SPM | Gravimetric | 24-hours every third day |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

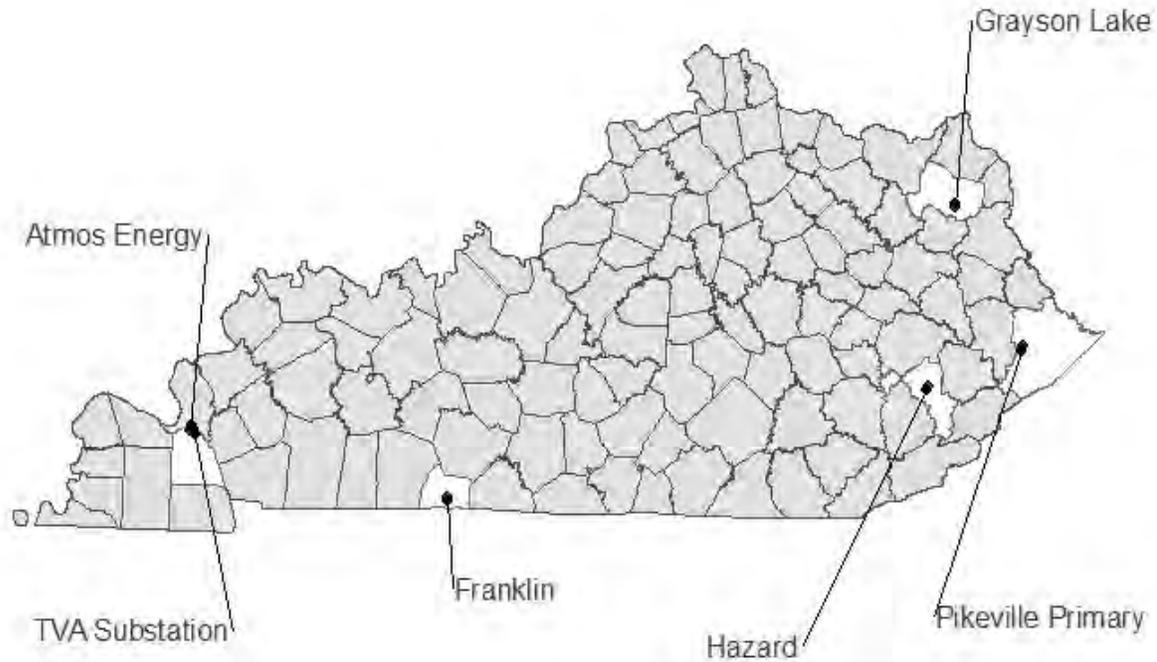
Area Representativeness:

The site represents population exposure on an urban scale for ozone. This site also represents population exposure on a neighborhood scale for particulates.



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Not in a Metropolitan or Micropolitan Statistical Area



| AQS ID / County | Site Address | PM2.5 | Cont. PM2.5 | PM10 | Cont. PM10 | SO2 | NO2 | NOy | CO | O3 | Pb | VOC | Carbonyl | PAH | PM2.5 Spec. | Carbon Spec. | RadNet | Met |
|-------------------------|------------------------------------|----------------|-----------------|-----------------|------------|-----|-----|-----|----|----------------|----|----------------|----------------|----------|-------------|--------------|--------|----------|
| 21-043-0500 Carter | 1486 Camp Webb Road Grayson | 1 ^X | | 2 ^{Cm} | | | | | | 1 | | 2 ^D | 2 ^D | 1 | | | | 1 |
| 21-157-0014 Marshall | Industrial Parkway Calvert City | | | | | | | | | | | 2 ^C | | | | | | |
| 21-193-0003 Perry | 354 Perry Park Road Hazard | 1 | 1 ^t | | | | | | | 1 ^e | | | | | | | | 1 |
| 21-195-0002 Pike | 109 Loraine Street Pikeville | 2 ^C | 1 ^{ti} | | | | | | | 1 ⁱ | | | | | | | | |
| 21-213-0004 Simpson | 573 Harding Road Franklin | | | | | | | | | 1 | | | | | | | | 1 |
| Totals | 5 | 4 | 2 | 2 | | | | | | 4 | | 4 | 2 | 1 | | | | 3 |

Tallies are equal to the actual number of monitors present. Superscripts represent additional information about the network.

D=Duplicate

m=PM10 Filter Analyzed for Metals

C=Collocated

i=AQI Reported

t=Continuous TEOM Monitor

X=Regional Background PM2.5 Monitor

CSA/MSA: Not in a MSA - Rural

401 KAR 50:020 Air Quality Region: Huntington (WV)-Ashland (KY)-Portsmouth-Ironton (OH) Interstate (103)

Site Name: Grayson Lake

AQS Site ID: 21-043-0500

Location: Camp Robert Webb, 1486 Camp Webb Road, Grayson Lake, KY 41143

County: Carter

GPS Coordinates: 38.23887, -82.98810 (NAD 83)

Date Established: May 13, 1983

Inspection Date: November 23, 2015

Inspection By: Jennifer F. Miller & James Mullins

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter in a fenced area located in a remote section of Camp Webb in Grayson, Kentucky. The nearest road is a service road to the site and is 98 meters from the site. Upon inspection, the sample lines and monitors were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices A, C, D, and E.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards; to determine background levels of PM_{2.5} and PM₁₀; to provide ozone data upwind of the Ashland area; and to measure rural concentrations of a sub-group of air toxics for use in a national air toxics assessment.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|--------------------------------------|-----------------------|--------------------|----------------------------------------------------------------------|--------------------------------------|
| AEM Ozone | 3.7 | SPM | UV photometry | Continuously March 1 – October 31 |
| FRM PM ₁₀ | 2.2 | SLAMS | Gravimetric | 24-hours every sixth day |
| - Metals PM ₁₀ | | NATTS SPM-Other | Determined from the PM ₁₀ samples using EPA method IO 3.5 | Same as PM ₁₀ |
| Collocated PM ₁₀ | 2.2 | SLAMS | Gravimetric | 24-hours every twelfth day |
| - Collocated metals PM ₁₀ | | NATTS SPM-Other | Determined from the PM ₁₀ samples using EPA method IO 3.5 | 24-hours; six samples per year |

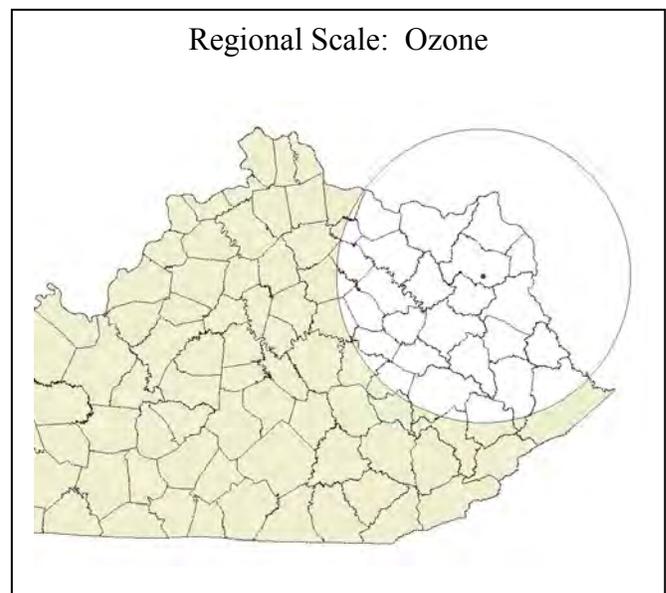
| | | | | |
|----------------------------------------|-----------------|--------------------|-----------------------------------------------------------------------------------------------------------------|--------------------------------|
| FRM PM _{2.5} | 2.3 | SLAMS | Gravimetric | 24-hours every third day |
| Volatile Organic Compounds | 3.8 | NATTS SPM-Other | EPA method TO-15. | 24-hours every sixth day |
| - Duplicate Volatile Organic Compounds | | NATTS SPM-Other | EPA method TO-15. Collected via same sampling system as primary VOCs. | 24-hours; six samples per year |
| Polycyclic Aromatic Hydrocarbons | 2.1 | NATTS SPM-Other | EPA method TO-13A | 24-hours every sixth day |
| Carbonyls | 4.1 | NATTS SPM-Other | EPA method TO-11A | 24-hours every sixth day |
| - Duplicate Carbonyls | | NATTS SPM-Other | EPA method TO-11A. Collected via same sampling system as primary carbonyls. | 24-hours; six samples per year |
| Meteorological | 12.2 4.7 | Other | AQM grade instruments for wind speed, wind direction, relative humidity, and temperature Solar Radiation | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

The site represents background levels on an urban scale for particulates and air toxics. This site also represents upwind/background levels on an regional scale for ozone.



CSA/MSA: Not in a MSA - Rural

401 KAR 50:020 Air Quality Control Region: Paducah – Cairo Interstate (072)

Site Name: TVA Substation

AQS Site ID: 21-157-0014

Location: Plant Cutoff Road & Industrial Parkway, Calvert City, KY 42029

County: Marshall

GPS Coordinates: 37.04520, -88.33087 (NAD 83)

Date Established: January 1, 2005

Inspection Date: December 9, 2015

Inspection By: Jennifer F. Miller

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is located off Ballpark Road in Calvert City, Kentucky. The inlets are approximately 230 meters from the nearest road. Upon inspection, the sample inlets and monitors were found to be in good condition.

Due to expansion of the fenced-compound of the TVA electrical substation, the samplers were relocated in June 2013. The new location is approximately 20 meters northwest from the original location and is still along the fence-line of the compound.

Monitoring Objective:

The monitoring objectives are to detect and quantify air toxic pollutants.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|---------------------------------------|-----------------------|-------------|------------------|----------------------------|
| Volatile Organic Compounds | 2.1 | SPM-Other | EPA method TO-15 | 24-hours every sixth day |
| Collocated Volatile Organic Compounds | 2.0 | SPM-Other | EPA method TO-15 | 24-hours every twelfth day |

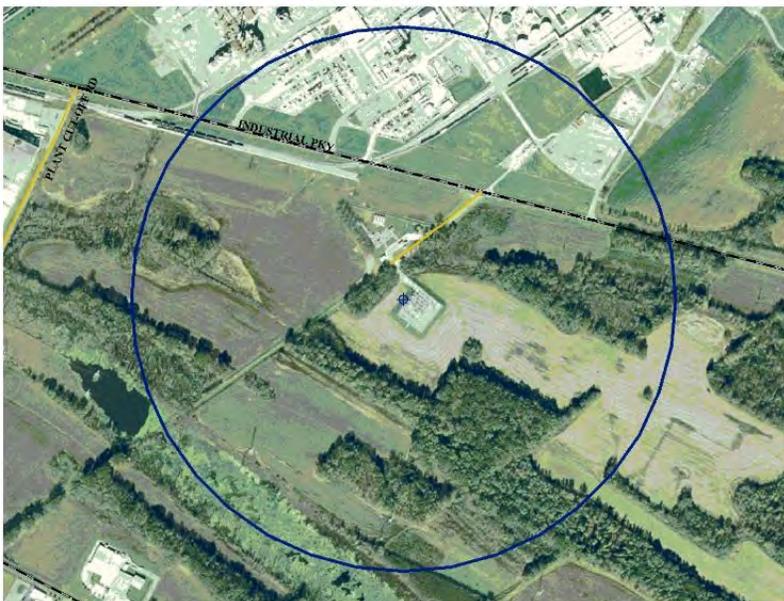
Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

This site represents source oriented exposure on a middle scale.

Middle Scale



CSA/MSA: Not in a MSA - Rural

401 KAR 50:020 Air Quality Control Region: Appalachian Intrastate (101)

Site Name: Hazard

AQS Site ID: 21-193-0003

Location: Perry County Horse Park, 354 Perry Park Road, Hazard, KY 41701

County: Perry

GPS Coordinates: 37.28329, -83.20932 (NAD 83)

Date Established: April 1, 2000

Inspection Date: September 10, 2015

Inspection By: Ashley Bedel

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of the Perry County Horse Park in Hazard, Kentucky. The sample inlets 33 meters from the nearest road. Upon inspection the sample lines and monitors were found to be in good condition. This site meets the requirements of 40 CFR 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards and to detect elevated pollutant levels for activation of emergency control procedures for ozone.

Monitors:

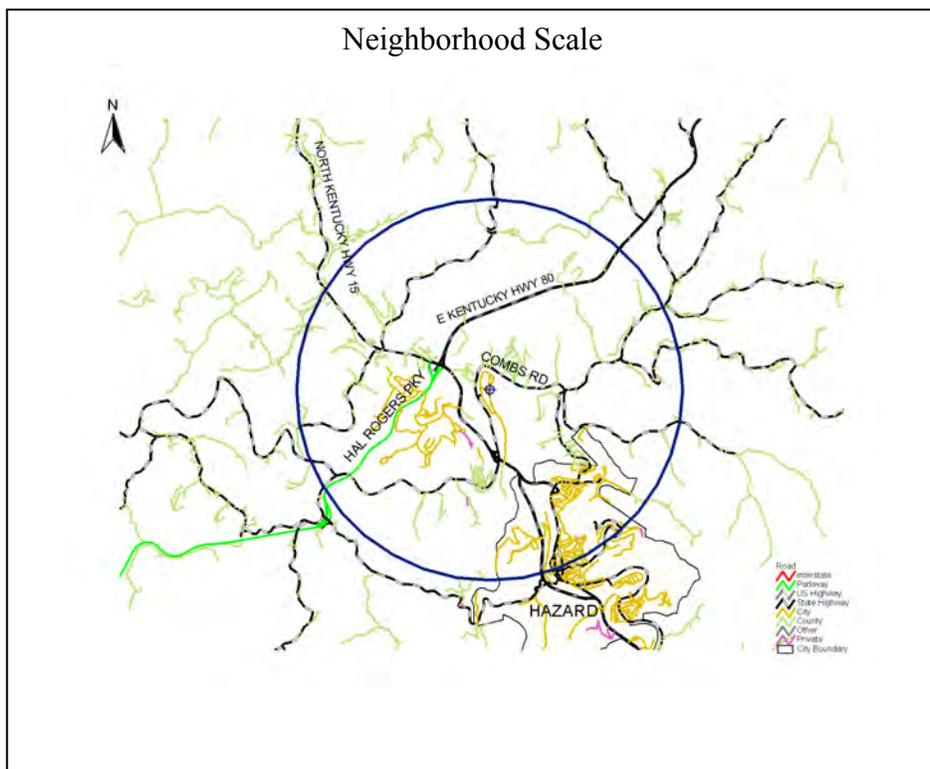
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|------------------------|-----------------------|----------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------|
| AEM Ozone | 4.6 | SPM EPISODE | UV photometry | Continuously March 1 – October 31 |
| FRM PM _{2.5} | 3.2 | SPM | Gravimetric | 24-hours every sixth day |
| PM _{2.5} TEOM | 5.3 | SPM | Tapered element oscillating microbalance, gravimetric | Continuously |
| Meteorological | 13.0 | Other | AQM grade instruments for wind speed, wind direction, relative humidity, barometric pressure, and temperature | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

The site represents population exposure on a neighborhood scale.



CSA/MSA: Not in a MSA - Rural

401 KAR 50:020 Air Quality Control Region: Appalachian Intrastate (101)

Site Name: Pikeville Primary

AQS Site ID: 21-195-0002

Location: KYTC District Office, 109 Loraine Street, Pikeville, KY 41501

County: Pike

GPS Coordinates: 37.48260, -82.53532 (NAD 83)

Date Established: May 1, 1994

Inspection Date: September 10, 2015

Inspection By: Ashley Bedel

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located behind the KYTC District Office building in Pikeville, KY. The sample inlets are 88 meters from the nearest road. Upon inspection the sample lines and monitors were found to be in good condition. This site meets the requirements of 40 CFR 58, Appendices A, C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards. While not required, the site also provides pollutant levels for daily air quality index reporting.

Monitors:

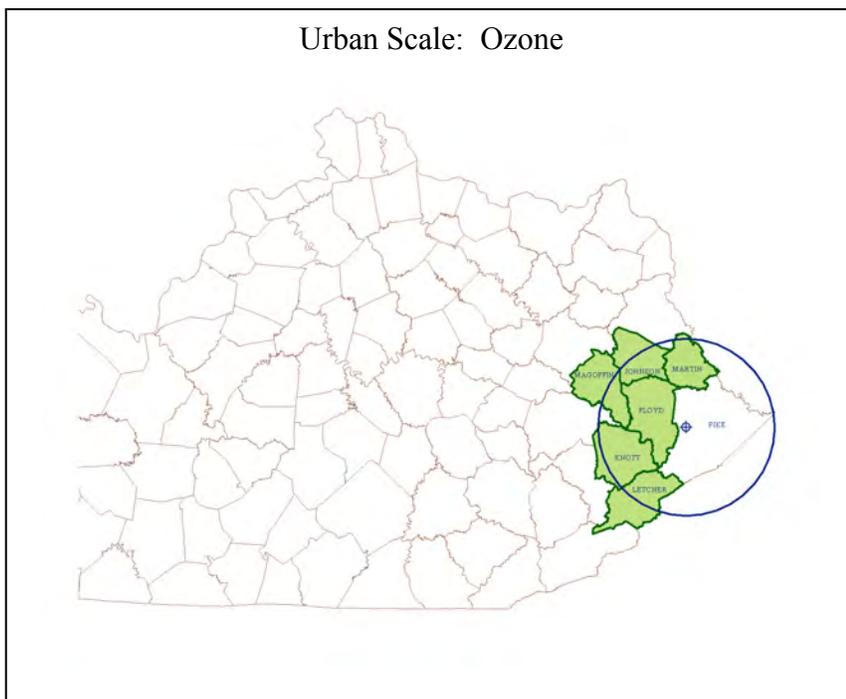
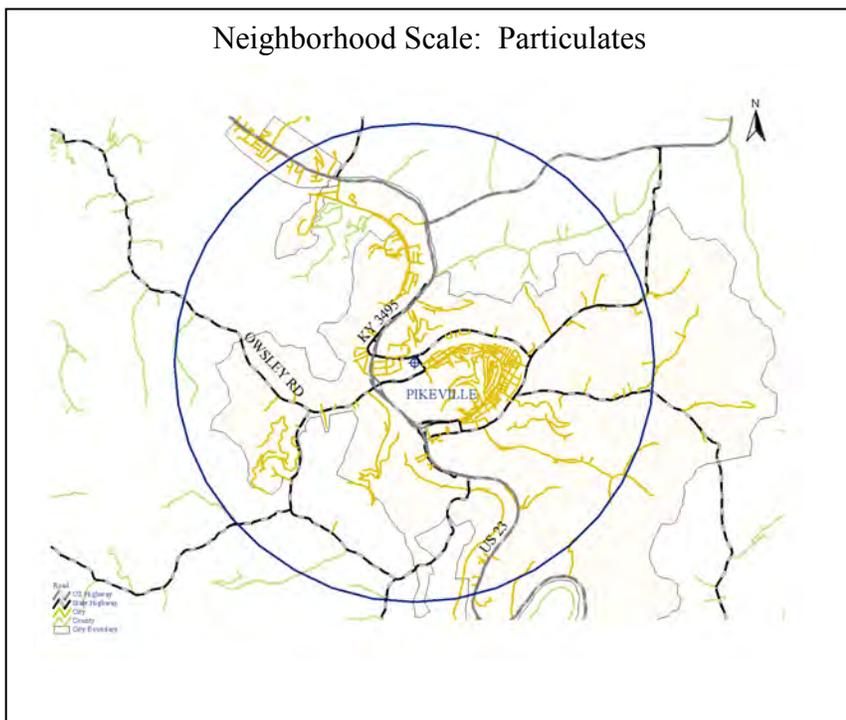
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|----------------------------------|-----------------------|-------------|---------------------------------------------------------|--------------------------------------|
| AEM Ozone | 3.7 | SPM AQI | UV photometry | Continuously March 1 – October 31 |
| FRM PM _{2.5} | 4.7 | SLAMS | Gravimetric | 24-hours every third day |
| Collocated FRM PM _{2.5} | 4.7 | SLAMS | Gravimetric | 24-hours every sixth day |
| PM _{2.5} TEOM | 4.7 | SPM AQI | Tapered elemental oscillating microbalance, gravimetric | Continuously |

Quality Assurance Status:

All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

The site represents population exposure on a neighborhood scale for particulates. This site also represents population exposure on an urban scale for ozone.



CSA/MSA: Not in a MSA - Rural

401 KAR 50:020 Air Quality Control Region: South Central Kentucky Intrastate (105)

Site Name: Franklin

AQS Site ID: 21-213-0004

Location: KYTC Maintenance Facility, 573 Harding Road (KY1008), Franklin, KY 42134

County: Simpson

GPS Coordinates: 36.708607, -86.566284 (NAD 83)

Date Established: June 19, 1991

Inspection Date: October 21, 2015

Inspection By: Ashley Bedel

Site Approval Status: Site and monitors meet all design criteria for the monitoring network.



The monitoring site is a stationary equipment shelter located on the grounds of the KYTC Garage on Harding Road (KY1008) in Franklin, Kentucky. The sample inlet is 39 meters from the nearest road. Upon inspection, the sample line and monitor were found to be in good condition. The site meets the requirements of 40 CFR 58, Appendices C, D, E and G.

Monitoring Objective:

The monitoring objectives are to determine compliance with National Ambient Air Quality Standards; to measure ozone levels upwind of Bowling Green; and to provide data on interstate ozone transport.

Monitors:

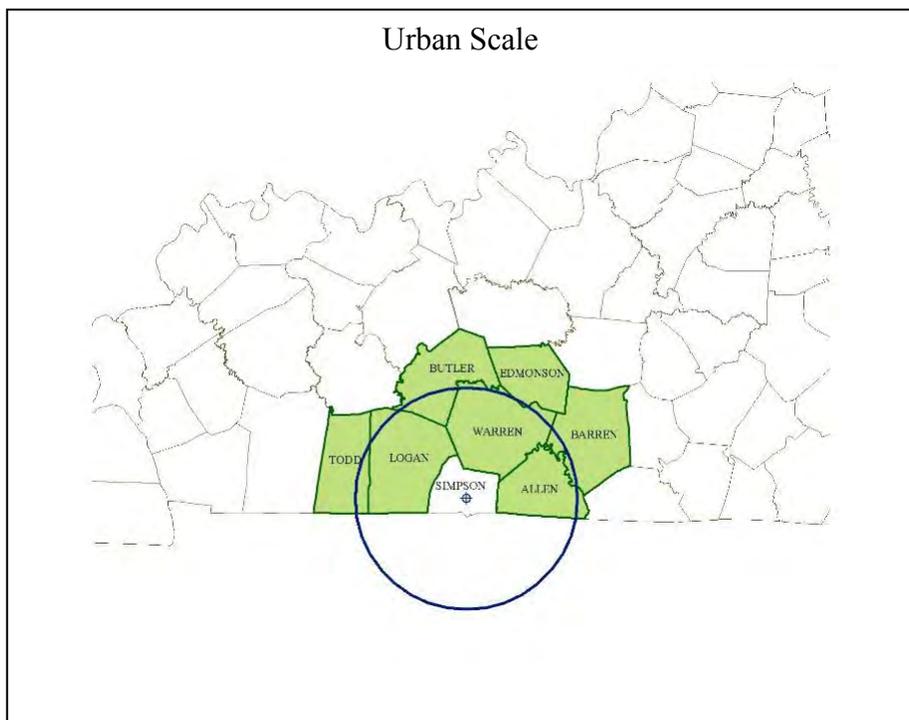
| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|----------------|-----------------------|-------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------|
| AEM Ozone | 4.3 | SPM | UV photometry | Continuously March 1 – October 31 |
| Meteorological | 7.5 | Other | AQM grade instruments for wind speed, wind direction, relative humidity, barometric pressure, and temperature | Continuously |

Quality Assurance Status:

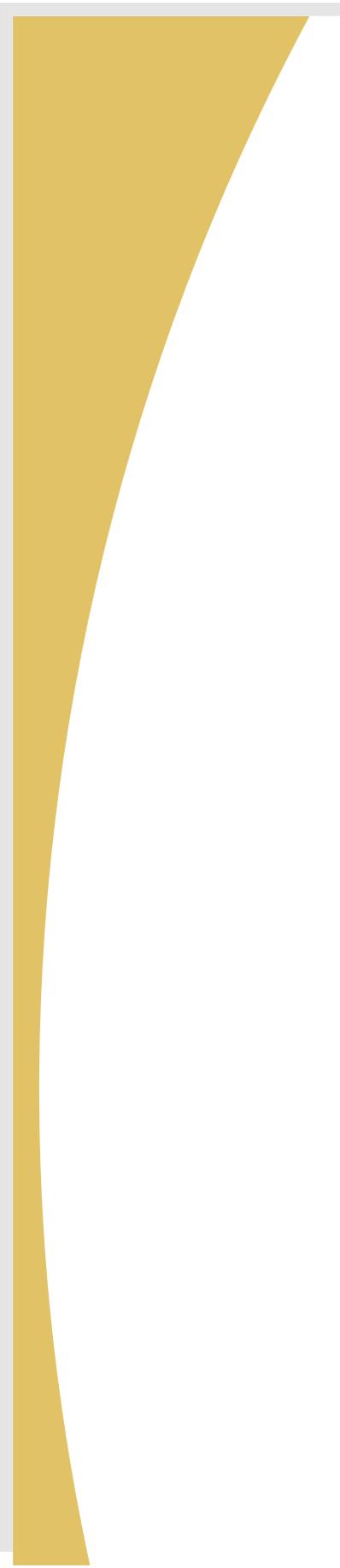
All Quality Assurance procedures have been implemented in accordance with 40 CFR 58, Appendix A.

Area Representativeness:

The site represents population exposure on an urban scale.



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APPENDIX A

**KENTUCKY CORE-BASED STATISTICAL
AREAS AND COUNTIES MAP**



APPENDIX B

**MEMORANDUM OF AGREEMENT
CINCINNATI, OH-KY-IN MSA**

MEMORANDUM OF AGREEMENT
ON AIR QUALITY MONITORING FOR CRITERIA POLLUTANTS FOR
THE CINCINNATI OH-KY-IN
METROPOLITAN STATISTICAL AREA (MSA)

Participating Agencies:

Kentucky Department for Environmental Protection (KDEP)
Division for Air Quality (DAQ)

Hamilton County Department of Environmental Services (HCDOES)

Indiana Department of Environmental Management (IDEM)
Office of Air Quality (OAQ)

PURPOSE/OBJECTIVES/GOALS

The purpose of this Memorandum of Agreement (MOA) is to establish the Cincinnati OH-KY-IN Metropolitan Statistical Area (MSA) Criteria Pollutant Air Quality Monitoring Agreement among KDEP, IDEM, and HCDOES to collectively meet United States Environmental Protection Agency (EPA) minimum monitoring requirements for particles of an aerodynamic diameter of 10 micrometers and less (PM10), particles of an aerodynamic diameter of 2.5 micrometers and less (PM2.5), and ozone; as well as other criteria pollutant air quality monitoring deemed necessary to meet the needs of the MSA as determined reasonable by all parties. According to 40 CFR Part 58, Appendix D, the Cincinnati OH-KY-IN MSA minimum monitoring requirements (based on a population of 2,172,000) are (2) ozone monitors, (2-4) PM-10 monitors, (3) FRM PM-2.5 monitors, and (2) collocated continuous PM-2.5 monitors with the FRM PM-2.5 monitors. This MOA will formalize and reaffirm the collective agreement in order to provide adequate criteria pollutant monitoring for the Cincinnati OH-KY-IN MSA as required by 40 CFR 58 Appendix D, Section 2(e).

PM2.5 MSA monitoring network includes:

| County | Federal Reference Method PM2.5 | Continuous PM2.5 | Speciation PM2.5 | Collocated PM2.5 |
|-------------------------------|--------------------------------|------------------|------------------|------------------|
| Campbell County, KY KDEP | 1 | 1 | 0 | 0 |
| Boone County, KY KDEP | 0 | 0 | 0 | 0 |
| Hamilton County, OH HCDOES | 4 | 2 | 1 | 1 |
| Butler County, OH HCDOES | 2 | 0 | 0 | 1 |
| Clermont County, OH HCDOES | 1 | 1 | 0 | 0 |
| Warren County, OH HCDOES | 1 | 1 | 0 | 0 |
| Franklin County, IN IDEM | 0 | 0 | 0 | 0 |
| Dearborn County, IN IDEM | 0 | 0 | 0 | 0 |
| Ohio County, IN IDEM | 0 | 0 | 0 | 0 |

Criteria Air Pollutant MSA monitoring network includes:

| County | PM10 | O ₃ | NO _x /NO _y /NO _z | CO | SO ₂ |
|-------------------------------|------|----------------|---------------------------------------------------|----|-----------------|
| Campbell County, KY KDEP | 0 | 1 | 1 | 0 | 1 |
| Boone County, KY KDEP | 0 | 1 | 0 | 0 | 0 |
| Hamilton County, OH HCDOES | 3 | 3 | 1 | 1 | 1 |
| Butler County, OH HCDOES | 2 | 2 | 0 | 0 | 0 |
| Clermont County, OH HCDOES | 0 | 1 | 0 | 0 | 0 |
| Warren County, OH HCDOES | 0 | 1 | 0 | 0 | 0 |
| Franklin County, IN IDEM | 0 | 0 | 0 | 0 | 0 |
| Dearborn County, IN IDEM | 0 | 0 | 0 | 0 | 0 |
| Ohio County, IN IDEM | 0 | 0 | 0 | 0 | 0 |

RESPONSIBILITIES/ACTIONS

Each of the parties to this Agreement is responsible for ensuring that its obligations under the MOA are met. As conditions warrant, the affected agencies may conduct telephone conference calls, meetings, or other communications to discuss monitoring activities for the MSA. Each affected agency shall inform the other affected agencies via telephone or email of any monitoring changes occurring within its jurisdiction of the MSA at its earliest convenience, after learning of the need for the change or making the changes. Such unforeseen changes may include evictions from monitoring sites, destruction of monitoring sites due to natural disasters, or any occurrences that result in an extended (greater than one quarter) or permanent change in the monitoring network.

LIMITATIONS

- All commitments made in this MOA are subject to the availability of appropriated funds and each agency's budget priorities. Nothing in this MOA obligates KDEP, IDEM, or HCDOES to expend appropriations or to enter into any contract, assistance agreement, interagency agreement or other financial obligation.
- This MOA is neither a fiscal nor a funds obligation document. Any endeavor involving reimbursement or contribution of funds between parties to this agreement will be handled in accordance with applicable laws, regulations, and procedures, and will be subject to separate agreements that will be affected in writing by representatives of the parties.
- This MOA does not create any right or benefit enforceable by law or equity against KDEP, IDEM, or HCDOES, their officers or employees, or any other person. This MOA does not apply to any entity outside KDEP, IDEM, or HCDOES.
- No proprietary information or intellectual property is anticipated to arise out of this MOA.

TERMINATION

This Memorandum of Agreement may be revised upon the mutual consent of KDEP, IDEM, and HCDOES. Each party reserves the right to terminate this MOA. A thirty (30) day written notice must be given prior to the date of termination.

APPROVALS

We agree with the provisions outlined in this Memorandum of Agreement and commit our agencies to implement them in a spirit of cooperation and mutual support.

Kentucky Department for Environmental Protection
Division for Air Quality

BY: John Lyons

TITLE: Director, Division for Air Quality

DATE: 5/13/10

Hamilton County Department of Environmental Services

BY: Cory Chadwick

TITLE: Director

DATE: 5/13/10

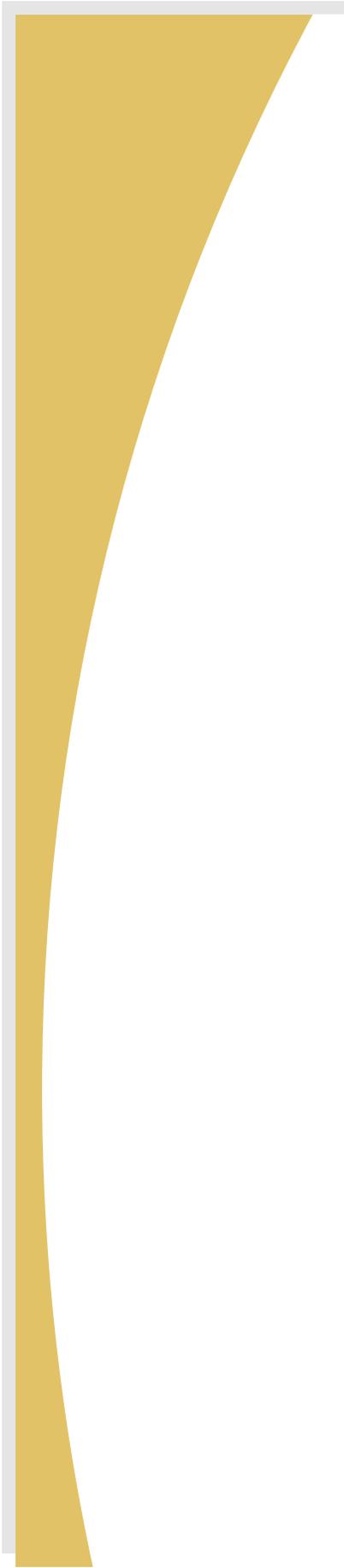
Indiana Department of Environmental Management
Office of Air Quality

BY: Keith Baugues

TITLE: Assistant Commissioner, Office of Air Quality

DATE: 5/12/10

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APPENDIX C

**MEMORANDUM OF AGREEMENT
EVANSVILLE, IN-KY MSA**

**MEMORANDUM OF AGREEMENT
ON AIR QUALITY MONITORING FOR CRITERIA POLLUTANTS FOR
THE EVANSVILLE, IN-HENDERSON, KY
METROPOLITAN STATISTICAL AREA (MSA)**

Participating Agencies:

Kentucky Department for Environmental Protection (KDEP)
Division for Air Quality (DAQ)

Indiana Department of Environmental Management (IDEM)
Office of Air Quality (OAQ)

PURPOSE/OBJECTIVES/GOALS

The purpose of this Memorandum of Agreement (MOA) is to establish the Evansville, IN-Henderson, KY Metropolitan Statistical Area (MSA) Criteria Pollutant Air Quality Monitoring Agreement among KDEP and IDEM to collectively meet United States Environmental Protection Agency (EPA) minimum monitoring requirements for particles of an aerodynamic diameter of 10 micrometers and less (PM 10), particles of an aerodynamic diameter of 2.5 micrometers and less (PM2.5), and ozone; as well as other criteria pollutant air quality monitoring deemed necessary to meet the needs of the MSA as determined reasonable by all parties. According to 40 CFR Part 58, Appendix D, the Evansville, IN-Henderson, KY MSA minimum monitoring requirements (based on a population of 350,000) are (2) ozone monitors, (0-1) PM-10 monitors, (1) FRM PM-2.5 monitor, and (1) collocated continuous PM-2.5 monitor with the FRM pm-2.5 monitor. This MOA will formalize and reaffirm the collective agreement in order to provide adequate criteria pollutant monitoring for the Evansville, IN-Henderson, KY MSA as required by 40 CFR 58 Appendix D, Section 2, (e).

PM 2.5 MSA monitoring network includes:

| County | Federal Reference Method PM2.5 | Continuous PM2.5 | Speciation PM2.5 | Collocated PM2.5 |
|----------------------------------------|---------------------------------------|-------------------------|-------------------------|-------------------------|
| Henderson County, KY KDEP | 1 | 1 | 0 | 0 |
| Vanderburgh County, IN IDEM | 3 | 1 | 1 | 1 |

Criteria Air Pollutant MSA monitoring network includes:

| County | PM10 | O ₃ | NO _x /NO/NO ₂ | CO | SO ₂ |
|-----------------------------------|------|----------------|-------------------------------------|----|-----------------|
| Henderson County, KY KDEP | 1 | 1 | 0 | 0 | 1 |
| Vanderburgh County, IN IDEM | 1 | 2 | 1 | 1 | 1 |

RESPONSIBILITIES/ACTIONS

Each of the parties to this Agreement is responsible for ensuring that its obligations under the MOA are met. As conditions warrant, the affected agencies may conduct telephone conference calls, meetings, or other communications to discuss monitoring activities for the MSA. Each affected agency shall inform the other affected agencies via telephone or email of any monitoring changes occurring within its jurisdiction of the MSA at its earliest convenience, after learning of the need for the change or making the changes. Such unforeseen changes may include evictions from monitoring sites, destruction of monitoring sites due to natural disasters, or any occurrences that result in an extended (greater than one quarter) or permanent change in the monitoring network.

LIMITATIONS

- All commitments made in this MOA are subject to the availability of appropriated funds and each agency's budget priorities. Nothing in this MOA obligates KDEP or IDEM to expend appropriations or to enter into any contract, assistance agreement, interagency agreement or other financial obligation.
- This MOA is neither a fiscal nor a funds obligation document. Any endeavor involving reimbursement or contribution of funds between parties to this agreement will be handled in accordance with applicable laws, regulations, and procedures, and will be subject to separate agreements that will be affected in writing by representatives of the parties.
- This MOA does not create any right or benefit enforceable by law or equity against KDEP or IDEM, their officers or employees, or any other person. This MOA does not apply to any entity outside KDEP or IDEM.
- No proprietary information or intellectual property is anticipated to arise out of this MOA.

TERMINATION

This Memorandum of Agreement may be revised upon the mutual consent of KDEP and IDEM. Each party reserves the right to terminate this MOA. A thirty (30) day written notice must be given prior to the date of termination.

APPROVALS

We agree with the provisions outlined in this Memorandum of Agreement and commit our agencies to implement them in a spirit of cooperation and mutual support.

Kentucky Department for Environmental Protection
Division for Air Quality

BY: John S. Lyons

TITLE: Director, Division for Air Quality

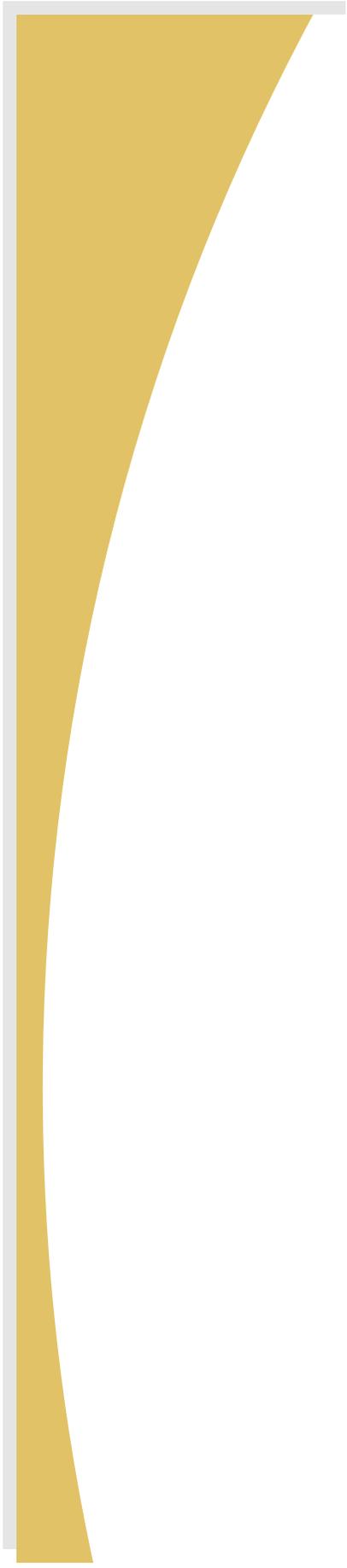
DATE: 5/14/10

Indiana Department of Environmental Management
Office of Air Quality

BY: Keith Baugues

TITLE: Assistant Commissioner, Office of Air Quality

DATE: 5/24/10



APPENDIX D

**MEMORANDA OF AGREEMENT
CLARKSVILLE, TN-KY MSA**



STATE OF TENNESSEE
 DEPARTMENT OF ENVIRONMENT AND CONSERVATION

Division of Air Pollution Control
 William R. Snodgrass TN Tower
 312 Rosa L. Parks Ave., 15th Floor
 Nashville, Tennessee 37243

July 1, 2014

Sean Alteri, Director
 Kentucky Division for Air Quality
 Kentucky Department for Environmental Protection
 200 Fair Oaks Lane
 Frankfort, KY 40601

Dear Mr. Alteri:

The United States Environmental Protection Agency (EPA) revised monitoring regulations found in 40 CFR Part 58, Appendix D states in part: "The EPA recognizes that there may be situations where the EPA Regional Administrator and the affected State or local agencies may need to augment or to divide the overall MSA/CSA monitoring responsibilities and requirements among these various agencies to achieve an effective network design. Full monitoring requirements apply separately to each affected State or local agency in the absence of an agreement between the affected agencies and the EPA Regional Administrator." This revision of the CFR also describes the minimum monitoring requirements for the NAAQS pollutants, including continuous PM 2.5 as it applies to MSA areas where the population is sufficient to warrant monitoring for that pollutant. Tennessee and Kentucky share the Clarksville, TN-KY MSA, which is comprised of Trigg and Christian counties in Kentucky and Montgomery county in Tennessee. The US Census Bureau lists this area as containing a population in excess of 260,000.

| CBSA Code | Geographic area | Legal/statistical Area description | July 1, 2013 Estimate | 2010 Census |
|-----------|--------------------|------------------------------------|-----------------------|-------------|
| 17300 | Clarksville, TN-KY | Metropolitan Statistical Area | 272,579 | 260,625 |

The Tennessee Division of Air Pollution Control (TDAPC) currently operates one (1) PM 2.5 FRM monitor and one (1) continuous PM 2.5 monitor in this area. The TDAPC believes the operation of the existing PM 2.5 monitors; (FRM and continuous), are sufficient to properly characterize the particulate air quality in the entire Clarksville, TN-KY MSA and comply with the requirements for both population and concentration based monitoring identified in the revised monitoring regulations as found at 40 CFR58, AppD. The TDAPC would like to invite the

Sean Alteri
July 2, 2014
Page 2

Kentucky Division for Air Quality to participate in Tennessee's annual ambient air monitoring network review. Tennessee commits to sharing with Kentucky any and all quality assured ambient air monitoring data collected in the Tennessee portion of the Clarksville, TN-KY MSA. Tennessee also will notify Kentucky in advance of the intent to relocate or shutdown any of the PM 2.5 monitors referenced above so that adequate monitoring arrangements can be made to meet the entire MSA monitoring requirements for PM 2.5.

Sincerely,



Barry R. Stephens, PE
Director, Air Pollution Control Division

BRS/lb

Cc: Heather McTeer-Toney, US EPA Region IV

Steven L. Beshear
Governor

Leonard K. Peters
Secretary



Energy and Environment Cabinet
Department for Environmental Protection
Division for Air Quality
200 Fair Oaks Lane, 1st Floor
Frankfort, Kentucky 40601-1403
Web site: air.ky.gov

May 15, 2015

Mr. Barry R. Stephens, PE
Director
Tennessee Division of Air Pollution Control
312 Rosa L. Parks Avenue, 15th Floor
Nashville, TN 37243

Dear Mr. Stephens:

In a letter from your office dated July 1, 2014, the Tennessee Division of Air Pollution Control (TDAPC) agreed to operate a continuous PM_{2.5} monitor and an intermittent FRM PM_{2.5} sampler, to meet the minimum network design requirements stated in 40 CFR 58, Appendix D for the Clarksville, TN-KY metropolitan statistical area (MSA). The Kentucky Division for Air Quality (Division) appreciates TDAPC's cooperation and looks forward to participating in TDAPC's annual air monitoring network review.

The Division currently operates one (1) intermittent FRM PM_{2.5} sampler and one (1) continuous ozone monitor at the Hopkinsville site (21-047-0006) in Christian County. In accordance with Table D-2 of 40 CFR 58, Appendix D, one (1) ozone monitor is required to be operated in the Clarksville, TN-KY MSA, based upon the most current population estimates from the US Census Bureau, as well as 2012-2014 ozone design values.

| Geographic Area | Area Description | 2014 USCB Population Estimate | 2014 Three-Year Ozone DV (ppm) |
|---------------------------|------------------|-------------------------------|--------------------------------|
| Christian County, KY | County | 74,250 | 0.067 |
| Trigg County, KY | County | 14,142 | 0.069 (CASTNET) |
| Montgomery County, TN | County | 189,961 | N/A |
| Clarksville, TN-KY | MSA | 278,353 | 0.069 |

To satisfy the regulatory requirement, the Division agrees to operate one ozone monitor at the Hopkinsville site. Also, the Division agrees to notify TDAPC in the event that shutdown or relocation of the ozone monitor is necessary.

Despite the fact that 2012-2014 design values show that no FRM PM_{2.5} samplers are required in the Clarksville MSA, the Division will continue to operate the PM_{2.5} sampler at

Mr. Barry Stephens

May 15, 2015

Page 2

Hopkinsville. The Division also agrees to notify TDAPC in the event that the Hopkinsville FRM PM_{2.5} sampler must be shutdown or relocated, as it is the design value monitor for the MSA.

The Division commits to sharing with TDAPC any and all quality-assured ambient monitoring data collected in the Kentucky portion of the Clarksville, TN-KY MSA. The Division also welcomes TDAPC participation in Kentucky's annual network review process. If you have any questions or concerns, please contact me at 502-564-3999.

Sincerely,



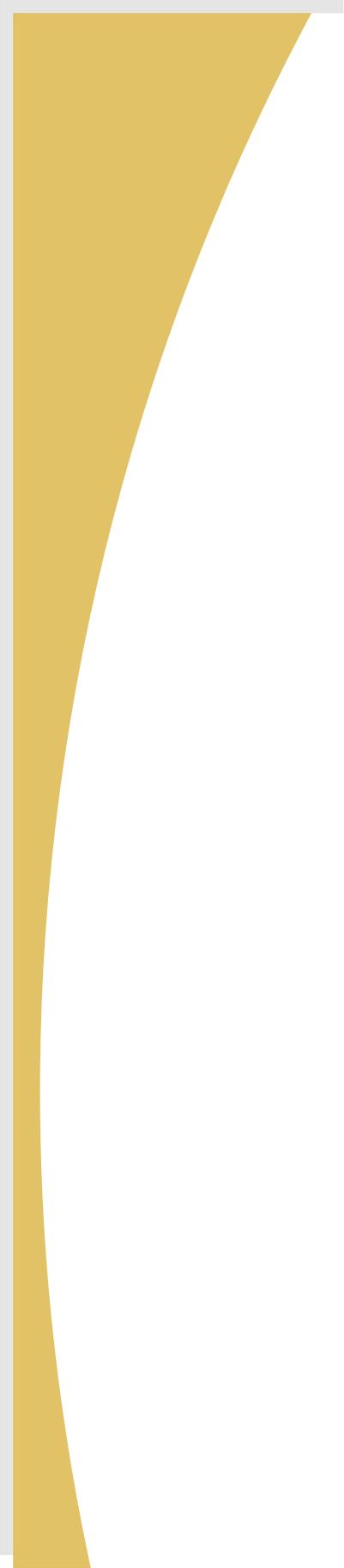
Sean Alteri,
Director

SA/jfm

c: -Heather McTeer Toney, USEPA Region IV

-Daniel Garver, USEPA Region IV

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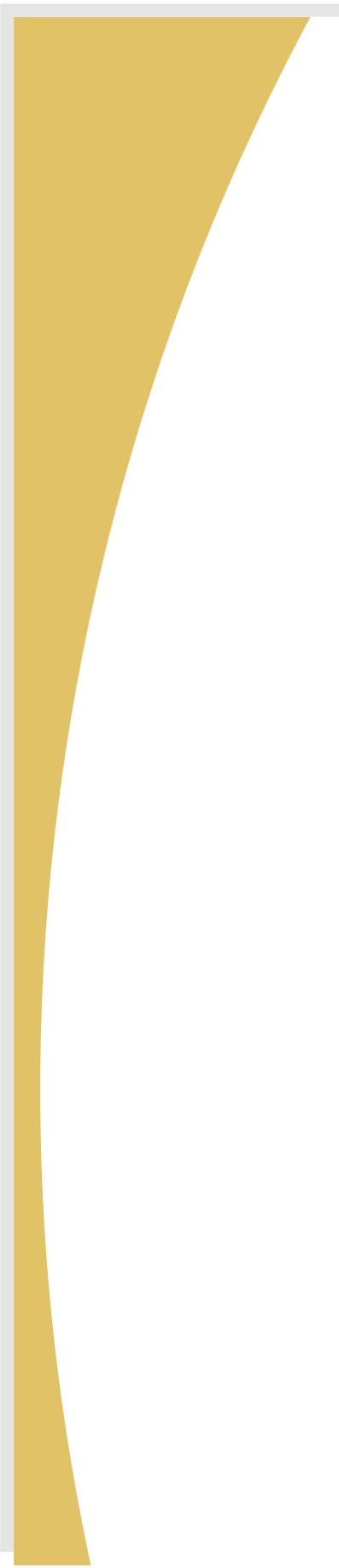


APPENDIX E

**SUMMARY OF LMAPCD NETWORK
CHANGES 2016**

Appendix E
Summary of LMAPCD Network Changes 2016

Louisville Metro Air Pollution Control District (LMAPCD) does not currently intend to make any changes to the ambient air monitoring network operated in Jefferson County, KY during the upcoming monitoring year. However, due to circumstances that may arise during the sampling year, some network information may change. LMAPCD will submit a notification of change and a request for approval to EPA Region 4 at that time, following a 30-day public comment period.



APPENDIX F

INTENDED USE OF CONTINUOUS PM_{2.5} FEMS

Appendix F
Intended Use of Continuous PM_{2.5} FEMs

Historically, continuous PM_{2.5} monitors that are designated as Federal Equivalent Methods (FEMs) have been excluded from comparisons to the PM_{2.5} NAAQS, as long as these monitors were specified as special-purpose monitors (SPMs). Data from these monitors was used for reporting of the AQI. Monitors could remain designated as SPMs for a period of two years of operation at each site. However, after that two-year period, the data was eligible for comparison to the NAAQS, regardless of monitor-type designation.

In December 2012, a new PM NAAQS and set of monitoring rules were finalized. These new monitoring rules amended the previous requirement to compare all data from FEMs collected after a period of two-years to the NAAQS. Instead, agencies could operate a continuous PM_{2.5} FEM for longer than two years and could elect to exclude the data from NAAQS-comparisons, provided that the monitor did not meet certain performance specifications. Data from monitors established for less than two years and designated as SPM remain ineligible for attainment decisions. Specifically, the final rule allows certain continuous PM_{2.5} FEM data to be excluded if:

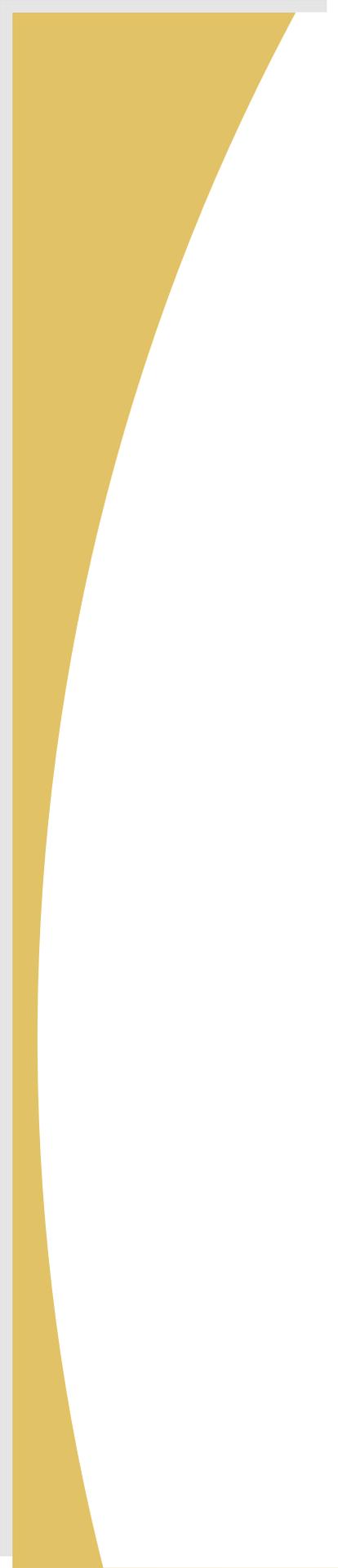
- the monitor does not meet performance criteria when compared to the data collected from collocated Federal Reference Methods (FRMs);
- the monitoring agency requests exclusion of data; and,
- the EPA Regional Office approves exclusion of the data.

Regardless of whether an exclusion is sought, each agency must address the use of all continuous PM_{2.5} FEMs in the network. Additionally, each monitor must be properly referenced by a set of parameter codes, primary monitor designations, and monitor-types. Data from non-FEM continuous PM_{2.5} monitors are not used for NAAQS comparisons and are only eligible for reporting of the AQI; as such, non-FEM monitors are not included in this statement.

KDAQ does not intend to operate any continuous FEM PM_{2.5} monitors during the upcoming year. However, LMAPCD will operate three Met-One BAM 1020 continuous PM_{2.5} FEMs, located at the Southwick Community Center (21-111-0043), Watson Lane (21-111-0051), and Cannons Lane (21-111-0067) sites. The EPA has determined that the data from the continuous PM_{2.5} FEMs located at these three sites are comparable to the data collected by collocated FRMs; as such, those monitors are also designated as SLAMs monitors and are eligible for NAAQS comparisons. A fourth BAM, located at Bates Elementary School (21-111-0027), is not configured as a FEM and is automatically ineligible for NAAQS comparisons.

The monitor designations for Met-One BAM 1020 continuous PM_{2.5} FEMs operated by LMAPCD are summarized in the chart below.

| Cannons Lane (21-111-0067), Southwick Community Center (21-111-0043), Watson Lane (21-111-0051) | | | | | | | | |
|-------------------------------------------------------------------------------------------------|------------------------|----------------|---------------------------------|--------------|-------------------------------|-------------------------------------------------|-----------------------------|-------------------|
| Scenario | Parameter Name | Parameter Code | Pollution Occurrence Code (POC) | Monitor Type | Primary Monitor (Collocation) | Used for substitutions of missing primary data? | Used for NAAQS Comparisons? | Eligible for AQI? |
| PM _{2.5} Continuous FEM is eligible for NAAQS comparisons. | PM2.5 Local Conditions | 88101 | 3 | SLAMS | FRM | Yes | Yes | Yes |



APPENDIX G

NEAR-ROAD MONITORING

Appendix G
Part A - Near-Road Monitoring

On February 9, 2010, the EPA released a new NO₂ Final Rule and a new set of monitoring requirements. Under the new monitoring requirements, State and Local agencies are required to establish NO₂ near-road monitoring stations based upon core based statistical area (CBSA) populations and traffic metrics.

Specifically, the final rule required:

- 1 near-road monitor in CBSAs with populations greater than or equal to 500,000; and
- 2 near-road monitors in CBSAs with populations greater than or equal to 2,500,000.

Additionally, the final rule required:

- 2 near-road monitors for any road segment that has an annual average daily traffic (AADT) count of 250,000 or more.

Similarly, the EPA revised the PM_{2.5} NAAQS and monitoring rule on December 14, 2012, and the CO monitoring rule on August 31, 2011. Together, these rules require CO and PM_{2.5} monitoring to be established at near-road sites for any CBSA with a population of one-million or greater. Ultimately, near-road sites are intended to be multi-pollutant sites. These sites are used to characterize the impacts vehicle exhaust and traffic patterns on public health.

In March 2013, the EPA finalized the use of a “phased” approach for establishing NO₂ near-road monitoring sites across the Nation. The phased approach necessitates:

- Phase 1: One required near-road monitor in CBSAs with a population of 1,000,000 or more must be established by January 1, 2014.
- Phase 2: Any second required near-road monitor in CBSAs that have a population greater than 2,500,000, or have a population of 500,000 or greater and have a traffic segment with an AADT of 250,000 or more, must be established by January 1, 2015.
- Phase 3: Required sites in remaining CBSAs with populations of 500,000 or more must be established by January 1, 2017.

Based upon population estimates and AADT counts, near-road monitors were required to be established in the following CBSAs during the implementation of Phase 1. No Phase 2 monitors are required in Kentucky.

| CBSA Name (500,000 or more people) | 2015 CBSA Population Estimate* | Highest Road Segment 2-Way AADT for CBSA** | Number of Monitors Required in CBSA |
|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------------------|------------------------------------------------|
| Cincinnati-Middletown, OH-KY-IN | 2,128,603 | 193,399 | 1 |
| Louisville-Jefferson County, KY-IN | 1,251,351 | 166,432 | 1 |

*Source: US Census Bureau, 2015 Population Estimates (Last accessed: April 5, 2016)

**Source: KYTC Traffic Database. http://datamart.business.transportation.ky.gov/EDSB_SOLUTIONS/CTS/. Last accessed: June 2015

The determination of the final locations of near-road monitoring locations within these CBSAs was a cooperative effort between multiple State and Local Agencies. The exact location of each site was determined using the following criteria:

- Fleet mix
- Roadway design
- Traffic congestion patterns
- Local topography
- Meteorology
- Population exposure
- Employee and public safety
- Site logistics

The requirement for a near-road site in the Cincinnati, OH-KY-IN MSA is fulfilled by a Memorandum of Agreement (MOA). The site is located in Ohio and is operated by the Southwest Ohio Air Quality Agency.

The near-road site in the Louisville-Jefferson County, KY-IN MSA has been established and is operated by the Louisville Metro Air Pollution Control District (LMAPCD). Specifics regarding this site are included in the site detail pages of this Annual Network Plan.

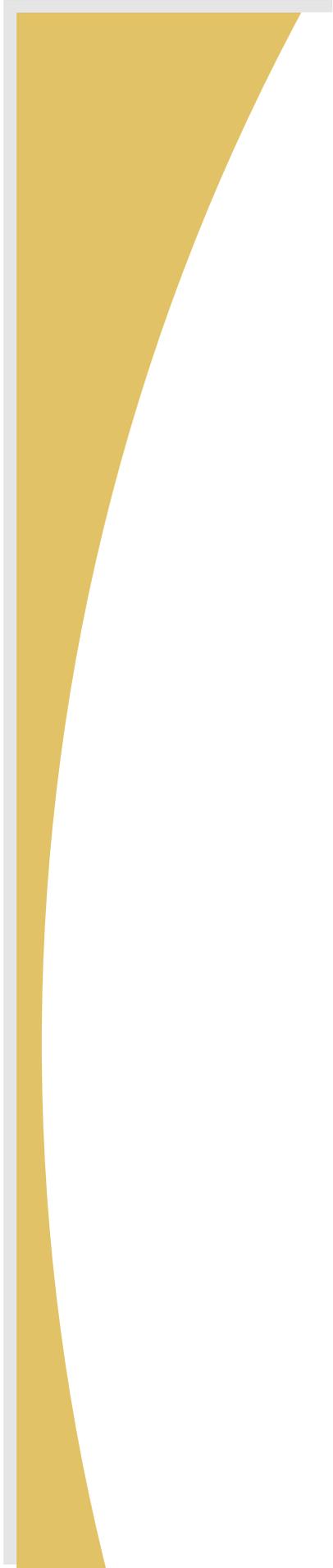
Appendix G
Part B - “Phase 3” Near-Road Monitoring

On May 5, 2016, the U.S. Environmental Protection Agency (EPA) proposed to revise a component of the minimum monitoring requirements for near-road nitrogen dioxide (NO₂) monitoring. Specifically, the EPA proposed to remove the requirement for near-road NO₂ monitoring stations in Core-Based Statistical Areas (CBSAs) having populations between 500,000 and 1,000,000 persons (e.g., Phase 3).

Under current regulations, these monitors are due to be installed and operational by January 1, 2017. Current near-road NO₂ monitoring data indicate air quality levels in the near-road environment are well below the National Ambient Air Quality Standard (NAAQS) for NO₂. In light of this information, and the relationship between population, traffic, and expected NO₂ concentrations in the near-road environment, EPA expects measured near-road NO₂ concentrations in relatively smaller CBSAs (e.g., CBSAs with populations less than 1,000,000 persons) would exhibit similar and, more likely, lower concentrations than what is being measured in larger urban areas.

This action would not change the requirements for near-road NO₂ monitors in more populated areas, area-wide NO₂ monitoring, or monitoring of NO₂ in areas with susceptible and vulnerable populations. EPA will accept comment on this proposal for 45 days after it publishes in the *Federal Register*. A fact sheet and pre-publication version of the notice are available at: <https://www3.epa.gov/airquality/nitrogenoxides/actions.html#may16>

Based upon 2015 US Census Bureau population estimates, the population of the Lexington-Fayette, KY CBSA is estimated at 500,535 people. Under the current regulatory requirement, a near-road site would need to be established by January 1, 2017. Accordingly, and with the concurrence of EPA Region 4, KDAQ has placed a hold on the planning activities for a near-road site in the Lexington-Fayette KY CBSA. EPA plans on completing the associated final rule before the January 1, 2017 deadline for Phase 3 operations. KDAQ will continue to follow this issue and adjust our plans as further information becomes available from the EPA.



APPENDIX H

SO₂ DATA REQUIREMENTS RULE (DRR)

Appendix H
Part A - SO₂ Data Requirements Rule (DRR)

On August 10, 2015, the EPA finalized requirements for air agencies to monitor or model ambient sulfur dioxide (SO₂) levels in areas with large sources of SO₂ emissions to assist implementation the 1-hour SO₂ National Air Ambient Quality Standard (NAAQS).

Known as the “Data Requirements Rule (DRR),” this action establishes that, at a minimum, air agencies must characterize air quality around sources that emit 2,000 tons per year (tpy) or more of SO₂. This rule gives air agencies the flexibility to characterize air quality using either modeling of actual source emissions or using appropriately sited ambient air quality monitors. An agency may avoid the requirement to characterize the air near a source by adopting enforceable emission limits that ensure that the source will not emit more than 2,000 tpy of SO₂.

The DRR set the following timeline:

- By January 15, 2016, air agencies are required to submit to the EPA a final list of sources in the state around which SO₂ air quality is to be characterized.
- By July 1, 2016, air agencies are required to identify the approach (ambient monitoring or air quality modeling) it will use to characterize air quality for each listed-source. Air agencies may also establish enforceable emissions limitations that will limit source-emissions to below 2,000 tpy.
- For source areas that an air agency decides to evaluate through ambient monitoring, the agency must submit relevant monitoring sites information to the EPA Regional Administrator by July 1, 2016, as part of its annual monitoring network plan.
- For source areas that an air agency decides to evaluate through air quality modeling, the air agency must provide a modeling protocol to the EPA Regional Administrator by July 1, 2016. The modeling analysis must be submitted to the EPA by January 13, 2017.
- The air agency must ensure that ambient monitors are operational by January 1, 2017.
- The data from these monitors must be quality assured and then submitted to the EPA’s Air Quality System in the same manner as is currently done for existing SO₂ monitors. The first 3 years of data will be collected for calendar years 2017 through 2019.
- If an air agency adopts emission limits keeping sources’ emissions below 2,000 tpy in lieu of characterizing the areas surrounding sources, these limits must be adopted and effective by January 13, 2017.

As allowed by the SO₂ Data Requirements Rule, a monitoring site will be established in Sebree, KY, in order to characterize the air near the Big Rivers Electric Corporation & Century Aluminum Sebree, LLC facilities. In accordance with the guidance of the *SO₂ NAAQS Designations Source-Oriented Monitoring Technical Assistance Document*, a site evaluation and proposal was prepared by Trinity Consultants. The site evaluation and proposal is included in Part B of this Appendix and fulfills the requirement to submit relevant site information to the EPA Regional Administrator by July 1, 2016, following a 30-day public comment period.

The proposed site is located in Henderson County near the town of Sebree, KY, and is included in the Evansville, IN-KY MSA. The parcel of land is owned by Century Aluminum, but is within 40 meters

of Alcan Aluminum Road, which is publicly accessible. There are no boundaries to restrict access to the land parcel from the road. An existing concrete block building and a security fence are to be refurbished to serve as the air monitoring shelter. As proposed, the site and equipment meet all necessary criteria, as established in 40 CFR 58, Appendices A, C, and E. The site provides for unobstructed air-flow that is representative of maximum concentration, source-oriented ambient air on a neighborhood scale.

At the time of publication of this Network Plan, KDAQ had entered into negotiations with Big Rivers Electric Corporation & Century Aluminum Sebree, LLC to provide operational support for the site. While exact logistics of site operations have yet to be determined, the monitor will be operated as a “SLAMS” monitor-type and will be operated under KDAQ’s authority as the Primary Quality Assurance Organization (PQAO). Further details regarding the site, including the site evaluation process, can be found in Part B of this Appendix on the following pages.

Appendix H

**Part B - SO₂ Monitor Siting Evaluation under the Data Requirements Rule for
Big Rivers Electric Corporation & Century Aluminum Sebree, LLC**



**SO₂ MONITOR SITING EVALUATION UNDER
THE DATA REQUIREMENTS RULE FOR
BIG RIVERS ELECTRIC CORPORATION &
CENTURY ALUMINUM SEBREE LLC
(REVISION 1)**

Prepared for:

Jamie Coomes
Environmental Manager
Century Aluminum Sebree, LLC
9404 State Route 2096
Robards, KY 42452

and

Mark Bertram
Environmental Manager
Big Rivers Electric Corporation
201 Third Street
Henderson, KY 42420

Prepared By:

TRINITY CONSULTANTS
1717 Dixie Highway, Suite 900
Covington, Kentucky 41011

May 10, 2016



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1. INTRODUCTION

This report presents a siting evaluation completed to select the location for a new continuous SO₂ ambient monitoring station in Henderson County, Kentucky nearby the neighboring Big Rivers Electric Corporation (BREC) and Century Aluminum Sebree, LLC (Century) facilities.¹ Details on the proposed monitoring equipment along with installation, calibration, and operating procedures for the monitoring station are also described.

This report has been prepared by Trinity Consultants (Trinity) under engagement by BREC and Century to fulfill a request issued by the Kentucky Division for Air Quality (KDAQ) in an October 22, 2015 letter to both facilities. That letter was driven by obligations KDAQ must address under the Data Requirements Rule (DRR)² to characterize air quality around sources that emit 2,000 tons per year (tpy) or more of SO₂ through modeling or monitoring for purposes of making designations with respect to the National Ambient Air Quality Standards (NAAQS). Facilities intending to use SO₂ ambient monitoring to characterize SO₂ concentrations in the area of their facilities were requested to provide a monitor siting evaluation to KDAQ by April 15, 2016.

1.1 FACILITY LOCATIONS

The BREC facility includes the Robert D. Green Station (Green), the Robert A. Reid Station (Reid), and the Henderson Municipal Power and Light Station (HMP&L). Although Reid and HMP&L are permitted as a separate entity from Green, hereafter these facilities are collectively referred to as Sebree Station. Sebree Station and Century are located on State Highway Junction 2096/2097, 3.0 miles (4.9 km) northeast of the city center of Sebree, Kentucky at the border of Henderson and Webster Counties.

The Century facility currently consists of three primary aluminum potlines and associated operations and is located just north and adjacent to Sebree Station. The facility is surrounded by a large tract of controlled property in all directions.

Both facilities are bounded on the east by the Green River and open farmland, and on the west by the Edward T. Breathitt Pennyryle Parkway (I-69), light industry, and farmland/wooded areas. To the north of Century and to the south of Sebree Station ash landfill area is primarily wooded areas. Figure 1-1 shows an aerial view of the facilities to provide detail on the nearby area and the proximity of the two facilities.

Figure 1-2 shows a more extended scale map of the area around the two facilities out to about 10-15 km at the confluence of Webster, McLean, and Henderson counties approximately 28 km south of Henderson, Kentucky and the Kentucky-Indiana border.

¹ This report (Revision 1) is an update to the original report submitted to KDAQ on April 15, 2016 and reflects comments and suggested changes received from agency officials. This update includes a change to the proposed monitoring site location and also site photographs for the proposed site in Appendices D and E.

² *Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO₂) Primary National Ambient Air Quality Standards (NAAQS): Final Rule*, Federal Register Vol. 80 No. 162, pages 51051-51088, August 21, 2015.

Figure 1-1. Area Surrounding the Sebree Station and Century Facilities

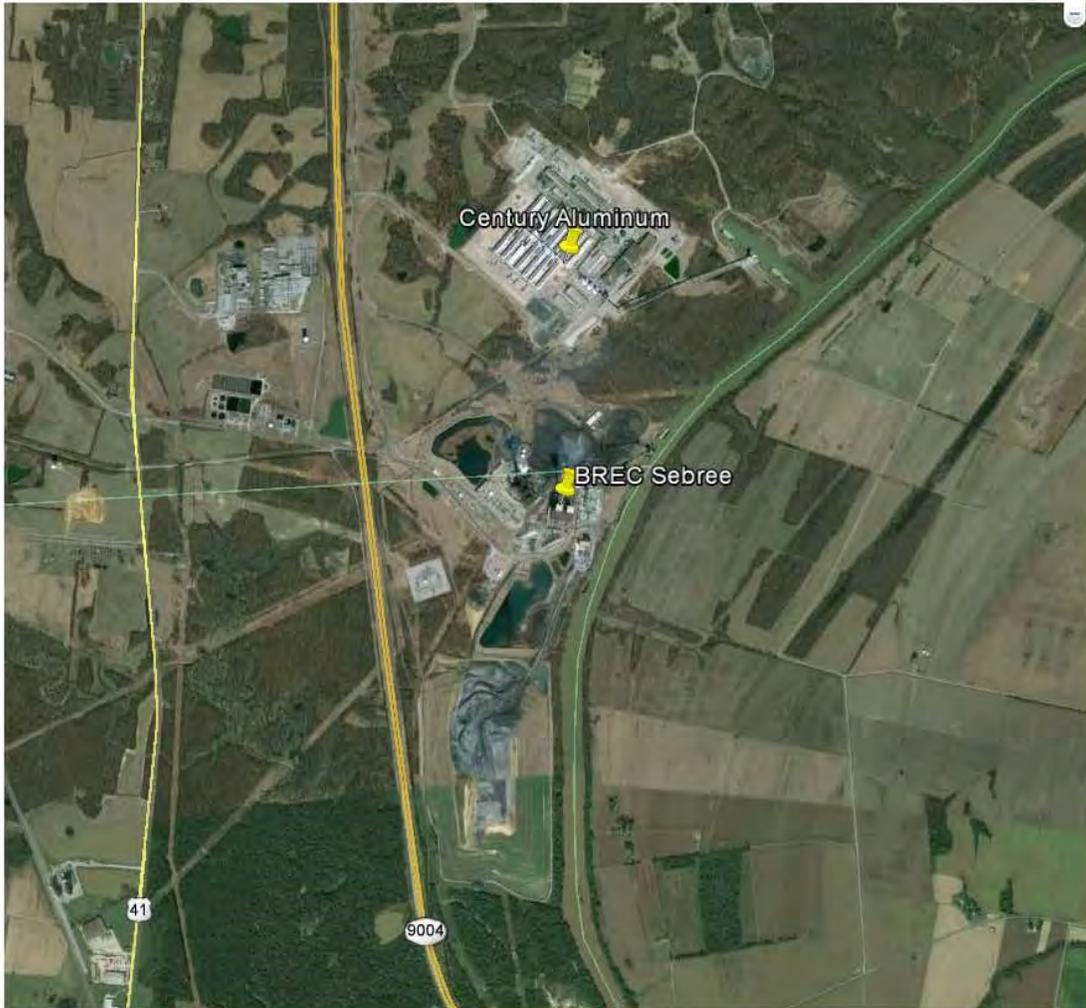
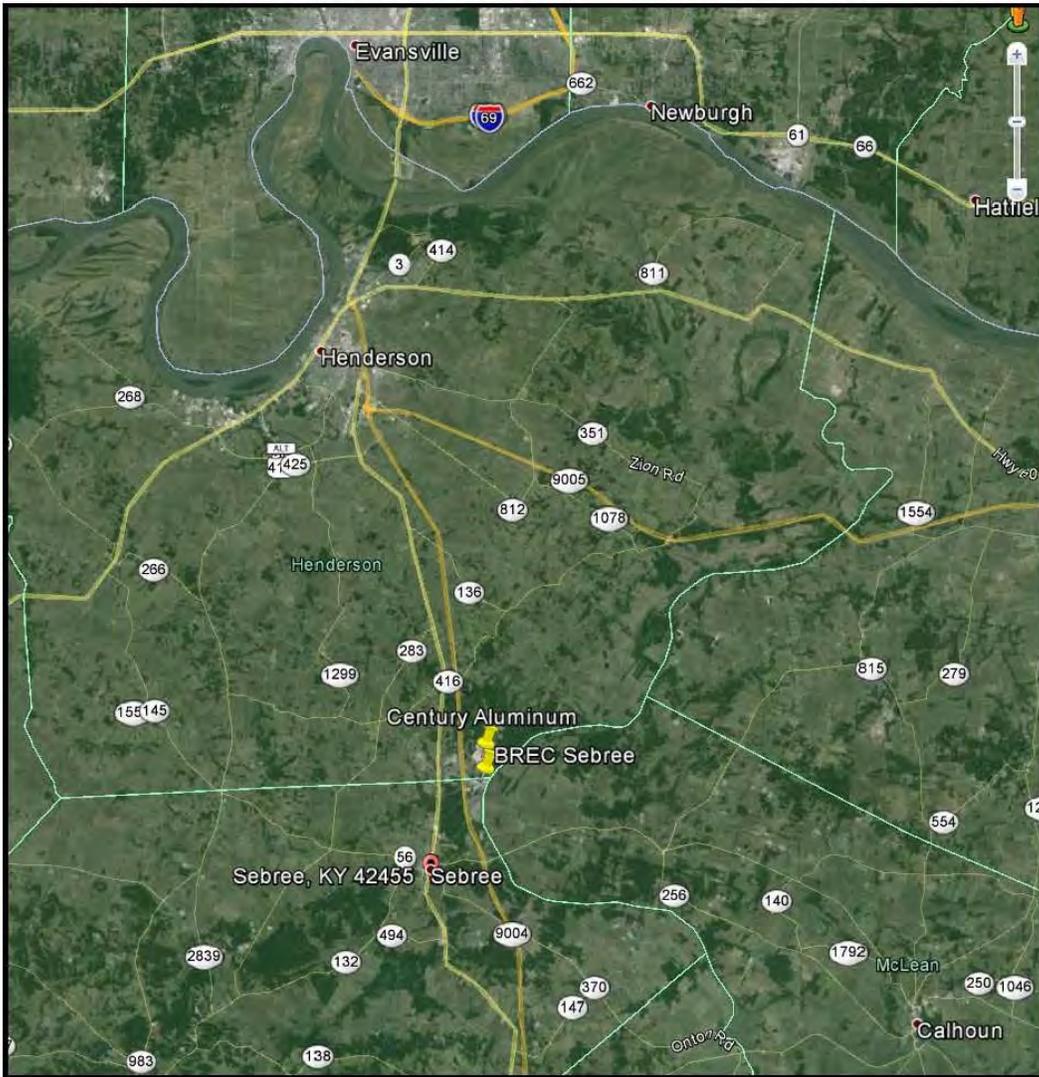


Figure 1-2. Regional Scale Location of Sebree Station and Century



1.2 REGULATORY BACKGROUND - SO₂ DATA REQUIREMENTS RULE

The U.S. EPA is currently going through a multi-phase area designation process with variable assessment and compliance timelines with respect to the 2010 1-hour SO₂ NAAQS. The timetable for designations of areas currently unclassified with respect to the 1-hour SO₂ NAAQS is addressed in 40 CFR 51, Subpart BB, referred to as the Data Requirements Rule (DRR). The focus of the DRR is on characterization of areas in proximity to large SO₂ emission sources where the areas do not have sufficient monitoring data to make a designation, and the areas have remained unclassified. A state may propose either monitoring or modeling to discern an area's potential compliance.

Under the DRR, if the SO₂ emissions from a source exceeded 2,000 tpy in 2014, the source is subject to the requirements of the DRR. In 2014, the Robert Reid Station and HMP&L Station 2 emitted a total of 12,202 tons of SO₂ according to the U.S. EPA's Air Markets Program Data.³ Additionally, the Green Station emitted a total of 4,000 tons of SO₂. This in turn makes both the Reid/HMP&L and Green Stations subject to the requirements of the DRR. Under 40 CFR § 51.1203 of the DRR (Air Agency Requirements), the area around the Sebree Station is subject to air quality characterization and thereafter, to designation as attainment or nonattainment of the 1-hour SO₂ NAAQS. Similarly, the Century plant emitted 4,739 tpy of SO₂ in 2014.⁴ This makes the Century facility also subject to the DRR requirements. Therefore, the area in the vicinity of Sebree Station and Century, possibly including some or all of Webster, Henderson, and McLean Counties in Kentucky, is required to be reviewed for compliance with the 1-hour SO₂ NAAQS and thereafter designated as attainment or nonattainment according to the DRR schedule.

As KDAQ is responsible for submitting the proposed SO₂ NAAQS designation determinations to U.S. EPA, KDAQ requested in an October 22, 2015 letter to each facility that each site either (1) submit the results of an air dispersion modeling analysis by March 31, 2016 demonstrating that modeled SO₂ design values are less than the NAAQS, or (2) submit a report by April 15, 2016 presenting the proposed location of at least one ambient SO₂ monitoring site to be installed and operational by January 1, 2017. Both Sebree Station and Century intend to pursue the option of siting and installing an ambient SO₂ monitoring station to best characterize the air quality in the area surrounding their facilities and allow designation of the area. Because of the proximity of the two facilities as well as the potential for combined air quality impacts, BREC and Century have decided to combine their interests and resources. This monitor siting evaluation therefore reviews the criteria for establishing a monitor and presents the conclusions based on the combined review of the two facilities.

1.3 APPROACH FOR MONITORING SITING EVALUATION

This siting evaluation report is presented to allow KDAQ to evaluate the location for the new ambient SO₂ monitoring station, the methodology that was followed to make the location selection, and to confirm that a single monitor fulfills the requirements of the DRR monitoring path. Guidance in the SO₂ NAAQS designation monitoring document provided by U.S. EPA⁵ (Monitoring Technical Assistance Document [TAD]) was followed to determine the locations of modeled maximum impacts, the frequency of such impacts at individual locations, and the likelihood that a monitor could be established in the vicinity of such resulting impacts within the context of the siting limitations normally associated with such monitor set up.

³ *Air Markets Program Data website*, <http://ampd.epa.gov/ampd/>

⁴ *Kentucky Emissions Inventory System Facility Report for 2014*.

⁵ *SO₂ NAAQS Designations Source-Oriented Monitoring Technical Assistance Document*, Draft, U.S. EPA, Office of Air Quality Planning and Standards, Air Quality Assessment Division, February 2016.

To identify the best locations for a monitor, the Monitoring TAD offers three different approaches:

1. Conduct new air dispersion modeling to assist in defining maximum impact areas;
2. Conduct exploratory monitoring via short-term mobile sampling to determine permanent monitor placement;
3. Use existing emissions data, existing nearby monitoring data, and existing dispersion modeling to determine site placement.

U.S. EPA's consideration and rationale for using new or existing modeling as a site selection method is twofold. First, representative ambient SO₂ monitors (as could be used in No. 3 above) are few in number and no current data exists near the BREC and Century facilities. Second, U.S. EPA views SO₂ as a "source-oriented" criteria pollutant that is relatively stable in the first few kilometers from the source, meaning that dispersion modeling is expected to be able to predict concentrations for individual and combined sources on a relatively small scale successfully.⁶ Thus, the DRR rule directs agencies (in this case KDAQ) to focus on specific sources as the main contributors to ambient air quality in the area surrounding those sources and to use dispersion modeling as a tool to select the best sites for monitoring.

For the BREC and Century facilities, the monitoring route and site selection process based on dispersion modeling (No. 1 method above) was chosen as the primary method to perform the monitor site selection. Dispersion modeling was conducted following the guidance of the Monitoring TAD, which generally follows the Modeling TAD⁷ with exceptions involving receptor grid set up and density. The methodology for conducting the air dispersion modeling used to define maximum impact areas is presented in Section 2. The methodology following the procedures recommended in the Monitoring TAD for selecting a monitoring station location based on the modeling results and taking into consideration other siting criteria is presented in Section 3. Information on the proposed ambient monitoring station, including equipment selection, and installation, calibration, and operating procedures to be followed, is presented in Section 4.

A summary description of the proposed monitoring station location for inclusion in Kentucky's 2016 Annual Ambient Air Monitoring Network Plan report is provided in Appendix A.

⁶ In preparation for providing modeling and monitoring guidance in the form of the TADs, U.S. EPA reviewed SO₂ ambient monitored and modeled concentrations around and near SO₂ sources and found that most of the highest impacts fall within a few 10's of kilometers from large sources and a few kilometers from smaller sources. Thus, the modeling can be used to focus on the likely impacts in near-field locations and assist in selecting the best locations for monitors.

⁷ *SO₂ NAAQS Designations Modeling Technical Assistance Document*, Draft, U.S. EPA, Office of Air Quality Planning and Standards, Air Quality Assessment Division, February 2016.

2. METHODOLOGY FOR DISPERSION MODELING CONDUCTED

As one of the recommended methods to site a monitor by the Monitoring TAD, dispersion modeling was used to define maximum impact areas around the Sebree Station and Century as an initial step in evaluating the location where an SO₂ ambient monitoring station could potentially be sited. The AERMOD Model⁸ was used to perform all the modeling analyses, as recommended in the Modeling TAD. In addition to AERMOD and to allow the best representation of simulated ambient air concentrations, the modeling guidance provided by the Monitoring TAD (which defers to much of the guidance in the Modeling TAD) was followed herein:

- The modeling analysis was used to defined normalized ambient concentrations. However, as opposed to the Monitoring TAD methodology, which is to divide all emissions by the highest hourly emission rate, the modeling used actual emissions as an input to allow the diverse set of sources to be properly weighted in terms of their contribution to ambient impacts. To obtain the normalization of air quality impacts suggested by the Monitoring TAD, the modeled concentrations were divided by the maximum concentration in the receptor grid, thereby having the same effect as normalizing the emissions. These normalized concentrations are hence fore referred to as Normalized Design Values (NDV), and are equivalent to the NDV ratio terminology used in the Monitoring TAD.
- Three years of modeling results were calculated to simulate a design value consistent with the 3-year monitoring period required for comparison to the NAAQS.
- Receptors were only placed in locations where a monitor could be placed (excluding waterbodies, waterways, etc.). Certain locations retained in the receptor grid that may not be suitable for a monitor site (e.g., those located directly on structures or within floodways) are separately addressed and excluded as necessary in the monitor siting evaluation step.
- Actual stack heights were used rather than following the Good Engineering Practice (GEP) stack height policy when using actual emissions.

All of these methods, which are consistent with those recommended in the Monitoring TAD, are meant to allow for the best representation of what a monitor would have measured over the 3-year modeling period (2012-2014). Following this modeling philosophy and guidance, the remainder of this section provides additional specifics on the methodology for the modeling used to perform the siting evaluation for the Sebree Station and Century area.

2.1 MODEL SELECTION

Modeling was performed for the 1-hour SO₂ analysis following the Monitoring and Modeling TADs' guidance. The AERMOD Model in its most current version as released by U.S. EPA was used to perform the dispersion modeling. The current applicable version of the AERMOD Model is Version 15181⁹ which was released on July 24, 2015 on the U.S. EPA's website¹⁰. The proposed update to U.S. EPA's modeling guidance in the form of

⁸ *Addendum User's Guide for the AMS/EPA Regulatory Model – AERMOD*, EPA-454/B-03-001, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 2004, Revised June 2015.

⁹ Stated by U.S. EPA to be part of the docket at Docket ID No. EPA-HQ-OAR-2015-0310 and available as of date of submittal of this siting evaluation.

¹⁰ Support Center for Regulatory Air Models, http://www.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod

the *Guideline on Air Quality Models*¹¹, was released on July 15, 2015 via the U.S. EPA technical website¹². The proposed guidance and revised AERMOD model have options that could affect the outcome of designation modeling with respect to some of the low wind options in the model.

When AERMOD is run with a meteorological dataset derived from one-minute meteorological data as is currently recommended by U.S. EPA, low wind speeds are much more prevalent than in prior versions of the modeling system that did not rely on one-minute meteorological data. To address the potential overestimates in ambient concentrations by AERMOD resulting from current meteorological datasets derived from one-minute average raw data, a number of low wind turbulence adjusting techniques have been proposed. These include adjusting the initial horizontal turbulence, adjusting the consideration of plume meander, and adjusting the friction velocity. The options are called ADJ_U* in AERMET and three LOWWIND options in AERMOD. However, none of the guidance proposals change the method of modeling being employed herein, and none of the proposed AERMOD model beta options that could be applied with respect to some of the low wind issues in AERMOD have been considered in this modeling analysis. Only AERMOD default options were used.

The pollutant identification was set to "SO₂" in AERMOD, which allowed additional internal model options to be available and used, thus enabling the output options to be configured properly. Because of the probabilistic form of the 1-hour NAAQS, selecting these correct input options allowed AERMOD to properly calculate an SO₂ design value based on the 3-year average of the 99th percentile of the annual distribution of the daily maximum 1-hour concentrations for comparison with the 1-hour SO₂ NAAQS of 196 µg/m³ (75 ppb).

Once these initial modeling files were processed, the top 200 receptors were determined based on their SO₂ design values, (as per Appendix A guidance in the Monitoring TAD), with the maximum design value being the top receptor (used to normalize all other concentrations). These top 200 receptors were then reprocessed through the AERMOD model now utilizing the MAXDAILY output option, which yielded the maximum daily modeled concentration at every receptor for every modeled day. Fewer receptors were processed in this secondary processing stage in order to keep the MAXDAILY output file a manageable size for additional calculations. The methodology behind utilizing these output options is further detailed in Section 3.

2.2 RURAL/URBAN OPTION SELECTION IN AERMOD

As stated in Section 6.3, Urban/Rural Determination, of the Modeling TAD, for any SO₂ dispersion modeling exercise, the "urban" or "rural" determination of the location surrounding the subject source is important in determining the applicable boundary layer characteristics that affect a model's calculation of ambient concentrations as well as the possible invocation of AERMOD's 4-hour half-life applicable to SO₂ in urban areas. Thus, a determination was made of whether the area around the Sebree Station and Century was urban or rural.

The first method discussed in the Modeling TAD (also referring therein to Section 7.2.3c of the *Guideline on Air Quality Models*, Appendix W) was used to determine the urban or rural status of the area around Sebree Station and Century. This is the "land use" technique because it examines the various land use within 3 km of the facilities and quantifies the percentage of area in various land use categories. Following this guidance, 2011 land use data (most recent available) were obtained from the U.S. Geological Survey¹³ through ArcGIS and a 3 km radius circle inscribed electronically around the center point between Sebree Station and Century. This center

¹¹ *Guideline on Air Quality Models*. Appendix W to 40 CFR Parts 51 and 52. Federal Register, November 9, 2005. pp. 68217-68261.

¹² <http://www.epa.gov/ttn/scram/>

¹³ <http://www.mrlc.gov/viewerjs/>

point is identical to the one utilized for generating the receptor grid in the modeling analyses, and hence represents the center of the modeling domain. All data were georeferenced and tabulated using the categories shown in Table 2-1 for urban and rural designation.

Figure 2-1 shows the layout of the land use where each color represents a particular land use, e.g., greens, yellows and browns are farmland, forests, and grasses, pinks are non-urban developed lands, and red and dark red are urban areas. Table 2-2 shows the results of this land categorization process. As can be seen the area is predominantly rural by an overwhelming margin at 94.7 percent, and therefore, was treated as rural in the AERMOD Model (that is, the urban option in AERMOD was not exercised and no urban heat island effects used to modify the nighttime stable conditions). The land use does not vary significantly in the immediate area surrounding Sebree Station and Century, hence the substantial margin indicating a rural determination for the center point was sufficient evidence to conclude the rural determination is representative of each individual facility and the majority of the modeling domain.

Table 2-1. Modeling TAD Urban / Rural Categories

| 2011 NLCD Land Cover Classification | | Auer Land-Use Classification | | Modeling TAD Rural or Urban |
|-------------------------------------|------------------------------|------------------------------|-------------------------------------------|-----------------------------|
| 11 | Open Water | A5 | Water Surfaces | Rural |
| 12 | Perennial Ice/Snow | A5 | Water Surfaces | Rural |
| 21 | Developed, Open Space | A1 | Metropolitan Natural | Rural |
| 22 | Developed, Low Intensity | R1 | Common Residential | Rural |
| 23 | Developed, Medium Intensity | I1, I2, C1, R2, R3 | Industrial/Commercial/Compact Residential | Urban |
| 24 | Developed, High Intensity | I1, I2, C1, R2, R3 | Industrial/Commercial/Compact Residential | Urban |
| 31 | Barren Land | A3 | Undeveloped (Grasses/Shrub) | Rural |
| 41 | Deciduous Forest | A4 | Undeveloped (Wooded) | Rural |
| 42 | Evergreen Forest | A4 | Undeveloped (Wooded) | Rural |
| 43 | Mixed Forest | A4 | Undeveloped (Wooded) | Rural |
| 52 | Shrub/Scrub | A3 | Undeveloped (Grasses/Shrub) | Rural |
| 71 | Grassland/Herbaceous | A3 | Undeveloped (Grasses/Shrub) | Rural |
| 81 | Pasture/Hay | A2 | Agricultural | Rural |
| 82 | Cultivated Crops | A2 | Agricultural | Rural |
| 90 | Woody Wetlands | A4 | Undeveloped (Wooded) | Rural |
| 95 | Emergent Herbaceous Wetlands | A3 | Undeveloped (Grasses/Shrub) | Rural |

Figure 2-1. Distribution of Land Use within 3km of Center Point Between Sebree Station and Century Sebree

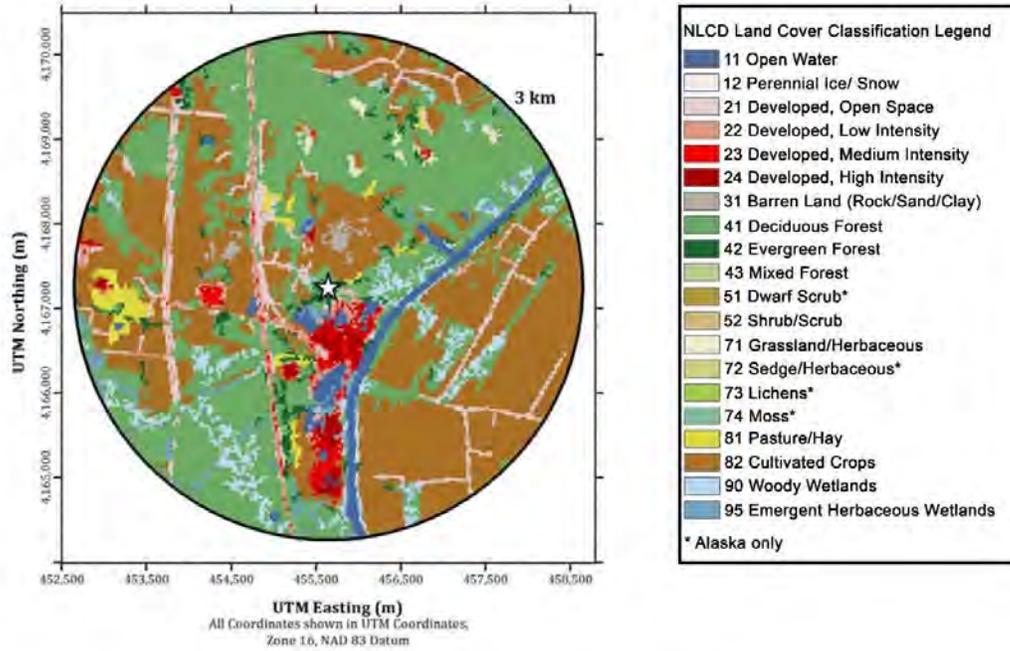


Table 2-2. Urban/Rural Determination

| <i>Percent Land Categorization</i> | | |
|------------------------------------------------------------------------|------------------------------|----------------|
| <i>ArcGIS Analysis Results for Sebree Station & Century Sebree</i> | | |
| Category ID | Category Description | Percent |
| 11 | Open Water | 3.3% |
| 21 | Developed, Open Space | 5.0% |
| 22 | Developed, Low Intensity | 2.5% |
| 23 | Developed, Medium Intensity | 1.5% |
| 24 | Developed, High Intensity | 1.3% |
| 31 | Barren Land | 0.6% |
| 41 | Deciduous Forest | 37.0% |
| 42 | Evergreen Forest | 2.1% |
| 43 | Mixed Forest | 0.0% |
| 52 | Shrub/Scrub | 0.0% |
| 71 | Grassland/Herbaceous | 0.5% |
| 81 | Pasture/Hay | 1.6% |
| 82 | Cultivated Crops | 38.6% |
| 90 | Woody Wetlands | 4.2% |
| 95 | Emergent Herbaceous Wetlands | 1.8% |
| | Total | 100% |
| | Urban | 5.3% |
| | Rural | 94.7% |

2.3 METEOROLOGICAL DATA

Meteorological data were required as input to the AERMOD model to allow the characterization of the transport and dispersion of the Sebree Station and Century emissions in the atmosphere. As per the Modeling TAD, three years of recent meteorological data coincidental with the latest three years of modeling to be performed for the area (2012-2014) were used. Selection of the most characteristic National Weather Service data was based on the most representative and nearby National Weather Service (NWS) site. Data from the NWS included surface (generally, 10 m tower-based) hourly data, one minute surface observations, and upper air (radiosonde) meteorological data for the most recent three full year data set (January 1, 2012 through December 31, 2014) and was processed from archived data from the most representative NWS meteorological station in the vicinity of Sebree Station and Century. Representativeness was determined on the basis of proximity, similarity in terms of land use (and its effect on surface roughness, albedo, and Bowen ratio), and professional meteorological judgement. AERMOD-ready meteorological data was prepared using the latest version of the AERMET meteorological processing utility (Version 15181). Standard U.S. EPA meteorological data processing guidance was used as outlined in a recent U.S. EPA memorandum¹⁴ as well as other AERMET and associated processor documentation.

A preliminary evaluation of the NWS meteorological data sites within approximately 120 km of the Sebree area indicated that several airports were located in the region (other non-airport data sets were determined to be deficient in terms of data collection and quality). Figure 2-2 shows the locations of the nearby airports (indicated by four letter designations beginning with K) having meteorological data sets that were considered for this modeling. Unfortunately, most of the airports within the vicinity of Sebree Station and Century do not utilize Automated Surface Observing Systems (ASOS) to record 1-minute data for use in the AERMINUTE preprocessor. Proximity of the meteorological station to the modeled facility is also an important consideration in meteorological station selection. The only meteorological station sites utilizing ASOS one-minute recording systems and falling within 120km of Sebree Station and Century were the Evansville Regional Airport (KEVV, 23.3 km north of Sebree Station and Century) and Outlaw Field Airport (KCKV, 113.6 km south of Sebree Station and Century). Table 2-3 presents the results of a NWS identification and selection analysis based on proximity to Sebree Station and Century where meteorological stations without adequate data are designated with red highlighting and candidate stations for the modeling analysis are designated without highlighting. For this modeling analysis, use of data from the Evansville Regional Airport (KEVV) was selected.

The selected data sets as presented in the following subsections were used together with the AERMET preprocessor (Version 15181), coordinates of the KEVV tower, and all appropriate input options describing the location and climate of the area to generate the required surface and profile meteorological data sets for 2012 through 2014.

¹⁴ Fox, Tyler, U.S. Environmental Protection Agency. 2013. "Use of ASOS Meteorological Data in AERMOD Dispersion Modeling." http://www.epa.gov/ttn/scram/guidance/clarification/20130308_Met_Data_Clarification.pdf

Figure 2-2. Meteorological Stations and SO₂ Monitors in the Area Surrounding Sebree Station and Century

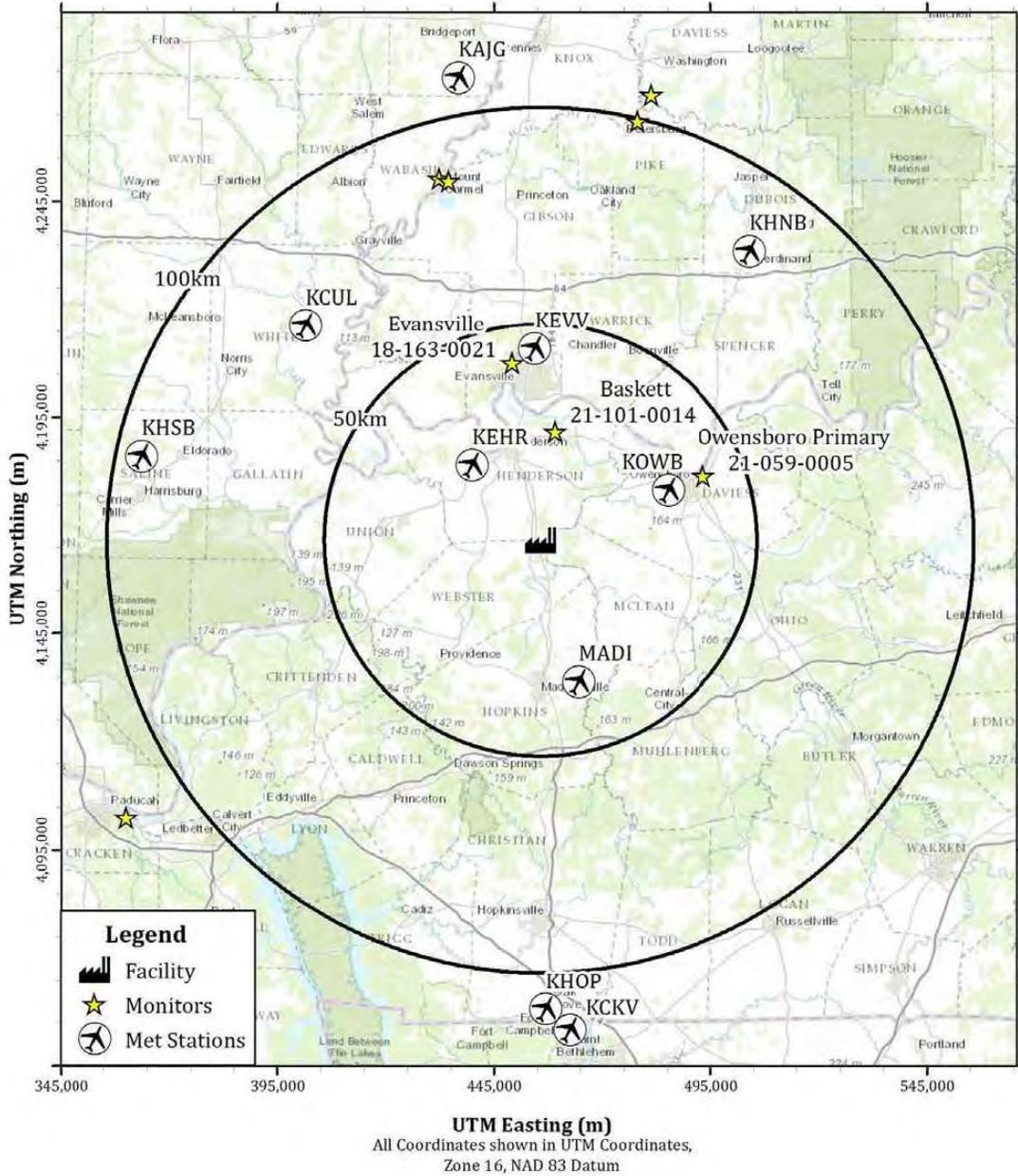


Table 2-3. Proximity Analysis of Meteorological Stations to Sebree Station and Century

| Station Name | WBAN Station ID | Station Call Sign | Lat. | Long. | UTM East Zone 17 (m) | UTM North Zone 17 (m) | ASOS One Minute Data Available | Distance to Sebree Station (km) |
|----------------------------------------|-----------------|-------------------|--------|---------|----------------------|-----------------------|--------------------------------|---------------------------------|
| Henderson City-County Airport | 53886 | KEHR | 37.800 | -87.683 | 439,872 | 4,183,845 | No | 23.3 |
| Owensboro-Daviess County Airport | 53803 | KOWB | 37.750 | -87.167 | 485,288 | 4,178,091 | No | 31.8 |
| Madisonville Municipal Airport | 00421 | MADI | 37.350 | -87.400 | 464,573 | 4,133,775 | No | 34.1 |
| Evansville Regional Airport | 93817 | KEVV | 38.044 | -87.521 | 454,285 | 4,210,825 | Yes | 44.2 |
| Carmi Municipal Airport | 63840 | KCUL | 38.089 | -88.123 | 401,521 | 4,216,285 | No | 73.4 |
| Huntingburg Airport | 53896 | KHNB | 38.249 | -86.954 | 504,025 | 4,233,444 | No | 82.5 |
| Harrisburg-Raleigh Airport | 53897 | KHSB | 37.811 | -88.549 | 363,649 | 4,185,976 | No | 94.0 |
| Mount Carmel Municipal Airport | 63853 | KAJG | 38.607 | -87.727 | 436,701 | 4,273,417 | No | 108.4 |
| Campbell AAF Airport | 13806 | KHOP | 36.667 | -87.483 | 456,838 | 4,058,041 | No | 108.6 |
| Outlaw Field Airport | 03894 | KCKV | 36.624 | -87.419 | 462,536 | 4,053,245 | Yes | 113.6 |
| Fairfield Municipal Airport | 53891 | KFWC | 38.379 | -88.413 | 376,581 | 4,248,812 | No | 114.0 |
| Central Coordinates of Sebree Station: | 455,647 | 4,166,660 | | | | | | |

2.3.1 Meteorological Data Processing - Surface Data

Unprocessed hourly surface meteorological field data was obtained from the U.S. National Climatic Data Center (NCDC) for the Evansville Regional Airport (KEVV) for January 1, 2012 through December 31, 2014 in the standard ISHD (integrated surface hourly data) format¹⁵. This data was then supplemented with TD-6405 (so-called "1-minute") wind data for each station¹⁶ and processed using the latest version of the AERMINUTE pre-processing tool (Version 15272). A threshold wind speed of 0.5 m/s was used in AERMET as per U.S. EPA guidance. The "Ice-Free Winds Group" AERMINUTE option was selected due to the fact that a sonic anemometer was installed at KEVV on September 26, 2006¹⁷.

2.3.2 Meteorological Data Processing - Upper Air Data

In addition to surface meteorological data, AERMET requires the use of data from an upper air sounding to estimate mixing heights. Upper air data from the nearest representative NWS radiosonde equipped station was utilized in the modeling analysis. In this case, two upper air stations were considered, namely, the Nashville International Airport (KBNA, WBAN No. 13897), which is about 176 km south of Sebree, and the Lincoln-Logan County Airport (KILX, WBAN No. 04833), which is about 318 km northwest of Sebree. While the Indiana Department of Environmental Management (IDEM) prefers the use of Lincoln with Evansville surface data¹⁸, the use of Nashville is thought to be the most representative choice for the Sebree area due to its proximity. Data was obtained from the National Oceanic and Atmospheric Administration (NOAA) in FSL (Forecast Systems Laboratory) format¹⁹ for the same period of record, namely, January 1, 2012 through December 31, 2014, for the Nashville, Tennessee upper air station.

2.3.3 Meteorological Data Processing - Land Use Analysis

Parameters derived from analysis of land use data (surface roughness parameter, Bowen ratio, and albedo) are also required by AERMET. In accordance with U.S. EPA guidance, these values were determined using the latest

¹⁵ <ftp://ftp.ncdc.noaa.gov/pub/data/noaa/>

¹⁶ <ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin>

¹⁷ http://www.nws.noaa.gov/ops2/Surface/documents/IFW_stat.pdf

¹⁸ <http://www.in.gov/idem/airquality/2376.htm>

¹⁹ <http://www.esrl.noaa.gov/raobs/>

version of the AERSURFACE tool (Version 13016).²⁰ AERSURFACE reads gridded land use, land cover data as provided by the United States Geological Survey (USGS)²¹ and associates such data with representative values of the three parameters listed above. The land use analysis is in part based on moisture conditions at the location of the meteorological data, that is, the Evansville Regional Airport (KEVV), which is the best representation of the data in terms of wet, dry, or average conditions in comparison to the 30-yr averages for the most recent complete calendar years (in this case, 1985 through 2014). To make the moisture conditions determination, climatological records of the annual precipitation in each modeled year (2012 through 2014) were compared to the 1985-2014 climatological record²².

Table 2-4 shows the 30 year precipitation by month for KEVV along with the seasonal totals, averages, and 30th percentile high and low values. These were compared to the actual rainfall in each season for each year of the 2012-2014 modeling period, which determined the average, wet, or dry precipitation option in AERSURFACE. Other specific AERSURFACE settings were used that represent the location of KEVV. These settings include location coordinates, monthly versus seasonal differentiation, aridity, and the surface moisture determination just discussed. This determination is used in AERSURFACE to adjust the Bowen ratio estimated by AERSURFACE, which in turn affects the calculation of the daytime mixing heights calculated in AERMET and used in AERMOD.

²⁰ U.S. Environmental Protection Agency. 2013. "AERSURFACE User's Guide." EPA-454/B-08-001, Revised 01/16/2013. http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf

²¹ <http://www.mrlc.gov/viewerjs/>

²² National Climatic Data Center. 2014 Local Climatological Data (LCD).

Table 2-4. Moisture Calculation for Evansville Regional Airport, KEVV (inches of precipitation)

| YEAR | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANNUAL | Winter | Spring | Summer | Fall |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-------|-------|-------|------|------|------|------|------|------|------|------------|--------|--------|--------|-------|
| 1985 | 1.76 | 4.24 | 6.10 | 3.80 | 2.97 | 4.68 | 1.18 | 3.76 | 3.59 | 4.46 | 7.61 | 1.74 | 45.89 | 7.74 | 12.87 | 9.62 | 15.66 |
| 1986 | 1.15 | 5.77 | 2.64 | 2.29 | 2.93 | 3.77 | 5.39 | 2.07 | 3.84 | 3.30 | 2.35 | 2.18 | 37.68 | 9.10 | 7.86 | 11.23 | 9.49 |
| 1987 | 0.77 | 3.51 | 2.11 | 2.31 | 3.90 | 5.97 | 3.19 | 0.47 | 1.98 | 1.23 | 3.36 | 5.71 | 34.51 | 9.99 | 8.32 | 9.63 | 6.57 |
| 1988 | 3.28 | 3.94 | 2.89 | 1.77 | 1.33 | 1.11 | 6.63 | 2.72 | 1.19 | 2.86 | 7.96 | 2.75 | 38.43 | 9.97 | 5.99 | 10.46 | 12.01 |
| 1989 | 3.35 | 7.00 | 6.40 | 4.19 | 3.72 | 4.00 | 7.83 | 3.46 | 2.21 | 2.16 | 1.64 | 1.38 | 47.34 | 11.73 | 14.31 | 15.29 | 6.01 |
| 1990 | 4.26 | 5.60 | 2.15 | 3.75 | 11.34 | 3.22 | 1.01 | 3.47 | 2.54 | 4.81 | 2.92 | 7.45 | 52.52 | 17.31 | 17.24 | 7.70 | 10.27 |
| 1991 | 3.02 | 2.99 | 4.27 | 2.56 | 3.11 | 0.65 | 2.58 | 0.46 | 2.60 | 3.05 | 3.67 | 3.72 | 32.68 | 9.73 | 9.94 | 3.69 | 9.32 |
| 1992 | 0.85 | 1.51 | 4.50 | 1.19 | 3.44 | 1.44 | 8.40 | 4.39 | 2.89 | 1.17 | 4.34 | 1.69 | 35.81 | 4.05 | 9.13 | 14.23 | 8.40 |
| 1993 | 3.57 | 2.61 | 3.23 | 4.38 | 4.20 | 4.65 | 2.37 | 2.17 | 5.59 | 3.76 | 6.62 | 2.68 | 45.83 | 8.66 | 11.91 | 9.19 | 15.97 |
| 1994 | 3.18 | 2.32 | 1.88 | 5.77 | 0.94 | 3.45 | 2.30 | 2.52 | 2.61 | 2.67 | 6.52 | 2.59 | 36.75 | 8.09 | 8.59 | 8.27 | 11.80 |
| 1995 | 2.82 | 2.98 | 2.53 | 5.59 | 13.51 | 4.56 | 2.88 | 3.60 | 0.47 | 2.01 | 2.32 | 3.19 | 46.46 | 8.99 | 21.63 | 11.04 | 4.80 |
| 1996 | 3.51 | 1.50 | 5.19 | 11.83 | 7.32 | 7.78 | 4.56 | 1.20 | 8.45 | 2.53 | 6.66 | 3.50 | 64.03 | 8.51 | 24.34 | 13.54 | 17.64 |
| 1997 | 4.20 | 3.35 | 6.90 | 4.16 | 7.57 | 6.12 | 1.71 | 4.02 | 1.31 | 1.73 | 4.17 | 2.34 | 47.58 | 9.89 | 18.63 | 11.85 | 7.21 |
| 1998 | 2.24 | 2.71 | 3.07 | 8.50 | 5.91 | 5.31 | 3.89 | 3.91 | 0.49 | 3.38 | 2.78 | 3.48 | 45.67 | 8.43 | 17.48 | 13.11 | 6.65 |
| 1999 | 6.00 | 1.94 | 4.30 | 6.15 | 3.21 | 6.27 | 2.00 | 0.64 | 0.29 | 2.80 | 0.51 | 5.13 | 39.34 | 13.07 | 13.66 | 8.91 | 3.70 |
| 2000 | 4.36 | 7.26 | 3.21 | 2.35 | 2.60 | 5.86 | 4.14 | 5.60 | 5.03 | 0.59 | 3.43 | 4.12 | 48.55 | 15.74 | 8.16 | 15.60 | 9.05 |
| 2001 | 1.29 | 3.26 | 2.23 | 1.60 | 3.02 | 3.82 | 5.54 | 6.09 | 2.40 | 7.27 | 5.40 | 7.16 | 49.88 | 11.71 | 7.65 | 15.45 | 15.07 |
| 2002 | 3.72 | 0.74 | 6.20 | 8.58 | 5.70 | 2.86 | 4.32 | 0.63 | 5.22 | 3.75 | 2.97 | 5.65 | 50.34 | 10.11 | 20.48 | 7.81 | 11.94 |
| 2003 | 0.90 | 4.92 | 2.60 | 3.91 | 6.48 | 4.80 | 4.38 | 1.88 | 3.17 | 1.61 | 4.36 | 1.20 | 39.91 | 7.02 | 12.99 | 10.76 | 9.14 |
| 2004 | 2.95 | 0.39 | 2.17 | 1.91 | 9.31 | 1.66 | 7.56 | 3.08 | 0.09 | 5.62 | 6.23 | 2.31 | 43.48 | 5.85 | 13.39 | 12.30 | 11.94 |
| 2005 | 4.59 | 2.77 | 2.85 | 2.13 | 2.33 | 4.88 | 2.69 | 8.51 | 2.00 | 0.73 | 5.93 | 1.76 | 41.17 | 9.12 | 7.31 | 16.08 | 8.66 |
| 2006 | 4.09 | 2.17 | 9.36 | 3.44 | 5.77 | 3.73 | 6.46 | 7.41 | 8.75 | 5.46 | 4.95 | 4.59 | 66.18 | 10.85 | 18.57 | 17.60 | 19.16 |
| 2007 | 5.47 | 3.41 | 2.66 | 2.88 | 2.73 | 2.71 | 1.97 | 0.99 | 2.22 | 4.64 | 1.77 | 6.34 | 37.79 | 15.22 | 8.27 | 5.67 | 8.63 |
| 2008 | 3.97 | 5.97 | 12.34 | 5.07 | 8.07 | 3.09 | 3.90 | 0.52 | 1.16 | 1.61 | 3.42 | 4.76 | 53.88 | 14.70 | 25.48 | 7.51 | 6.19 |
| 2009 | 2.85 | 2.76 | 3.32 | 6.01 | 6.47 | 2.20 | 6.46 | 1.91 | 5.17 | 8.21 | 1.22 | 3.62 | 50.20 | 9.23 | 15.80 | 10.57 | 14.60 |
| 2010 | 2.41 | 1.58 | 3.97 | 3.27 | 3.03 | 2.49 | 3.51 | 0.84 | 0.36 | 1.06 | 8.46 | 1.80 | 32.78 | 5.79 | 10.27 | 6.84 | 9.88 |
| 2011 | 1.65 | 4.52 | 5.34 | 11.77 | 7.90 | 6.52 | 6.66 | 0.62 | 8.20 | 2.49 | 8.32 | 6.04 | 70.03 | 12.21 | 25.01 | 13.80 | 19.01 |
| 2012 | 3.39 | 1.75 | 2.51 | 3.44 | 2.29 | 0.15 | 2.34 | 4.10 | 7.60 | 2.90 | 1.19 | 3.47 | 33.13 | 8.61 | 6.24 | 6.59 | 11.69 |
| 2013 | 6.76 | 2.77 | 4.08 | 3.86 | 5.08 | 7.55 | 3.59 | 1.64 | 2.81 | 6.07 | 2.04 | 7.33 | 53.58 | 16.86 | 13.02 | 12.78 | 10.92 |
| 2014 | 1.69 | 2.26 | 2.85 | 10.97 | 3.72 | 3.87 | 4.02 | 4.80 | 2.55 | 4.20 | 2.85 | 3.43 | 47.21 | 7.38 | 17.54 | 12.69 | 9.60 |
| Precipitation location from http://www.ncdc.noaa.gov/cdo-web/datatools/findstation | | | | | | | | | | | | | Upper 30th | 11.11 | 17.31 | 12.88 | 11.94 |
| KEVV precipitation data - obtained 2014 cumulative report from http://www1.ncdc.noaa.gov/pub/outliers | | | | | | | | | | | | | Lower 30th | 8.58 | 8.97 | 9.11 | 8.65 |
| A = Average Precipitation | | | | | | | | | | | | | 2012 | A | D | D | A |
| W = Wet Precipitation | | | | | | | | | | | | | 2013 | W | A | A | A |
| D = Dry Precipitation | | | | | | | | | | | | | 2014 | D | W | A | A |

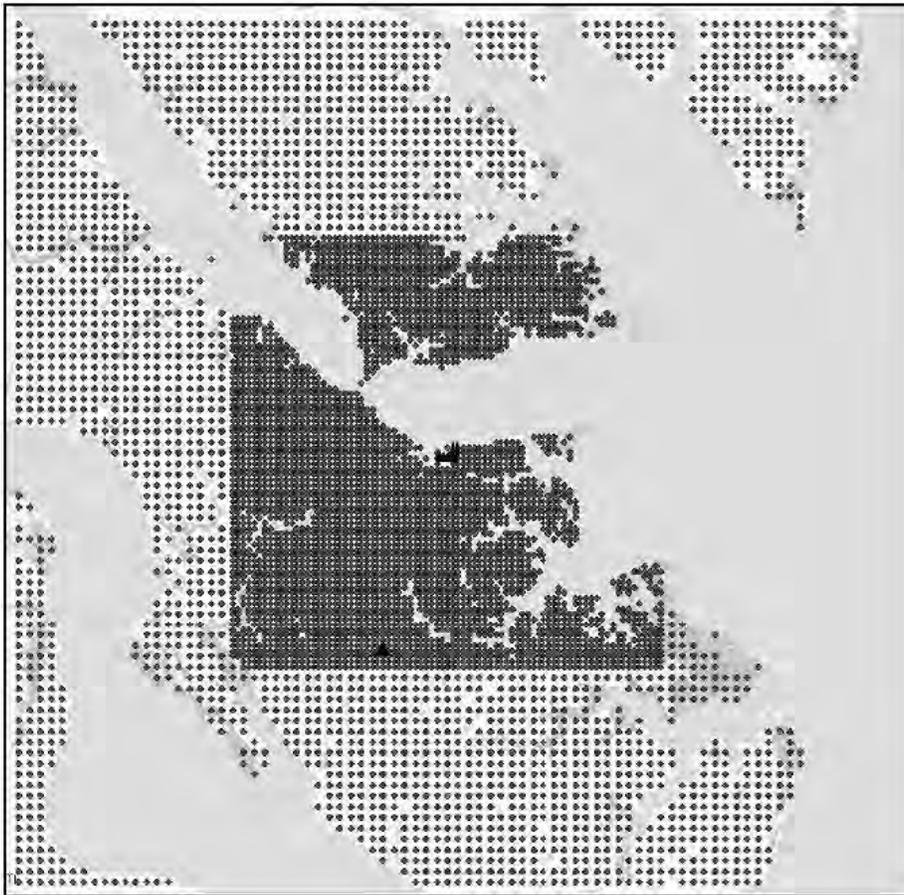
2.4 COORDINATE SYSTEM

In all modeling input and output files, the locations of emission sources, structures, and receptors were represented in the appropriate Zone of the Universal Transverse Mercator (UTM) coordinate system using the North American Datum 1983 (NAD83). The Sebree Station, Century, the surrounding area and the whole of the modeling domain are within Zone 16.

2.5 RECEPTOR LOCATIONS

Sections 3 and Appendix A of the Monitoring TAD suggest the number, density, and arrangement as well as the exclusion of specific receptor locations. The dispersion modeling followed the guidance of both the Modeling TAD and the Monitoring TAD in terms of only putting receptors in areas where it is feasible to place an actual monitor. As shown in the example Figure 2-3 from the Modeling TAD, no receptors were placed in lakes, rivers or similar areas.

Figure 2-3. Modeling TAD Example Receptor Grid Showing Excluded Locations Over Water



The initial receptor grid for the combined modeling of Sebree Station and Century was a nested, square Cartesian grid identical to the receptor grid example in Appendix A of the Monitoring TAD. This “traditional” full receptor grid aligns with the Monitoring TAD’s recommendation that this grid is typical for the majority of modeling applications. This grid is composed of 11,441 receptors including:

- **Fine Cartesian Grid:** A “fine” grid containing 250-meter spaced receptors extending to 10 km from a center point between Sebree Station and Century,
- **Coarse Cartesian Grid:** A “coarse” grid containing 500-meter spaced receptors extending from 10 km to 20 km from the center point between Sebree Station and Century, exclusive of receptors on the fine grid.

In the AERMOD modeling runs that were completed, all 11,441 receptors in the Fine and Coarse grids described above were retained with no exclusions for sites which are prohibitive for locating an ambient monitor. Following the monitoring TAD guidance, certain receptors were excluded upfront in processing the modeling results. These excluded receptors included 1) receptors that fell over waterbodies²³ (e.g., rivers, lakes) and 2) receptors not considered to be ambient, including those within the controlled property boundaries of the two facilities. These exclusions took place prior to ranking the candidate monitor locations. Figure 2-4 shows the remaining set of 11,187 receptors included in all post-processing and ranking of the modeling analyses after 254 receptors were excluded for the reasons stated above. Figure 2-5 presents a close-in view of the same receptor grid encompassing the area within about 5 km of the combined adjacent properties of Sebree Station and Century.

The red line in Figure 2-5 shows the combined boundary of the main plant site property parcels of Sebree Station and Century, which are adjacent to each other. The respective plant sites of each facility are controlled and the general public does not have unrestricted or legal access to the area within this boundary.²⁴ Although within this controlled property area, several receptor locations were retained on the strip of Century property north of Moss and Moss Rd because access is less controlled than areas closer to the main plant activity centers. Portions of the property running along the south side of Moss and Moss Rd are fenced, signed, and restricted. All access points into the main property area along Moss and Moss Rd are blocked by locked gates. The Green River provides a barrier to access the properties from the east and southeast. Portions of the west edges of the property running parallel to Alcan Rd are currently fenced directly preventing access. Other sections that are not currently fenced off are monitored and patrolled. In consideration of the physical fencing, security patrols, and physical barriers (i.e., Green River), the controlled and restricted property space between Moss and Moss Rd (which runs through the center of Century’s property), and the ash landfill at the southern edge of BREC’s property, were not considered as ambient air. Therefore, receptors of the Fine Grid falling within these areas were excluded in post-processing modeling results.

²³ Water body boundaries were defined based on information in the USGS National Hydrography Dataset (<http://nhd.usgs.gov/data.html>)

²⁴ Employees of contractors, vendors, and suppliers to BREC and Century that provide services to either plant (e.g., electricians, maintenance workers, engineers, consultants, farmers, etc.) obviously have access to the plant site areas; however, such individuals are not considered the general public as they have a business relationship with BREC and Century.

Figure 2-4. Receptor Grid Used in Post-Processing of Modeling Conducted

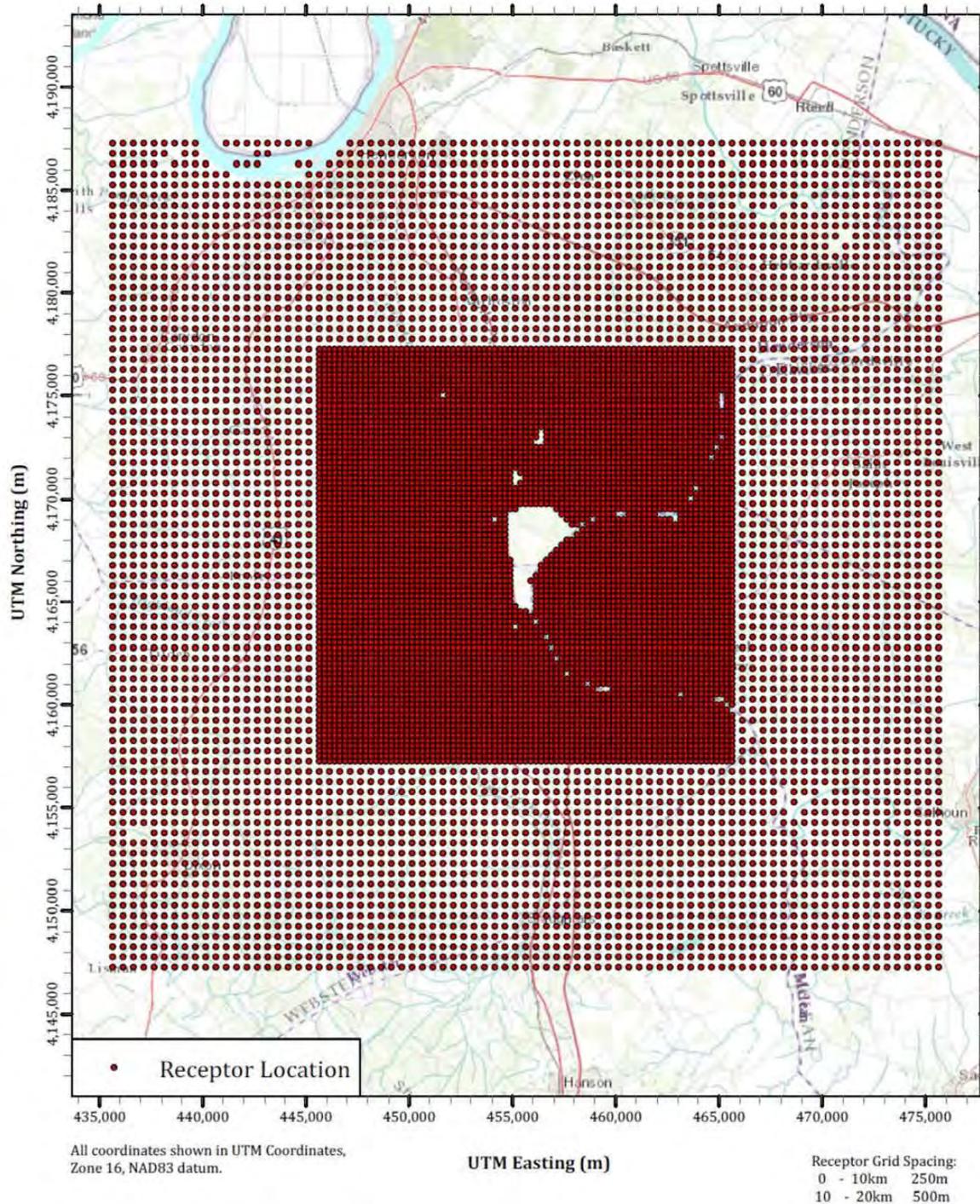
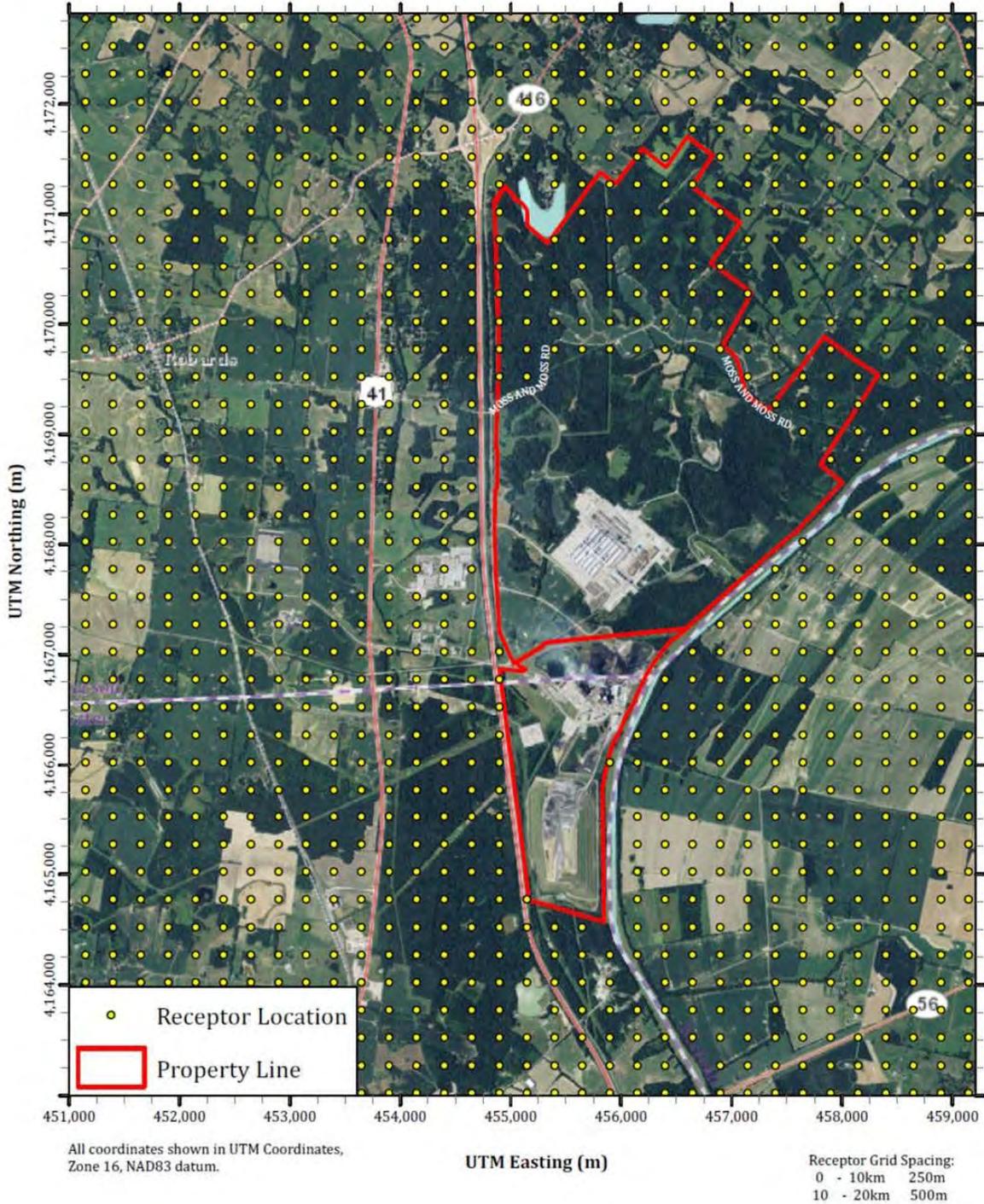


Figure 2-5. Inner Portion of the Receptor Grid Used in Post-Processing of Modeling Conducted



Apart from the locations described above that were excluded from the modeling results, other areas surrounding the BREC and Century plants are also not suitable for siting a new monitoring station. For example, some receptors retained in the modeling domain fall within floodways or major roadway right-of-ways, are within private and restricted property of other companies, are in otherwise inaccessible locations or densely wooded areas, or have poor line-of-sight to the facilities. However, as these areas are still considered ambient air locations with respect to BREC and Century, for the purposes of the modeling analyses, receptors in these areas were not excluded. Considerations regarding the suitability of monitor locations are instead addressed as part of the subsequent evaluation of the ranked modeling results presented in Section 3.3.

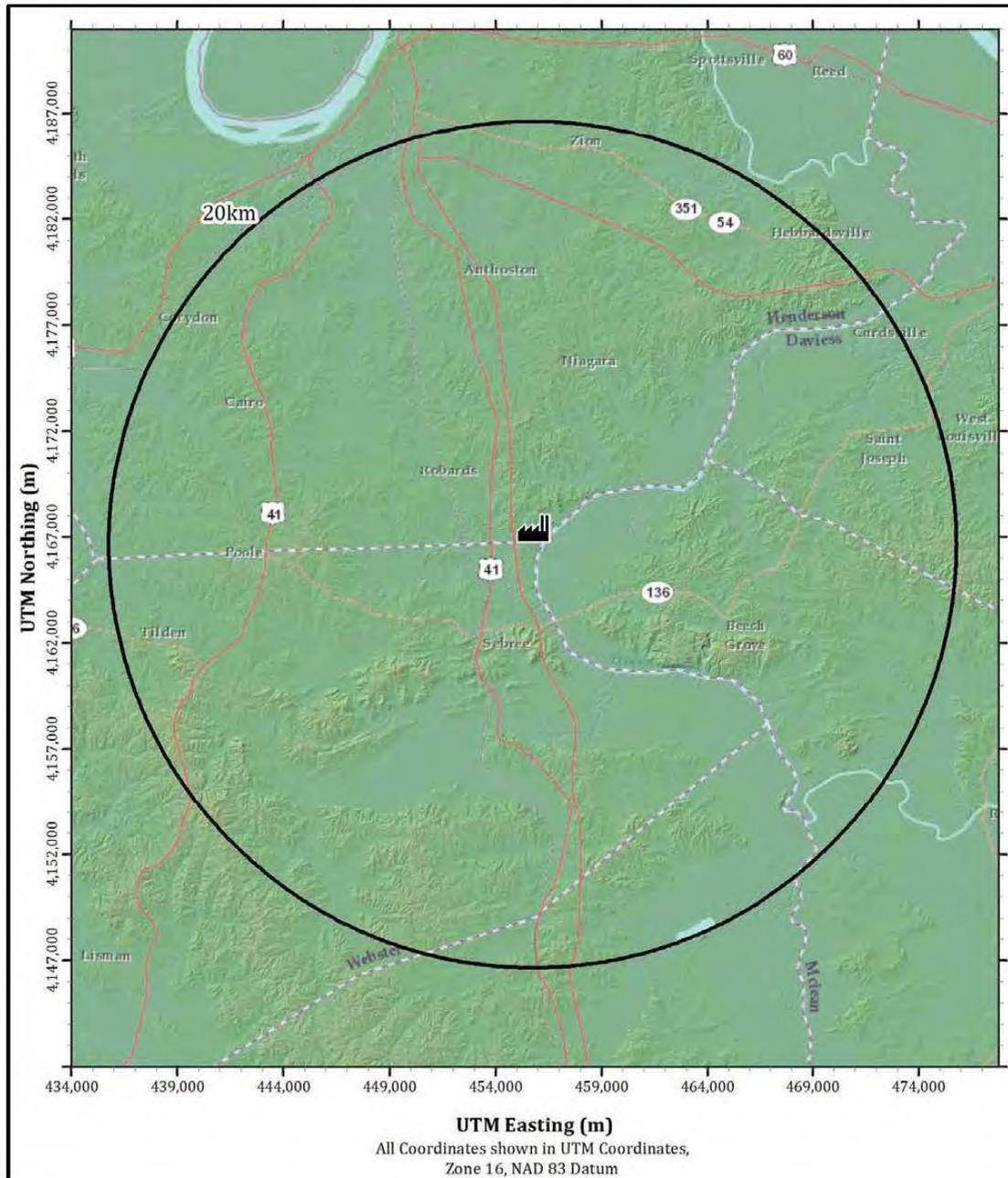
2.6 TERRAIN ELEVATIONS

The terrain elevation for each receptor, building, and emission source was determined using USGS 1 arc-second National Elevation Data (NED). The NED, obtained from the USGS²⁵, has terrain elevations at 30-meter intervals. Using the AERMOD terrain processor, AERMAP (Version 11103), the terrain height for each receptor, and outlying buildings included in the model were determined by assigning the interpolated height from the digital terrain elevations surrounding each object. These were used directly in the AERMOD model.

In addition, AERMAP was used to compute the hill height scales associated with each elevated receptor located above the Sebree Station and Century source base elevation. This computation enables the model to determine the effect that terrain will have on plumes from the sources. AERMAP searches all nearby elevation points for the terrain height and location that has the greatest influence on each receptor to determine the hill height scale for that receptor. AERMOD then uses the hill height scale in order to select the point where a plume may divide between going around a terrain feature and lofting over the feature. Initial review of the area indicates that a few nearby hills exist near the Sebree Station and Century and thus, the inclusion of terrain elevations in the modeling is paramount. Figure 2-6 shows a relief map of the area.

²⁵ <http://www.mrlc.gov/viewerjs/>

Figure 2-6. Relief Map of Area within 20 km of Sebree Station and Century



2.7 SEBREE STATION EMISSION SOURCES

The Sebree Station has six major sources of SO₂ emissions that emit through a total of six stacks (not including a by-pass stack for HMP&L). The units are identified as follows:

1. Reid Station Unit 1, (R1) a Coal Fired/Natural Gas Indirect Heat Exchanger,
2. Reid Station Turbine, (RT) a Natural Gas Combustion Turbine,
3. Henderson Station Unit 1, (H1) a Coal Fired Indirect Heat Exchanger,
4. Henderson Station Unit 2, (H2) a Coal Fired Indirect Heat Exchanger,
5. Green Station Unit 1, (G1) a Coal Fired Boiler, and
6. Green Station Unit 2, (G2) a Coal Fired Boiler

There are a total of six significant stacks at Sebree Station. R1, RT, G1, and G2 each have dedicated stacks conveying only emissions from a single unit. H1 and H2 share a stack with side-by-side flues with each unit having a dedicated flue conveying emissions only from a single unit. On an infrequent basis, H1 and H2 can each route emissions to a separate bypass stack with only a single flue to convey emissions.

The preferred modeling approach for establishing modeled emission rates recommended in the Modeling TAD is the use of CEMS data. CEMS data were available for all Sebree Station stacks. Thus, CEMS-derived, hour-by-hour modeled emission rate datasets provided the most accurate representation of the actual emissions history of the BREC sources for the 2012-2014 time period considered in the modeling. The Sebree Station modeling analysis relied on CEMS and other parametric monitoring data in the form of hourly SO₂ emission rates, boiler heat input rates, exhaust flowrates, temperature, and other relevant hourly operating parameters to construct the most representative three-year SO₂ emissions dataset by the hour of operation over the 2012-2014 time period. However, Reid Station Unit 1 will soon be converted to utilize 100% natural gas as fuel. Given this approaching conversion, this modeling analysis proactively excluded the 2012-2014 CEMS data for Reid Unit 1 and instead used potential SO₂ emissions as based on AP-42 emission factor calculations for natural gas combustion.

Other minor sources of SO₂ emissions at Sebree Station include one 310 hp diesel-fired emergency engine (EU06), one 1,130 hp diesel-fired emergency engine (EU10), one 100 hp diesel-fired emergency fire-pump (EU07), and one 380 hp diesel-fired emergency fire-pump (EU09). All of the emergency sources are intermittent²⁶ and thus, do not contribute to the annual distribution of daily maximum 1-hour SO₂ concentrations.²⁷ This was confirmed by reviewing the hours of operation of each unit for each year of 2012-2014: EU06 – 10, 36, 29 hrs; EU07 – 10, 10, 9 hrs; EU09 – 0, 0, 44 hrs; and EU10 – 0, 0, 28 hrs. Therefore, the four emergency generators were not included in the modeling analysis.

Startup and shutdown operations of all the units were addressed in a manner consistent with the intermittent source guidance in the Modeling TAD and the associated U.S. EPA clarification memorandum²⁸. Because these operations were very intermittent, they were determined to not contribute to the annual distribution of daily maximum 1-hour SO₂ concentrations, and thus, were not independently considered other than by the reporting of emissions related to the CEMS monitoring as a contributor to the emissions rates assigned in the modeling analysis.

²⁶ The hours of operation will be fully reported for 2012-2014 in the subsequent monitor siting evaluation report to be submitted by April 15, 2016.

²⁷ *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO₂ National Ambient Air Quality Standard*, Memorandum from Tyler Fox, Leader Air Quality Modeling Group to U.S. EPA Regional Air Division Directors, March 1, 2011.

²⁸ *Ibid*

Table 2-5 below summarizes the stack parameters that were used in the modeling of the six main stacks at Sebree Station.

Table 2-5. Sebree Station Source Characterization

| Stack Identification | X Coordinate (m) ^a | Y Coordinate (m) ^a | Stack Height (ft) | Stack Diameter (ft) | Exit Velocity (ft/s) | Exit Temperature (°F) | Emission Rate (lb/hr) |
|--------------------------|-------------------------------|-------------------------------|-------------------|---------------------|----------------------|-----------------------|-----------------------|
| Green - Boiler 1 (G1) | 455,889.8 | 4,166,718 | 350 | 15.0 | CEMS | CEMS | CAMD |
| Green - Boiler 2 (G2) | 455,835.9 | 4,166,727 | 350 | 15.0 | CEMS | CEMS | CAMD |
| Henderson - Unit 1 (H1) | 455,632.6 | 4,166,795 | 350 | 16.0 | CEMS | CEMS | CAMD |
| Henderson - Unit 2 (H2) | 455,632.6 | 4,166,788 | 350 | 16.0 | CEMS | CEMS | CAMD |
| Henderson - Bypass Stack | 455,676.4 | 4,166,735 | 350 | 15.0 | CEMS | CEMS | CAMD |
| Reid - Unit 1 (R1) | 455,714.6 | 4,166,688 | 250 | 11.8 | 29.5 | 320 | 0.49 |
| Reid - Turbine (RT) | 455,595.4 | 4,166,758 | 110 | 16.0 | CEMS | CEMS | CAMD |

^a UTM Zone 16, NAD 83.

Any missing hourly values for the combustion unit stacks for flow rate or temperature were filled in using a load-based substitution technique.²⁹ Specifically, the missing data value for the specified operating load were filled using the average of hourly CEMS data (flowrate or temperature) calculated in the corresponding load range. For the selected 2012-2014 time period, this fill-in procedure was only necessary for filling small blocks of hours that were relatively infrequent and not spaced closely in time. For this reason, the more conservative substitution schemes based on peak emissions or use of emission factors mentioned in the Modeling TAD were not necessary. All CEMS data analysis for the hour-by-hour source data for each of the six stacks are available for review in a spreadsheet file in Microsoft Excel[®] designating the data obtained directly from the CEMS data handling system and the U.S. EPA's Air Markets Program (CAMD) as well as calculation and concatenation procedures to put in the AERMOD hourly input file format. An electronic copy of this spreadsheet can be provided upon request.

2.8 CENTURY EMISSION SOURCES

At the Century Plant, primary aluminum is produced through the electrolytic reduction of raw alumina (Al₂O₃) in vessels termed reduction cells or "pots". Century operates three nearly identical potlines. Each pot is constructed as a complete electrolytic circuit with anode, cathode, and electrolyte. When electric current is applied through metal rods to the carbon anodes, alumina is reduced producing molten aluminum metal and carbon dioxide (CO₂). Pots are periodically tapped and molten aluminum is either transferred in crucibles to customers or is first cast into aluminum sows, billets, ingots or other hard forms and then shipped off-site. Raw material inputs to the pots include alumina, bath, carbon anodes, and various other additives to the aluminum production process such as aluminum fluoride.

The vast majority of SO₂ emissions are emitted from the three potlines and one anode bake furnace. Each potline is composed of two potrooms that each contain 64 reductions cells for a total of 128 cells per potline. The emissions from the reduction cells in each potline are captured through hooding systems and are sent to

²⁹ Missing Data Estimation Procedures, Appendix C, 40 CFR Part 75, Subpart H, June 12, 2002.

two Alcoa A-398 alumina fluidized bed dry scrubbers, each of which has five reactors. Any fugitive emissions not caught by the hooding system are vented through the roof of each potline.

To provide baked carbon anodes to the reduction cells, Century operates an anode paste mixing and forming operation and an anode bake furnace, in which the “green anodes” are baked. The green anodes are formed from petroleum coke, recycled spent anode material, and pitch, which serves as a binder. The formed anodes are compressed and placed within the bake furnace, where they are baked to remove volatiles, leaving a solid carbon block. The emissions from the anode bake furnace are sent to an Alcoa A-446 alumina fluidized bed scrubber.

The Century facility has a number of miscellaneous sources of SO₂ emissions, including four Homogenizing Furnaces, two groups of Holding Furnaces, a Remelt Furnace, an Electrode Boiler, an Indirect Heat Exchanger, and six Emergency Generators. However, all the furnaces and boilers are natural gas fired and these emission sources make up less than one tenth of one percent (0.1%) of the total SO₂ emissions at the Sebree Plant.

The SO₂ emission units at the facility (and their corresponding Subject Item Designations) included in the modeling analysis are the following:

- Potlines 1-3 (Source ID - E1, E3, and E5)
- Remelt Furnace (Source ID - A6-90)
- Holding Furnaces (Source ID - F1 & F2)
- Homogenizing Furnaces (Source ID --H4)
- Anode Bake Furnace (Source ID - N2)
- Electrode Boiler (Source ID - S5)
- Indirect Heat Exchanger (Source ID - S6)

The remaining sources of SO₂ emissions are emergency use engines (intermittent sources) and thus, do not normally contribute to the annual distribution of daily maximum 1-hour SO₂ concentrations. These sources were therefore excluded from the modeling analysis:

- Natural Gas Emergency Generator (Z2)
- Cummins Propane Generator (Z3)
- Detroit Diesel Fire Pump Engine (Z4)
- Building Natural Gas Emergency Generator (Z5)
- Rock House Natural Gas Emergency Generator (Z6)
- Lift Station Propane-Fired Emergency Generator (Z7)

For all stack sources listed in the first set of sources above, the preferred modeling approach for establishing modeled emission rates recommended in the Modeling TAD is the use of CEMS data on an hour-by-hour basis. However, Century does not currently operate CEMS at the Sebree facility, hence another approach for acquiring temporally variable actual emissions was necessary. Century has utilized monthly production logs in tandem with mass balance-derived emission factors for the potlines and anode bake furnace to discern representative monthly emission rates. This is an acceptable approach under the Modeling TAD as detailed in “Section 5.2.3 Calculating Temporally Varying Emissions”. These variable and production-based emissions avoid the pitfall of only having annual emissions spread evenly throughout an entire year, which would not accurately characterize emission distributions over that time span.

SO₂ emissions from the natural gas fired furnaces and boilers were modeled at potential SO₂ emission rates because their emissions represent only a very small fraction of the overall facility SO₂ emissions. Little is gained

by the complexity of utilizing temporally variable emissions for these sources in terms of better ambient air quality characterization.

Fugitive emissions from the potline roof vents, which are estimated to be 1% of the total SO₂ emissions from the potlines, are represented in the model as buoyant line sources. Tables 2-6 and 2-7 present the source characteristics for the Century stack and line sources used in the modeling analysis.

Commensurate with the Monitoring TAD's source-oriented monitor approach, other sources of SO₂ emissions in the area surrounding the Sebree Station and Century were not included in the modeling analysis as they are too distant and/or have too small an SO₂ emission rate to influence the monitor siting analysis for Sebree Station and Century.

Table 2-6. Century Plant Point Source Characterization

| Modeling ID | Description | UTM Easting ¹ (m) | UTM Northing ¹ (m) | Elevation ² (ft) | Stack Height (ft) | Stack Temp (F) | Stack Velocity (ft/s) | Stack Diameter (ft) |
|-------------|---------------------------------------------|---------------------------------|----------------------------------|--------------------------------|----------------------|-------------------|--------------------------|------------------------|
| A6 02 | Remelt Furnace (90); Gas Burners | 455,802.4 | 4,168,312.8 | 446.0 | 43.00 | 601.00 | 39.00 | 6.20 |
| F1 01 | Holding Furnaces (11); Metal Processing | 456,128.7 | 4,167,785.8 | 446.0 | 90.00 | 317.00 | 25.70 | 3.17 |
| F1 02 | Holding Furnaces (12); Metal Processing | 456,139.3 | 4,167,798.0 | 446.0 | 90.00 | 317.00 | 25.70 | 3.17 |
| F1 03 | Holding Furnaces (13); Metal Processing | 456,161.3 | 4,167,821.1 | 446.0 | 90.00 | 317.00 | 25.70 | 3.17 |
| F1 04 | Holding Furnaces (14); Metal Processing | 456,173.5 | 4,167,834.6 | 446.0 | 90.00 | 317.00 | 25.70 | 3.17 |
| F1 05 | Holding Furnaces (15); Metal Processing | 456,189.8 | 4,167,853.6 | 446.0 | 90.00 | 317.00 | 25.70 | 3.17 |
| F1 06 | Holding Furnaces (16); Metal Processing | 456,200.8 | 4,167,865.9 | 446.0 | 90.00 | 317.00 | 25.70 | 3.17 |
| F2 01 | Holding Furnaces (17); Metal Processing | 456,217.4 | 4,167,883.3 | 446.0 | 90.00 | 317.00 | 25.70 | 3.17 |
| F2 02 | Holding Furnaces (18); Metal Processing | 456,227.6 | 4,167,894.9 | 446.0 | 90.00 | 317.00 | 25.70 | 3.17 |
| H1 01 | Homogenizing Furnace (11) | 456,219.8 | 4,167,811.4 | 446.0 | 62.00 | 900.00 | 41.11 | 4.00 |
| H2 01 | Homogenizing Furnace (21) | 456,229.2 | 4,167,822.1 | 446.0 | 62.00 | 900.00 | 41.11 | 4.00 |
| H3 01 | Homogenizing Furnace (31) | 456,238.3 | 4,167,832.8 | 446.0 | 62.00 | 900.00 | 41.11 | 4.00 |
| H4 01 | Homogenizing Furnace (131) | 456,287.5 | 4,167,896.2 | 446.0 | 70.00 | 970.00 | 57.50 | 1.50 |
| N2 02 | Anode Bake Furnace (261 Furnace) | 456,070.9 | 4,168,064.0 | 446.0 | 70.00 | 177.86 | 31.11 | 4.21 |
| S5 01 | Electrode Boiler (S5) (E1) | 455,952.2 | 4,168,046.4 | 446.0 | 98.00 | 320.00 | 7.00 | 3.00 |
| S6 01 | Indirect Heat Exchanger (S6) (E1) | 455,953.7 | 4,168,044.3 | 446.0 | 98.00 | 320.00 | 7.00 | 3.00 |
| E1 02N | Potline #1 (E1); Potline #1 A-398 Scrubbers | 455,864.8 | 4,167,888.6 | 440.3 | 80.62 | 208.00 | 34.32 | 3.98 |
| E1 02S | Potline #1 (E1); Potline #1 A-398 Scrubbers | 455,807.6 | 4,167,824.3 | 440.3 | 80.62 | 211.00 | 34.52 | 3.98 |
| E3 02N | Potline #2 (E3); Potline #2 A-398 Scrubbers | 455,796.7 | 4,167,949.7 | 440.3 | 80.62 | 217.00 | 36.02 | 3.98 |
| E3 02S | Potline #2 (E3); Potline #2 A-398 Scrubbers | 455,740.1 | 4,167,885.5 | 440.3 | 80.62 | 218.00 | 38.12 | 3.98 |
| E5 02N | Potline #3 (E5); Potline #3 A-398 Scrubbers | 455,694.3 | 4,168,040.9 | 440.3 | 104.92 | 229.00 | 41.68 | 11.28 |
| E5 02S | Potline #3 (E5); Potline #3 A-398 Scrubbers | 455,636.0 | 4,167,975.9 | 440.3 | 104.92 | 225.00 | 41.75 | 11.28 |

¹ Coordinates taken from a to-scale site plan projected in the UTM NAD83 Zone 16 coordinate system.

² Elevation of the plant grade (446ft).

Table 2-7. Century Plant Buoyant Line Source Characterization

| Model ID | Description | UTM Easting ¹ (m) | UTM Northing ¹ (m) | Elevation ² (ft) | End X Coordinate (m) | End Y Coordinate (m) | Release Height (ft) | Vent Temp (F) | Vent Velocity (ft/s) |
|----------|-----------------------------|---------------------------------|----------------------------------|--------------------------------|----------------------------|----------------------------|---------------------------|------------------|----------------------------|
| E1_01A | E1-1- Potroom 101 Roof Vent | 455,735.6 | 4,167,704.8 | 446.0 | 455,977.1 | 4,167,978.0 | 48.56 | 116.8 | 1.71 |
| E1_01B | E1-1- Potroom 102 Roof Vent | 455,698.4 | 4,167,737.8 | 446.0 | 455,939.3 | 4,168,011.0 | 48.56 | 116.8 | 1.71 |
| E3_01A | E3-1- Potroom 103 Roof Vent | 455,668.0 | 4,167,765.0 | 446.0 | 455,909.4 | 4,168,038.0 | 48.56 | 116.8 | 1.71 |
| E3_01B | E3-1- Potroom 104 Roof Vent | 455,631.3 | 4,167,797.5 | 446.0 | 455,871.8 | 4,168,071.0 | 48.56 | 116.8 | 1.71 |
| E5_01A | E5-1- Potroom 105 Roof Vent | 455,566.6 | 4,167,854.3 | 446.0 | 455,808.1 | 4,168,127.0 | 48.56 | 116.8 | 1.71 |
| E5_01B | E5-1- Potroom 106 Roof Vent | 455,529.5 | 4,167,887.3 | 446.0 | 455,770.1 | 4,168,161.0 | 48.56 | 116.8 | 1.71 |

¹ Coordinates taken from a to-scale site plan projected in the UTM NAD83 Zone 16 coordinate system.

² Elevation of the plant grade (446ft).

2.9 BUILDING INFLUENCES

The U.S. EPA's Building Profile Input Program (BPIP) with Plume Rise Model Enhancements (PRIME) (Version 04274), was used to account for building downwash influences. The purpose of a building downwash analysis is to determine if the plume discharged from a stack will be influenced by the turbulent wake of any onsite buildings or other structures, resulting in downwash of the plume. The downwash of the plume can result in elevated ground-level concentrations in the near wake of a building and is required for consideration in the modeling. Buildings and structures (including tanks and large baghouse and electrostatic precipitator structures) were included as appropriate for each facility. Figure 2-7 shows a 3-D view of the buildings/structures (dark blue) and sources (light blue) considered for the Sebree Station looking from south to north. Figure 2-8, likewise shows a 3-D view of the buildings/structures (dark blue) and sources (light blue) considered for the Century operations looking from south to north.

Figure 2-7. Three Dimensional View of Buildings and Structures Modeled for the BREC Sebree Station

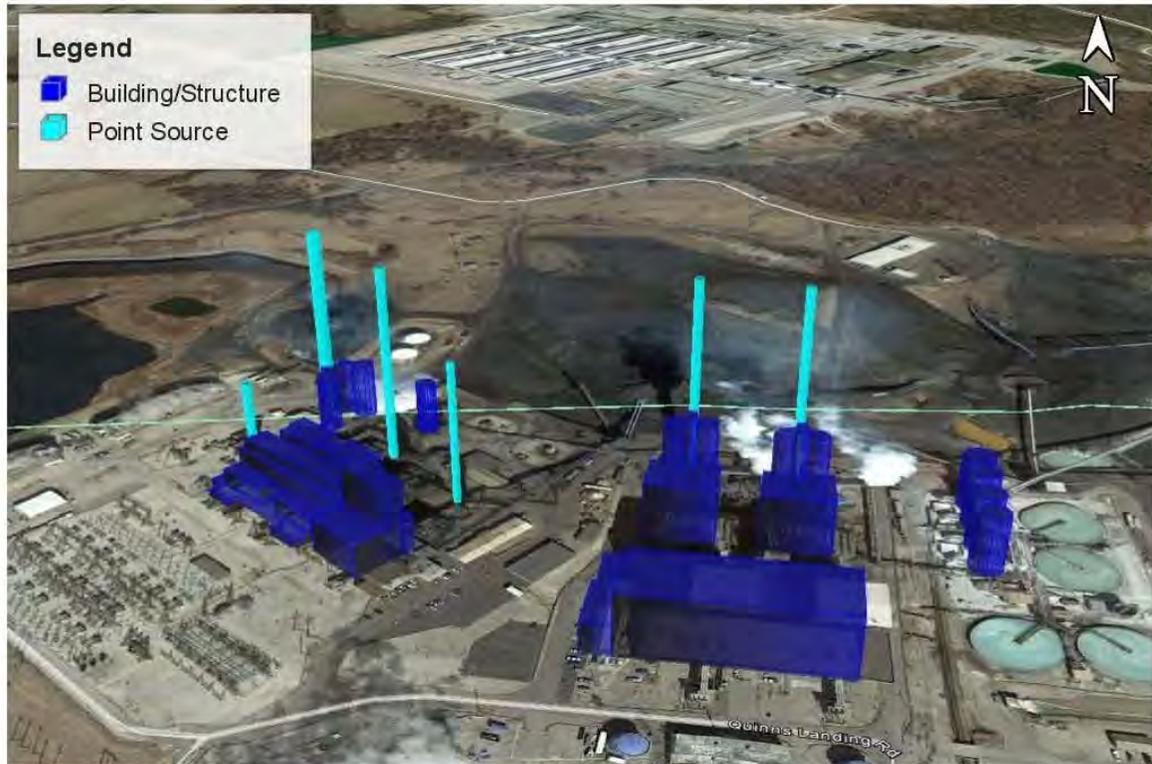


Figure 2-8. Three Dimensional View of Buildings and Structures Modeled for Century



2.10 AERMOD MODELING FILES

All modeling files will be provided to KDAQ via secure electronic file transfer in conjunction with submittal of this report. Model and processor input, output, and data files will be provided. Spreadsheets tabulating source, emission, and other input data sets will also be provided.

3. MONITORING SITE EVALUATION

3.1 METHODOLOGY FOR EVALUATING CANDIDATE MONITOR SITES

A siting evaluation for the installation of an ambient air quality SO₂ monitor was conducted following the Monitoring TAD. After consideration of the locations that can be excluded, either because they are not ambient air or because the siting of a monitor is impractical (i.e., they are located over water bodies), modeling results for the remaining locations were examined. The dispersion modeling conducted using the methodology outlined in Section 2 provided two items for determining the most representative monitor placement near the BREC and Century facilities, namely (1) the locations of the estimated highest ambient concentrations from the modeling, and (2) the frequency of occurrence that the highest concentration occurs at each receptor location included in the modeling over the three year meteorological data set. Ranking the highest concentration receptors and the highest frequency of occurrence receptors, followed by the combined ranking of these receptors provided the recommended Monitoring TAD metrics. These metrics were then used to identify areas where the deployment of an ambient monitor would provide a representative site to evaluate the air quality for the surrounding area.

3.2 SITE EVALUATION BASED ON HIGHEST IMPACT MAPPING

The evaluation of potential monitoring sites followed the method outlined in Appendix A of the Monitoring TAD. Generally, this approach included first a review of the impacts at each non-excluded receptor (as described in Section 2.5 for the general class of prohibitive monitor locations not including exclusions for other reasons as described below), by evaluating spatial distributions of the normalized design value concentration ratios on x-y plots to focus on the areas of highest impact. Next, the frequency of occurrence of a maximum impact at the top 200 highest concentration receptors was graphed on x-y plots. Finally, a sequential review of the top 200 highest impacted receptors was conducted based on their ranking in terms of combined maximum concentration ratios and frequencies of highest concentration ratio occurrence. Clustering of these highest ranked receptors allowed prioritization of potential sites for monitoring. More specifically, the approach followed the sequential steps outlined below:

Step 1 – Set up the AERMOD Model following the approved protocol methodologies submitted previously to KDAQ³⁰ and the updated methodology presented in Section 2 of this report (for aspects dealing with a monitor siting evaluation). Actual emissions were used for each facility, which kept the weighting of source impacts in proper proportion to each other. To accomplish the Monitoring TAD recommended generation of the Normalized Design Values (NDVs), each concentration estimate made by the model was divided by the maximum concentration overall (in the form of the standard) such that each concentration was expressed as a fraction of the maximum concentration overall.

Step 2 – The AERMOD Model was run with all receptors across the whole modeling domain using AERMOD default options for the 2012-2014 meteorological data set and the receptors described in Figure 2-4.

Step 3 – The AERMOD modeling concentrations expressed in the form of the design form of the standard for each receptor were imported into a spreadsheet and normalized design values computed. These spreadsheet tabulations were interfaced into ArcGIS for further processing. As per the Monitoring TAD, page A-1, and the

³⁰ Modeling protocols for both the BREC Sebree Station and Century Aluminum Sebree were submitted to KDAQ on or about December 31, 2015. Both protocols were approved with minor modifications addressed in this siting evaluation report.

discussion presented in Section 2.5 concerning the receptor grid, this processing excluded receptors from further consideration that were located in areas prohibitive to establishing fixed monitoring sites including waterbodies (rivers, streams, lakes) and within the fenced or otherwise controlled and restricted access areas of Century and Sebree Station.

Step 4 – As per the Monitoring TAD, page A-5, a graphic was created showing the ratio of the NDV for each receptor to that of the overall maximum NDV, as presented in Figure 3-1. These NDV ratios represent the ratio of the 3-year average of each year's 4th daily highest 1-hour maximum concentration to the maximum value in the receptor grid in the same form of the NAAQS. A wind rose for EVV 2012-2014 meteorological data was included in Figure 3-1 for reference in reviewing potential high concentration locations.

Step 5 – As per the Monitoring TAD, the top 200 receptors according to the highest impacts differentiation are then identified for further review. Figure 3-2 plots these 200 top receptors with the value corresponding to the ratio of the NDV at each receptor to the receptor with the highest NDV shown at each receptor location.³¹

Step 6 – For the top 200 NDV receptors, the number of days over the 3 modeled years (2012-2014) for which each receptor had the overall highest 1-hour concentration for the day among all receptors in the evaluation was tallied. These frequency values are plotted in Figure 3-3 on an x-y graph showing the receptors with the most frequent high concentration days as darker colors.

Step 7 – The receptors were then scored on the basis of the NDV ratios first (Figure 3-2) and then separately based on the frequency of highest concentration impacts (Figure 3-3). These scores were then added together with the lowest possible score being 2, which would indicate one receptor had both the highest NDV ratio (the maximum receptor) and also the highest number of one hour maximum events. A table showing the scoring process for the top 20 overall ranked receptors is shown in Table 3-1. These combined score values are plotted in Figure 3-4.

Step 8 – The combined scores shown in Figure 3-4 were then ranked from 1 to 200. A plot of the overall receptor rankings (1 to 200) is shown in Figure 3-5 for the nearfield receptors in the top 200 (not all of the 200 receptors shown in this figure) and in Figure 3-6 showing all top 200 receptors (with some shown to the south of Sebree on slightly elevated terrain). Figure 3-7 identifies the rank number for some of the higher ranked receptor locations in this area for comparison with those on the nearfield plot in Figure 3-5.³²

Step 9– Given the plot of the ranking order of each of the top 200 receptors (in Figures 3-5 and 3-6), an evaluation is then conducted starting with the top ranked location (i.e., the receptor with a ranking number of 1). If this location is unsuitable because it is unavailable, inaccessible, does not meet other general monitor siting criteria, the next highest ranked location (i.e., the receptor with a ranking number of 2) is evaluated, and so on until a suitable and acceptable location is identified. Other general monitoring criteria considered in the evaluation include, for example, terrain characteristics, accessibility to vehicles and power, security, and proximity and line of sight to the SO₂ sources. This evaluation and assessment process is documented in the following report section.

³¹ Figures 3-1 and 3-2 both show the locations via x-y plots of the highest normalized design value concentrations of 1-hour SO₂ impacts in the form of the 99th percentile form of the NAAQS. The figures are identical except that in Figure 3-2, only the top 200 receptors are shown and the actual normalized NDVs are indicated at each receptor so that the relative values between different candidate sites can be evaluated.

³² Note that in some cases, two receptor locations share the same rank number in the sequence because they had equal combined NDV impact and frequency scores.

Figure 3-1. 1-Hour SO₂ Normalized Design Value Concentrations In Nearfield Modeling Domain

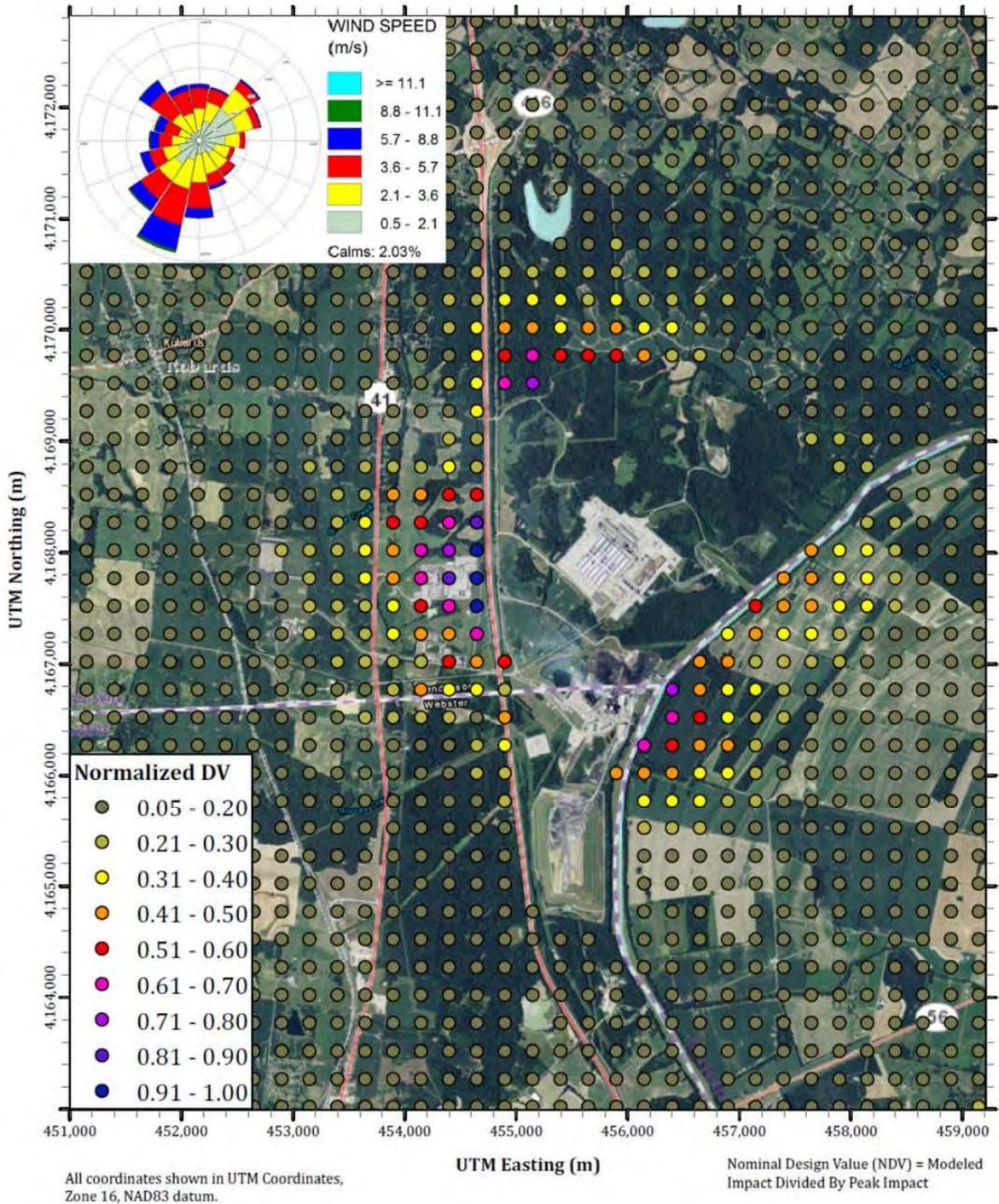


Figure 3-2. Top 200 Receptors in Nearfield Modeling Domain with Normalized Design Values Shown

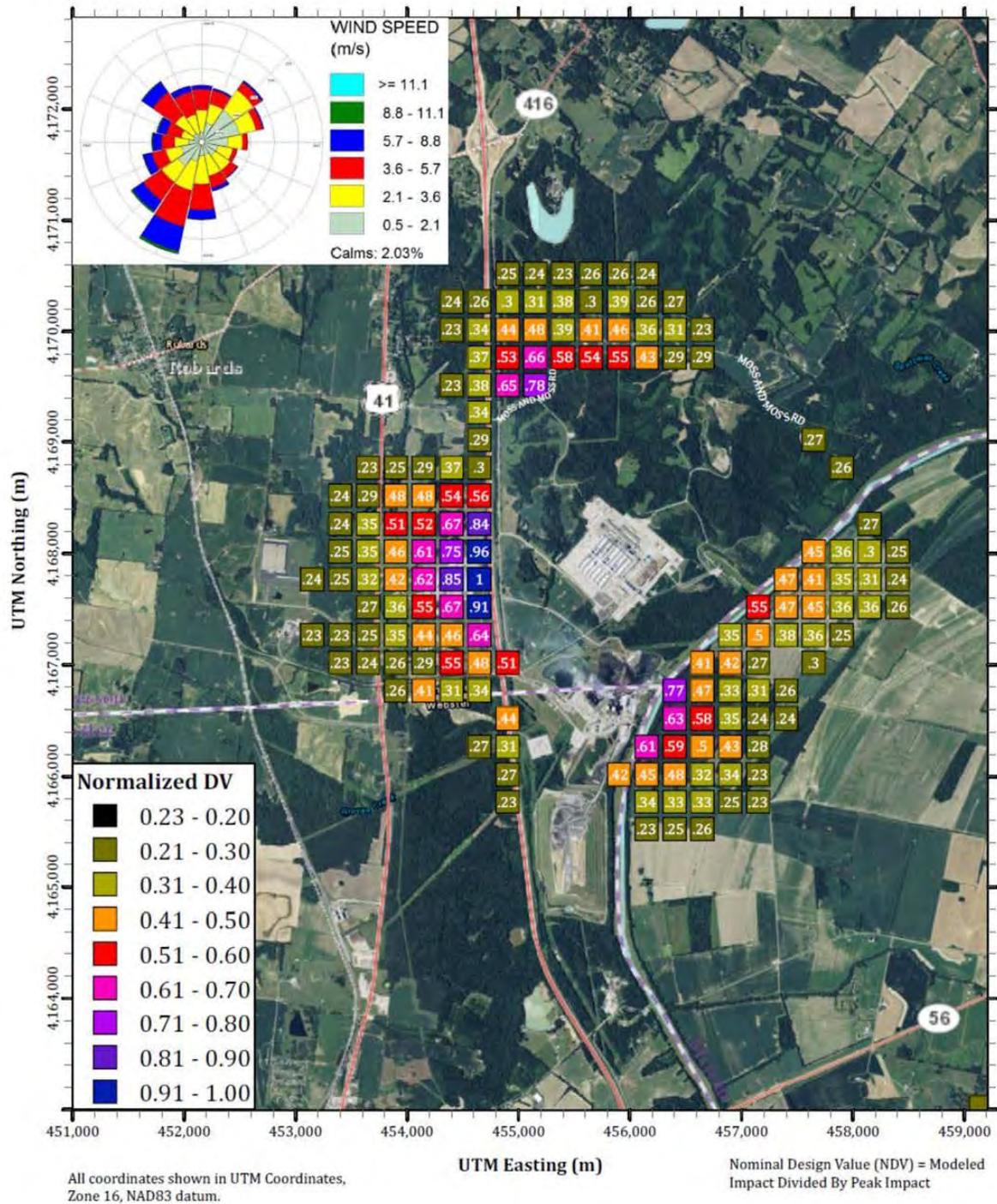


Figure 3-3. Cumulative Number of Days That an Individual Receptor (Among Top 200) had the 1-hour Daily Maximum Concentration Among All Receptors

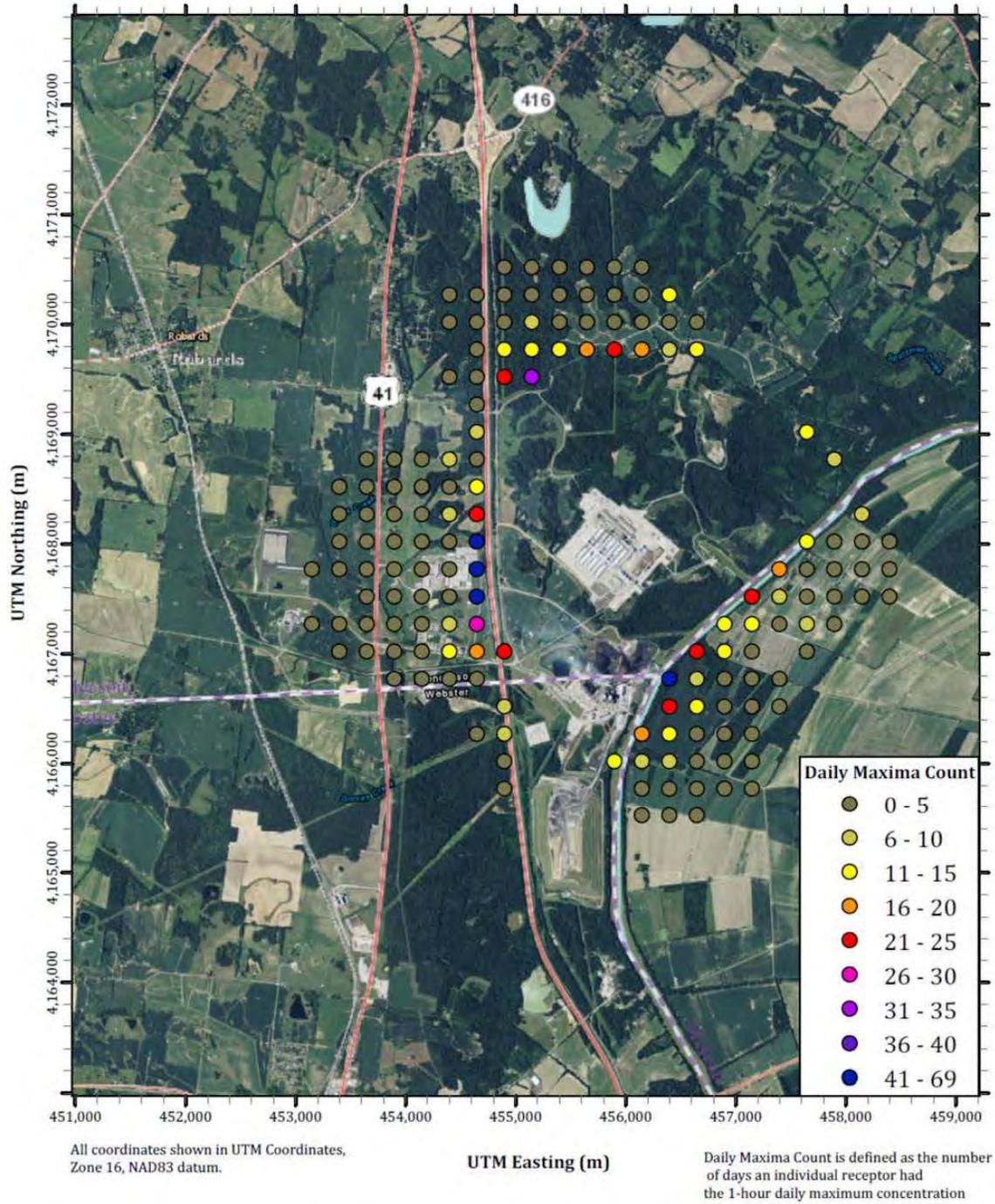


Table 3-1. Scoring and Ranking Calculation Illustration for Top 20 Ranked Receptors

| UTM Easting (m) | UTM Northing (m) | Normalized Design Value | NDV Rank | Number of Days With | | Receptor Score | Scoring Rank |
|-----------------|------------------|-------------------------|----------|-----------------------|----------------|----------------|--------------|
| | | | | Maximum Concentration | Frequency Rank | | |
| 454,649.1 | 4,167,770.7 | 1.00 | 1 | 69 | 1 | 2 | 1 |
| 454,649.1 | 4,168,020.7 | 0.96 | 2 | 43 | 4 | 6 | 2 |
| 454,649.1 | 4,167,520.7 | 0.91 | 3 | 44 | 3 | 6 | 2 |
| 456,399.1 | 4,166,770.7 | 0.77 | 7 | 45 | 2 | 9 | 4 |
| 455,149.1 | 4,169,520.7 | 0.78 | 6 | 34 | 5 | 11 | 5 |
| 454,649.1 | 4,168,270.7 | 0.84 | 5 | 24 | 7 | 12 | 6 |
| 454,649.1 | 4,167,270.7 | 0.64 | 13 | 27 | 6 | 19 | 7 |
| 454,899.1 | 4,169,520.7 | 0.65 | 12 | 23 | 9 | 21 | 8 |
| 456,399.1 | 4,166,520.7 | 0.63 | 14 | 23 | 9 | 23 | 9 |
| 455,149.1 | 4,169,770.7 | 0.66 | 11 | 14 | 25 | 36 | 10 |
| 457,149.1 | 4,167,520.7 | 0.55 | 23 | 21 | 13 | 36 | 10 |
| 456,149.1 | 4,166,270.7 | 0.61 | 17 | 16 | 20 | 37 | 12 |
| 449,399.1 | 4,160,770.7 | 0.52 | 30 | 24 | 7 | 37 | 12 |
| 455,899.1 | 4,169,770.7 | 0.55 | 26 | 22 | 12 | 38 | 14 |
| 455,399.1 | 4,169,770.7 | 0.58 | 19 | 15 | 23 | 42 | 15 |
| 455,649.1 | 4,169,770.7 | 0.54 | 27 | 19 | 15 | 42 | 15 |
| 454,899.1 | 4,167,020.7 | 0.51 | 33 | 21 | 13 | 46 | 17 |
| 455,399.1 | 4,162,020.7 | 0.56 | 22 | 14 | 25 | 47 | 18 |
| 454,399.1 | 4,168,270.7 | 0.67 | 9 | 9 | 42 | 51 | 19 |
| 456,399.1 | 4,166,270.7 | 0.59 | 18 | 11 | 36 | 54 | 20 |

Figure 3-4. Top 200 Receptors Total Score Reflecting NDV and Daily Maxima Frequency

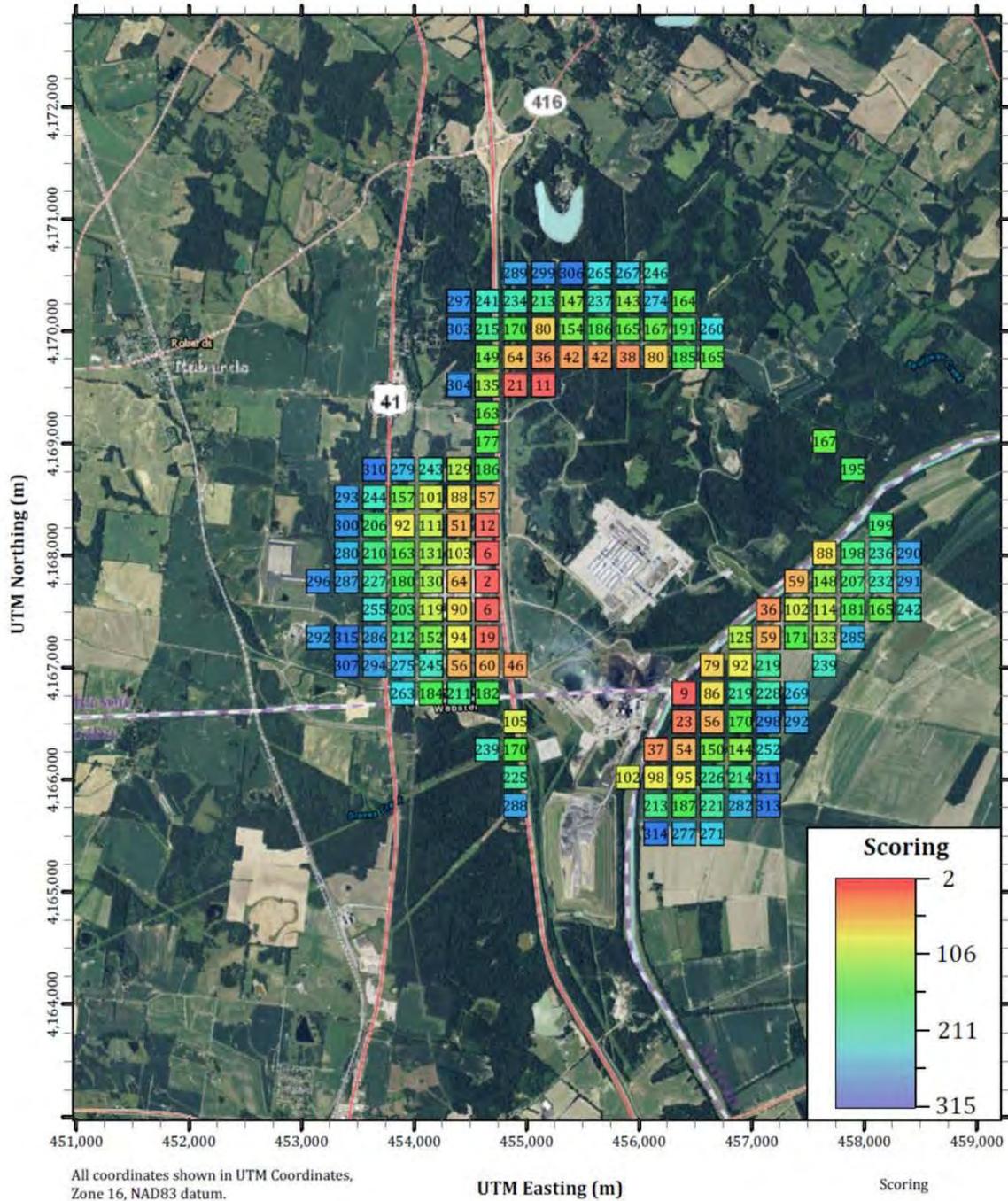


Figure 3-5. Top 200 Receptors Ranked (from 1 to 200) by Relative Score Reflecting NDV and Daily Maxima Frequency (Area Near Facilities)

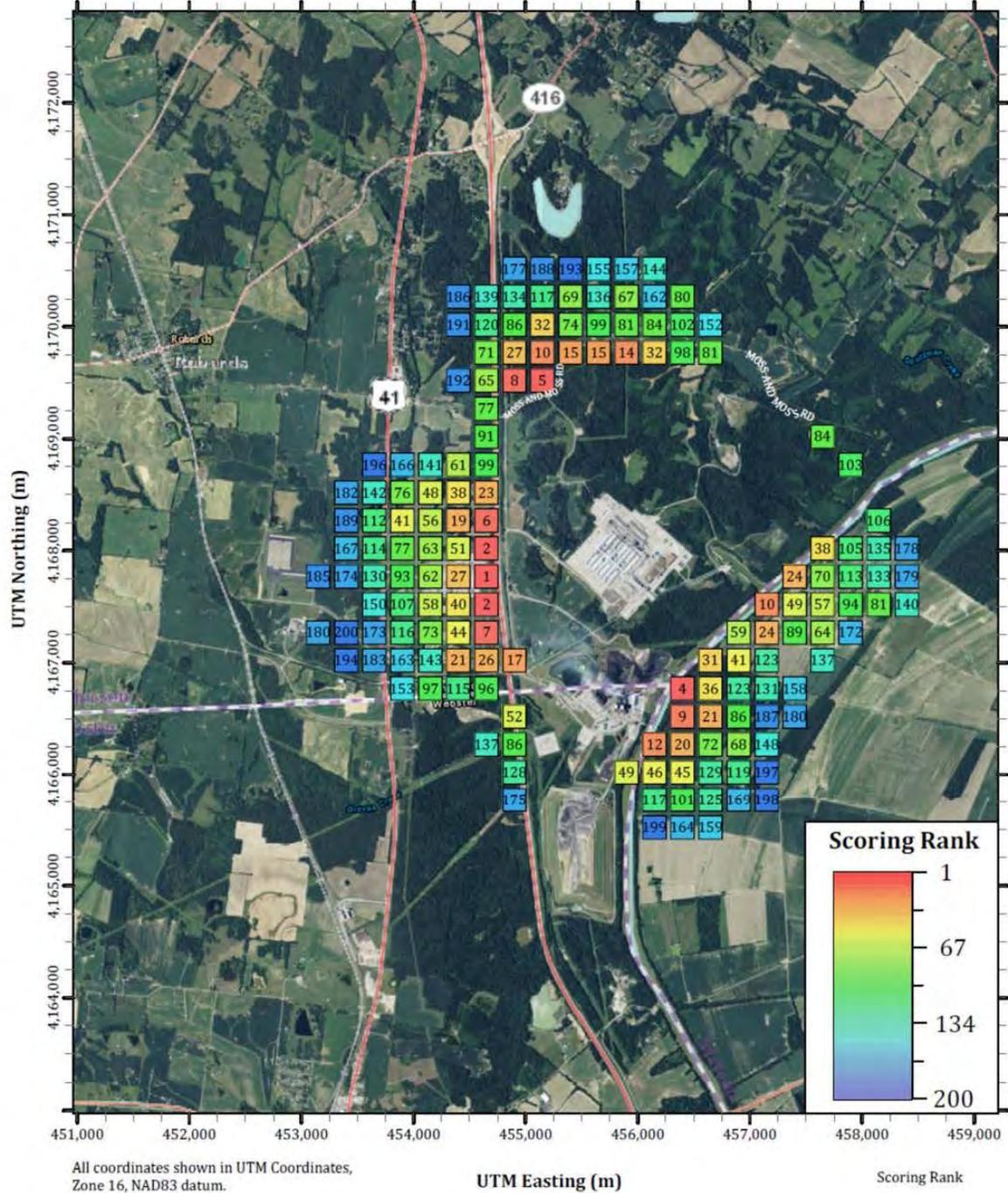
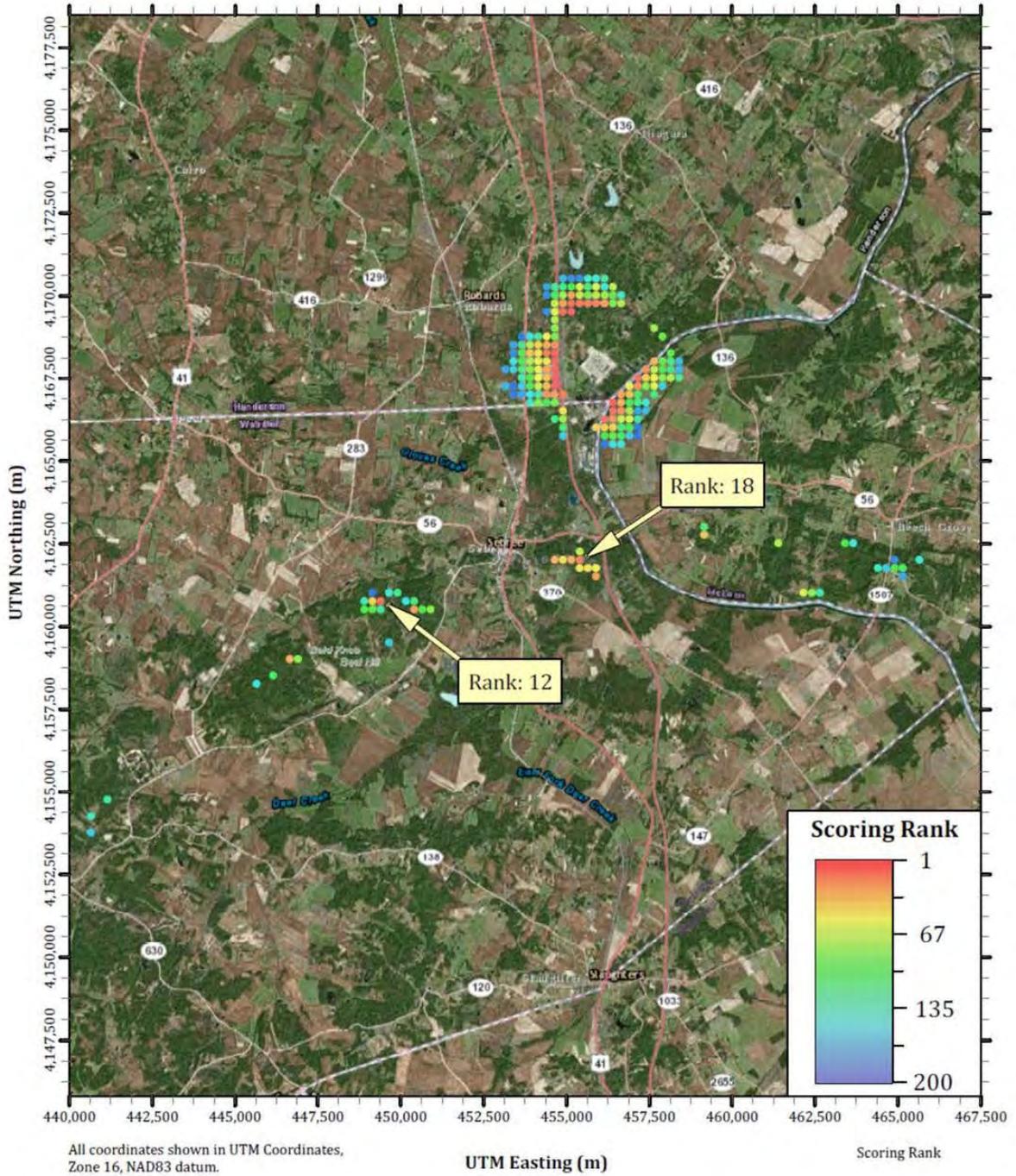


Figure 3-6. Top 200 Receptors Ranked (from 1 to 200) by Relative Score Reflecting NDV and Daily Maxima Frequency (Extended Area Covering All 200 Receptors)



3.3 ASSESSMENT OF CANDIDATE MONITOR SITE LOCATIONS

As shown in Figures 3-1 and 3-2, the location where the highest predicted 1-hour SO₂ design value concentration ratios occur is the area directly west of the main Century plant site operations. The top three normalized design values as shown in Figure 3-2 (1, 0.96, and 0.91) all occur at the receptors in this area. As revealed in Table 3-1, two of these receptors also had the highest frequency of the daily maximum SO₂ concentrations and the third receptor had the fourth highest frequency. Thus, as shown in Figure 3-5, these three receptor locations are the top ranked candidate sites (i.e., with a ranking number of 1 being the top ranked location and a ranking number of 200 being the bottom rank).

These three top ranked receptor locations all fall within a property parcel owned by Tyson Foods, Inc. (Tyson)³³ Figure 3-7 shows a close-in view of this area with the Tyson owned property parcel shown in yellow.

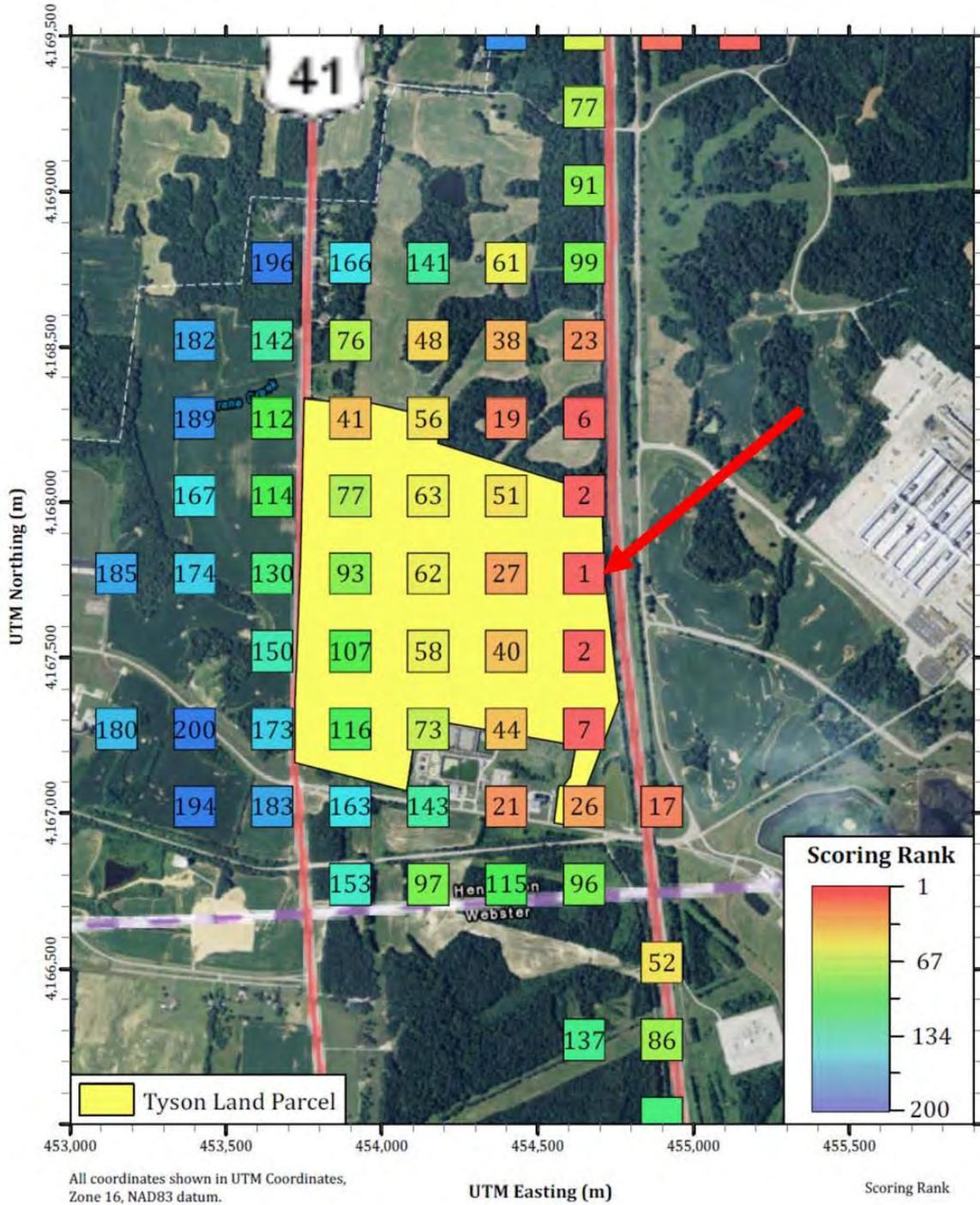
On March 17, 2016, a representative of BREC contacted Tyson to seek permission to install and operate an ambient monitoring station on Tyson's property. Upon consideration, Tyson provided a written response to BREC indicating that Tyson would not allow the siting of a monitor on their property.³⁴ Therefore, all the candidate locations shown in Figure 3-7 that are located within Tyson's property boundary were eliminated from further consideration.³⁵

³³ KDAQ Agency Interest Number 45238; Source ID 21-101-00120. Tyson Foods operates a chicken processing and rendering plant at this location.

³⁴ Email from Mr. Todd Wright (Tyson Foods) to Mr. Tom Shaw (BREC) on March 18, 2016, "RE: Location of an ambient monitor on Tyson property".

³⁵ Although the 2nd highest ranked receptor falls within the Tyson property, the north east edge of the 250-m square area encompassed by this receptor does extend onto the adjacent parcel, which is owned by Century. However, that portion is heavy wooded and is not accessible by vehicle. The next adjacent location (6th ranked receptor) is more ideally suited in consideration of other monitor siting criteria, as is subsequently discussed.

Figure 3-7. Top Ranked Candidate Monitor Locations in the Area West of Century



Two other locations near the facilities also had relatively higher NDV ratio and frequency results. These are the area to the southeast of Century just across the Green River, and the wooded area within Century's property boundary just north of Moss and Moss Rd and east of Alcan Aluminum Rd (State Route 2096). Each of these sites is discussed in turn.

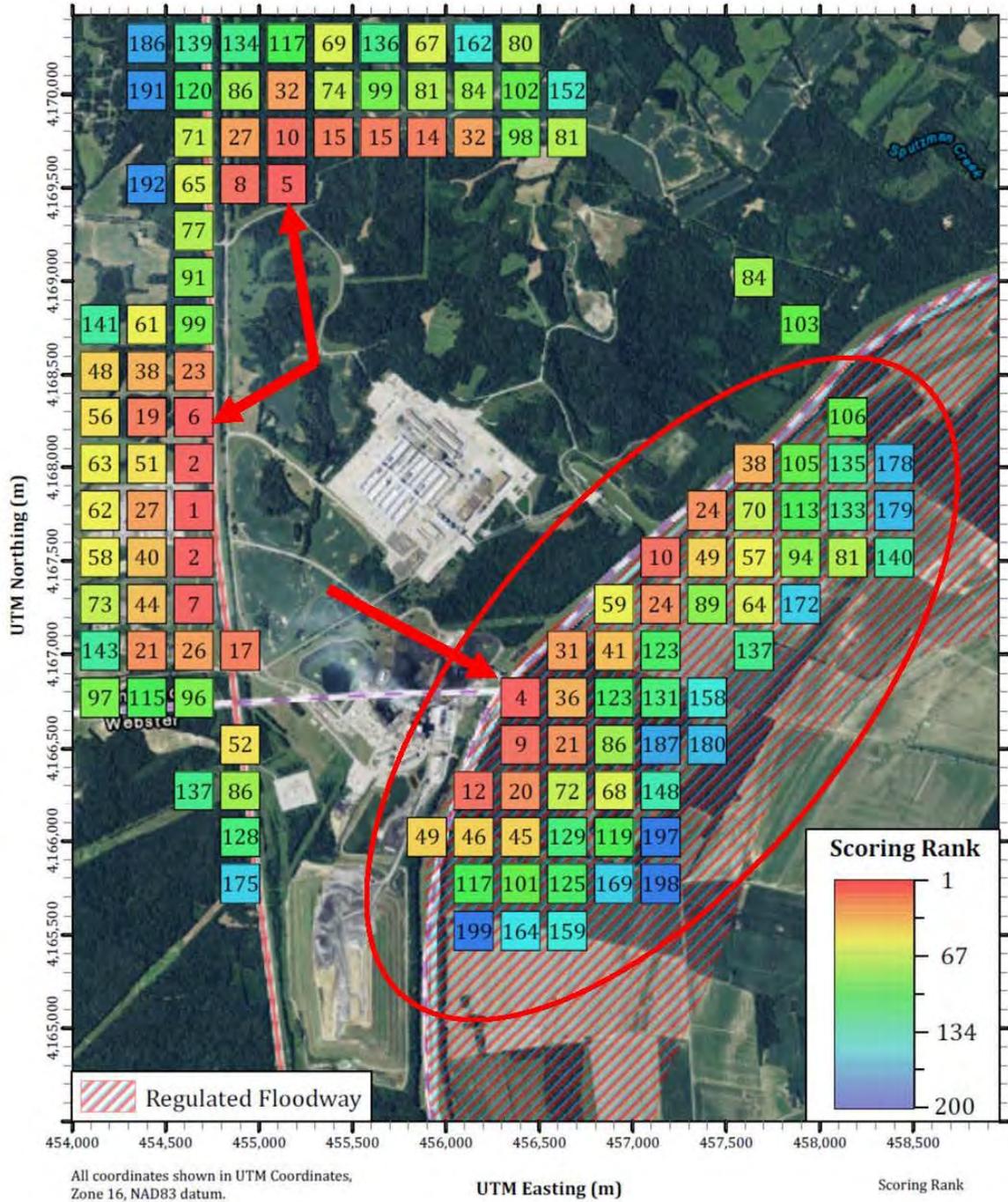
The area of land to the southeast of the Green River showing multiple receptors ranking in the top 200 on Figure 3-5, is flat farmland. The highest normalized NDV in this area is 0.77 and this location was the location of the highest daily maximum concentration 45 times over the three years modeled. As shown in Table 3-1 and Figure 3-5, this receptor location is ranked 4th overall.

Despite the relatively high NDV and frequency count at this location, the 4th ranked receptor location and all the other lower ranked receptors in this area are not suitable for siting the new monitoring station. The entire area extending about 1 km southeast of the Green River is located within the 100-year floodplain. More importantly, this area is within a defined floodway. Figure 3-8 shows the boundaries of the regulated floodway around the Green River based on the floodway dataset obtained from the Federal Emergency Management Agency.³⁶

Section 4 of 401 KAR 4:060 (Stream Construction Criteria) governs what can be built within a regulatory floodway. Pursuant to this rule, except as provided in Subsection 2 of the rule, all encroachments, including fill, new construction, substantial improvements, and other development is prohibited unless certification with supporting technical data by a licensed engineer is provided, that demonstrates that the encroachments shall have "no impact" or not result in any increase in flood levels during occurrence of the base flood discharge. As covered in Subsection 2, permitted activities in the floodway are generally limited to, for example, farming, silviculture, recreation, parking, and storage yards. Because a permanent shelter building for a monitoring station would obstruct flood flows, siting of a monitor in this area likely would be prohibited. Regardless there are obvious practical reasons while it would not be ideal to install expensive monitoring equipment in a floodway. This area is also poorly accessible to vehicles and there is no configuration for power for a shelter. Because of the prohibitions applicable to floodways and the other practical reasons cited, the candidate receptor locations in this area were eliminated from further consideration.

³⁶ <https://msc.fema.gov/portal/advanceSearch>

Figure 3-8. Candidate Locations in the Farmland Area on Southeast Edge of Green River, North of Moss and Moss Rd, and West of Century



The other hot spot at Moss and Moss Rd shows normalized design values of between 0.53 and 0.78 at 7 receptors in Figure 3-2 along Moss and Moss Rd inside Century's property boundary. These receptors also showed relatively high frequency of daily 1-hour maximum concentrations as shown in Table 3-1. As shown in Figure 3-8, this area includes the 5th and 8th highest ranked receptor locations. The 5th ranked location is located within a wooded area on Century's property. There are also several patches of wooded areas between this location and the Century SO₂ emission points with no direct line of site. This location is also much farther from the Sebree Station than the hot spot area directly west of Century. A high voltage power line runs over this area. The right-of-way and high voltage in this area would also create challenges for siting a monitor at this location. Thus, this site was not considered to be a good candidate site.

The 6th ranked receptor location is located just west of I-69 (Pennyrile Parkway) within a land parcel between Tyson to the south and Moss and Moss Rd to the north. Century owns this entire area with the exception of two small sub-parcels, one where a small cemetery is located and the other encompassing the northeast corner of the parcel. The 250-m by 250-m area centered on the 6th ranked receptor is a mix of cleared farmed land and wooded areas. Just off the northwest corner of this area is the location of an old monitoring site. Although the records are not complete, the belief is that this site was historically used for collecting ambient fluoride measurements.

If a new monitoring site was constructed within the 6th ranked receptor location area, a new pad and monitoring shelter would have to be constructed with new electrical service. However, it is anticipated that power to this area could be configured because it is very close (within about 200 feet) to where the historical fluoride monitoring site was located. This area is reasonably accessible via an access road running south from Moss and Moss Rd down to the cemetery.

Although one ranking lower than the 5th ranked receptor located north of Moss and Moss Rd, the 6th ranked receptor has a higher NDV (0.84 versus 0.78). As shown in Table 3-1, the frequency of highest daily maximum values for the 6th ranked receptor, 24 days, is only slightly less than that for the 5th ranked receptor, 34 days. The 6th ranked receptor location is closer in proximity to the SO₂ emission points at Century and Sebree Station than the 5th ranked receptor. If not for a thin line of trees running along Pennyrile Parkway, a direct line of site to Century would exist. A direct line of site to the stacks at Sebree Station does exist given their height. Thus, this site was considered a candidate monitoring site.

Lower ranked receptors were also considered. The next lower ranked receptor location (7th), is located within the land parcel owned by the Henderson Municipal Water Utility, and is located only 1,000 meters south of the 6th ranked location. While offering no other advantages from a monitor siting perspective, siting a monitor in this area would require securing access rights from the property owner. Because this site has a much lower NDV than the 6th ranked receptor location, little consideration was given to this location for the monitor over the higher ranked 6th-rank site.

For similar reasons, the locations of the 8th, 9th, 10th, and 11th ranked locations shown on Figure 3-5 also do not warrant further consideration. The 8th and 10th ranked receptor location suffers from the same limitations as those cited earlier for the adjacent 5th ranked receptor. The 9th and 11th ranked receptors are located in the floodway of the Green River.

The 12th ranked receptor, shown on Figure 3-6, is located about 10 km southwest of the Century and BREC facilities on an elevated ridge running in the east-west direction and south of the town of Sebree. Due to the higher elevations along this ridge, several small clusters of receptors that have NDVs and score rankings in the top 200 are situated on this ridge. Due to the much greater distance from the SO₂ sources at Century and Sebree

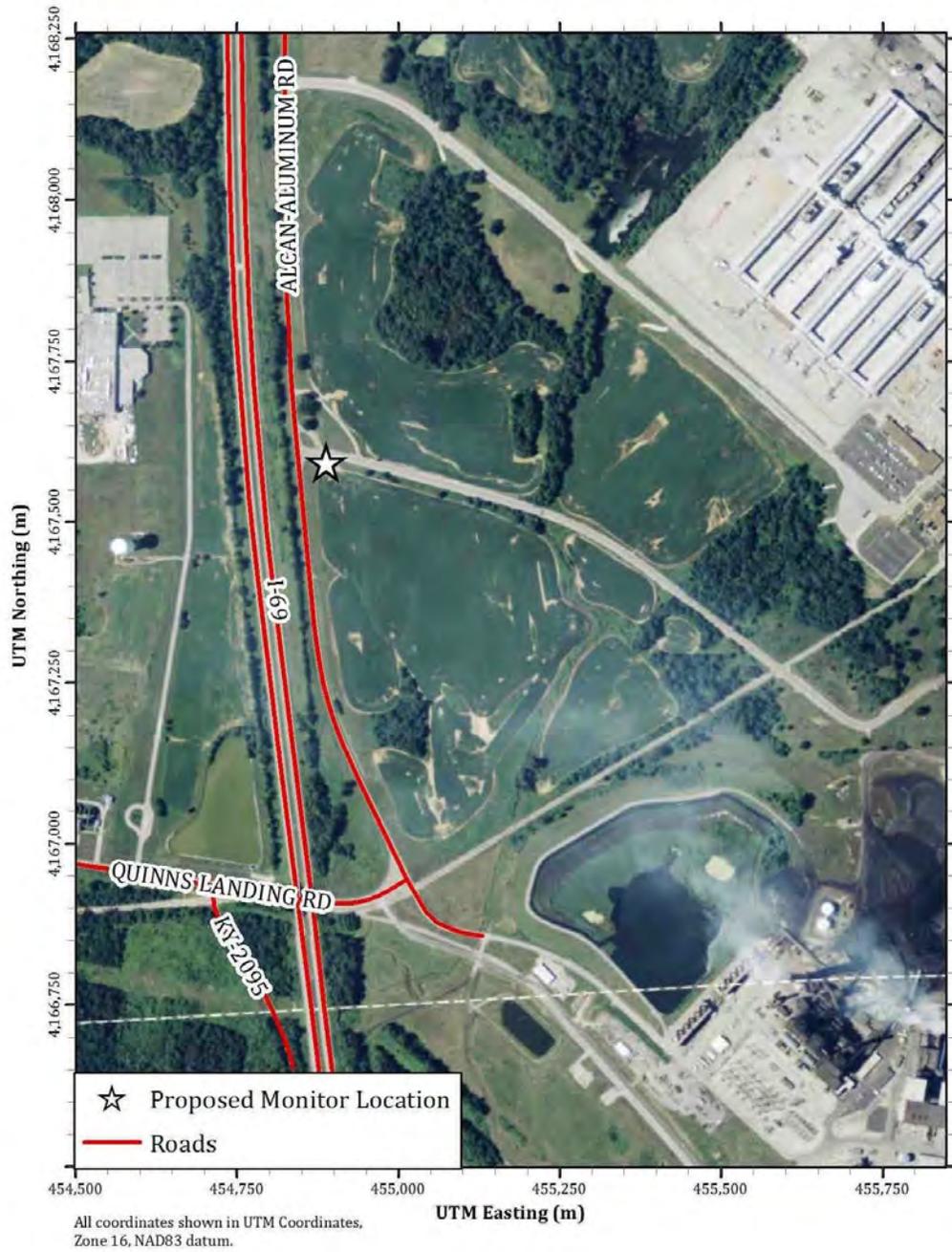
Station, and the much lower frequency values for these locations, they are less suitable locations for siting a new monitor relative to the 6th ranked receptor location.

A continuing analysis of receptors with lower rankings was unwarranted as they were all located in one of the four hot spot areas already addressed and they all have a lower ranking than the 6th ranked receptor location. Further, because of the close proximity of the three principal hot spot areas around the facilities (one of which is unsuitable by definition for siting a monitor because it is in a floodway), and the fact that they all have similar NDVs, no justification is evident for incurring the additional economic costs of developing and operating additional monitoring site locations.

Given all characteristics cited earlier, the area encompassed by the 6th ranked receptor would be a strong candidate location for the new ambient monitoring station. However, additional considerations were made by U.S. EPA Region 4 and KDAQ personnel. These considerations pertain to monitor siting criteria, including line of sight, accessibility, safety, potential obstructions, and access to power. The discussions between all parties concluded with a recommendation from U.S. EPA Region 4 and KDAQ that a more preferred monitor siting location exists closer to each of the facilities, which would resolve many of the aforementioned issues with the 6th ranked receptor area. The target location for the new monitoring station is shown in Figure 3-9. The specific spot targeted is at UTM coordinates 454,888.00 m East 4,167,592.0m North (Zone 16, NAD93 datum), which corresponds to latitude-longitude coordinates, 37.654381, -87.511427. This site is situated near the western edge of Century's property boundary and at the intersection of Alcan Aluminum Road (State Route 2096) and Big Rivers coal truck entrance road as shown in Figure 3-9. The site is located just 239 meters east of the first and second top ranked receptors and closer to both the Century and Big Rivers emission sources. Thus, this is the proposed site for installation of the proposed SO₂ ambient monitoring station.

Details on the proposed SO₂ monitoring shelter, equipment, and operating procedures is covered in the next report section.

Figure 3-9. Site of Proposed Monitor Location



4. SO₂ MONITORING STATION INSTALLATION AND OPERATIONS

This section of the site evaluation report provides some initial planning activities required as part of an installation of an ambient air quality monitor. This information is provided at a high level with limited specificity in this overview, but should provide KDAQ and other reviewing agencies with sufficient information to allow an initial assessment of the refined nature of the planned Quality Assurance Project Plan (QAPP), instrument selection, site preparation, quality assurance procedures, reporting, calibration, and overall mobilization to be followed. More specificity will be prepared upon review and concurrence with the reviewing parties within KDAQ. Both the SO₂ monitoring and meteorological monitoring are discussed.

4.1 QUALITY ASSURANCE PROJECT PLAN

Century and BREC anticipate engaging a third party contractor to handle the installation, maintenance, and operation of the proposed SO₂ monitoring station. However, KDAQ will be the Primary Quality Assurance Organization (PQAO); as such, the contractor will perform all work in accordance with procedures established by the KDAQ for its SLAMS monitoring network. Upon receiving sign-off from KDAQ and EPA Region 4 regarding the location for the proposed SO₂ ambient monitoring station, the selected contractor (hereafter referred to simply as the “monitoring firm”) will work with KDAQ to develop a Quality Assurance Project Plan (QAPP) prior to start of data collection activities. The QAPP will describe in detail the necessary quality assurance/quality control and other technical activities that will be implemented to ensure the SO₂ monitoring data obtained will satisfy the stated performance criteria as well as meet the needs of the required monitoring under the DRR.

QAPP specifications are detailed in EPA’s Quality Manual^{37,38} and in EPA Requirements for QA Project Plans (QA/R-5).³⁹ These documents describe the QAPP as being divided into four basic element groups covering project management, data generation and acquisition, assessment and oversight, and data validation and usability activities. Each element group is subsequently divided into elements covering various topics. The list of elements that will be included into the QAPP are presented in Table 4-1.

Each group of the QAPP describes the objectives of the specific monitoring study and the procedures to be followed to achieve those objectives. The necessary practices and procedures as stipulated in the following EPA documents will be contained in the QAPP to be developed:

- Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. II: Ambient Air Quality Monitoring Program, EPA-454/B-13-003, May, 2013, and revised Appendix D, July 2014;

³⁷ In accordance with EPA Order 5360.1 CHG 2, EPA requires that environmental programs be supported by a quality system that complies with the American National Standard ANSI/ASQC E4-1994, Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs. ANSI/ASQC E4-1994 is a national consensus standard authorized by the American National Standards Institute (ANSI) and developed by the American Society for Quality (ASQ) that provides a basis for planning, implementing, documenting, and assessing an effective quality system for collecting and evaluating environmental data for decisions and for use in the design, construction, and operation of environmental technologies.

³⁸ <https://www.epa.gov/quality/epa-quality-manual-environmental-programs>

³⁹ <https://www.epa.gov/quality/epa-qar-5-epa-requirements-quality-assurance-project-plans>

- Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements March 2008;
- Meteorological Monitoring Guidance for Regulatory Modeling Applications EPA-454/R-99-005 (assuming that a meteorological system will concurrently be collocated with the ambient SO₂ system);
- 40 CFR Part 58, Appendix A Quality Assurance Requirements for SLAMS, SPMs and PSD Air Monitoring;
- 40 CFR Part 58, Appendix E Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring; and
- 40 CFR Part 50, Appendices A-2.

To perform sampling and analysis operations consistently, the monitoring firm will follow the standard operating procedures (SOPs), as developed by KDAQ. SOPs are written documents that detail the method for an operation, analysis, or action with prescribed techniques and steps and are officially approved as the method for performing routine and repetitive tasks. SOPs will ensure consistent performance with organizational practices. The SOPs serve as training aids, provide ready reference and documentation of proper procedures, reduce work effort, reduce error occurrences in data, and improve data comparability, credibility, and defensibility. Each SOP will be sufficiently clear and written in a step-by-step format to be readily understood by a person knowledgeable in the general concept of the procedure.

Table 4-1. QAPP Elements

| Group A. Project Management | Group B. Data Generation and Acquisition | Group C. Assessment and Oversight | Group D. Data Validation and Usability |
|---------------------------------------|----------------------------------------------------------------|-----------------------------------------|-----------------------------------------------|
| A1. Title and Approval Sheet | B1. Sampling Process Design | C1. Assessments and Response Actions | D1. Data Review, Verification, and Validation |
| A2. Table of Contents | B2. Sampling Methods | C2. Reports to management | D2. Verification and Validation Methods |
| A3. Distribution List | B3. Sample Handling and Custody | | D3. Reconciliation with User Requirements |
| A4. Project/Task Organization | B4. Analytical Methods | | |
| A5. Problem Definition and Background | B5. Quality Control | | |
| A6. Project/Task Description | B6. Instrument/ Equipment Testing, Inspection, and Maintenance | | |
| A7. Quality Objectives and Criteria | B7. Instrument/ Equipment Calibration and Frequency | | |
| A8. Special Training/Certifications | B8. Inspection/ Acceptance of Supplies and Consumables | | |
| A9. Documentation and Records | B9. Non-direct Measurements | | |

| | | | |
|--|---------------------|--|--|
| | B10.Data Management | | |
|--|---------------------|--|--|

Care will be taken to appropriately distinguish between Quality Control (QC) and Quality Assurance (QA). Though the two are very similar, there are some basic differences. QC is concerned with the product, while QA is process-oriented. QC is a subset of QA. QA for ambient air monitoring operations is the overall systematic process of planning, implementation, monitoring, verifying and determining whether the collected data meets or exceeds the data quality objectives (DQOs).

Quality Assessments are independent measurements/reviews (verifications) made of the QC System (i.e., the technical functions, technical processes and physical characteristics that measure the attributes and performance of the monitoring procedure). The monitoring firm will provide an independent auditor to perform the quality assurance audits in accordance with EPA guidelines.

4.2 INSTRUMENT SELECTION AND PROCUREMENT

Instrument selections for both the ambient SO₂ concentrations and the meteorological data are proposed to provide equipment that can produce excellent resolution, reliability, and optimum data recovery. The instrumentation proposed in the following sections is based upon past field-proven reliability and availability as well as its compatibility with known existing SLAMS-quality instrumentation currently used in other monitoring programs. Proposed air quality equipment specification sheets are presented in Appendix B. Likewise, proposed meteorological instrumentation is described in Appendix C. It is anticipated that all equipment proposed for the SO₂ monitoring station will be purchased and installed new.

4.2.1 SO₂ Monitoring Equipment

For the continuous SO₂ monitoring that will be performed at the new station, the following primary equipment will be used:

- Teledyne-Advanced Pollution Instrumentation (T-API) Model T100 SO₂ analyzer
- T-API Model T700 Dynamic Dilution Calibrator
- T-API Model T701 Zero Air System

4.2.1.1 Teledyne-Advanced Pollution Instrumentation SO₂ Analyzer

The T-API Model T100 UV Fluorescence SO₂ analyzer will be the primary measurement device used. The T-API Model T100 carries the EPA Method Equivalency Designation EQSA-0495-100, uses the proven UV fluorescence principle, coupled with state of the art microprocessor technology to provide accurate and dependable measurements of low-level SO₂. Exceptional stability is achieved with the use of an optical shutter to compensate for PMT drift and a reference detector to correct for changes in UV lamp intensity. A hydrocarbon “kicker” and advanced optical design combine to prevent inaccuracies due to interferents.

The SO₂ analyzer is equipped with an internal datalogger. This datalogger will keep a record of SO₂ concentrations in case the primary datalogging system fails. The SO₂ analyzer will be installed in a climate-controlled air quality monitoring shelter.

4.2.1.2 Teledyne-API Model T700 Dynamic Dilution Calibrator

In conjunction with the T-API model T100 SO₂ analyzer, a T-API Model T700 Dynamic Dilution calibrator will be installed and used. The Model T700 is a microprocessor-based instrument for calibration of precision gas

analyzers. Using a combination of highly accurate mass flow controllers and compressed sources of standard gases, calibration standards are provided for multipoint span, precision, and zero checks. The Model T700 flow calibrator can be manually or remotely operated.

4.2.1.3 Teledyne-API Model T701 Zero Air System

A T-API Model T701 zero air system will be used with the dilution calibrator. The Model T701 will provide a source of clean dry air. The regenerative heatless dryer removes water without requiring any warm-up, and provides a gas with a dew point of less than minus 20°C, independent of inlet dew point. The dryer also assists in the removal of other gases, greatly increasing the life of the chemical scrubbers.

The Model T701 includes an oil-less diaphragm-less pump plus scrubbers to remove contaminants. Inlet air is pulled into a pump and routed through a pre-cooler which takes out most of the water. The air then passes through the regenerative scrubber where the final drying action is taken.

Figure 4.1 presents a picture of rack-mounted T-API analyzers, a multi-gas calibrator, and zero air system.

Figure 4-1. Teledyne-API Analyzers and Affiliated Equipment



4.2.2 Air Quality Shelter

The proposed SO₂ monitoring equipment will be housed in an aluminum ambient air monitoring shelter. The shelter measures a minimum of 8' x 8' x 8' high and features a heavy duty industrial HVAC heating and air conditioning system, instrument rack, cabinet, countertop, and gas cylinder mounts. The shelter is equipped with a 100-amp electrical load center. A typical shelter setup like that anticipated to be used is shown in Figure 4-2.

Figure 4-2. Air Quality Shelter (Typical)



4.2.3 Data Acquisition System

At the monitoring station, SO₂ data will be continuously recorded on a Campbell Scientific, Inc. CR850 data acquisition system (see Figure 4-3). The CR850 is a versatile data acquisition system that offers the following features:

- 1) User programmable options
- 2) Built-in data instruction set
- 3) Large internal data storage
- 4) Solid-state data memory modules
- 5) Ethernet interface
- 6) PC compatibility
- 7) Built-in surge protection
- 8) Ability to control external devices (i.e. on-site calibrators).

Figure 4-3. CR850 Data Acquisition System



4.2.4 Telecommunications

A Cradlepoint Technologies IP router with a cellular-based access point will be used for remote access to the site's datalogger to download data and check the status of on-site equipment. The site will be securely available via a password protected static IP address and be available for data collection and interrogation 24/7/365.

4.3 SYSTEM INSTALLATION AND INITIAL CALIBRATION

Once the monitoring location has been finalized and approved by KDAQ, Century and BREC will work with the selected ambient monitoring firm to provide a power drop to the new monitoring shelter as well as a clear, level area suitable for each shelter to reside. The monitoring firm will acceptance test the air quality equipment at its own monitoring laboratory before installation at the approved monitoring site. The monitoring firm will also program the data acquisition systems to collect all data and control routine zero, span, and one-point QC checks for each SO₂ analyzer.

All instrumentation will be housed in the climate-controlled monitoring shelter. The SO₂ analyzer will draw sample air through approximately 15 feet of Teflon tubing. The sample probe material for gaseous reactive gases will only be constructed with smooth, non-reactive and non-porous materials (i.e., FEP Teflon). Connective tube fittings will also be constructed of smooth non-reactive and non-porous materials (e.g. Teflon). Opaque conduit will be used to house the SO₂ sample line to protect it from UV effects.

The residence time of SO₂ within the sample train is critical. Residence time is defined as the amount of time it takes for a sample of air to travel from the sample probe inlet to the sample inlet at the back of the analyzer. For SO₂, sample residence must be less than 20 seconds based on the guidance in QA handbook Volume II, Appendix F. The residence time of the proposed SO₂ sample inlet system is approximately four seconds.

After installation, initial field calibrations will be performed on the SO₂ analyzer, and the calibrator itself. Equipment installation and field calibrations will be thoroughly documented in an installation report. The system installation and field calibrations will ensure that the initial data meet quality assurance standards.

4.4 MONITOR STATION OPERATIONS AND DATA REPORTING

The following section describes the routine monitoring operations that will be conducted for the proposed SO₂ monitoring station. These operations include routine field operations, calibration and maintenance of monitoring equipment, and emergency trips.

With training from the monitoring firm, a local technician from Century, BREC or another local third-party contractor will serve as the primary first responder for the monitoring station. The backup primary first responder will come from the local third party contractor with additional Century and BREC personnel trained as qualitative backup. The monitoring firm will communicate with the local technician and will provide him/her with required supplies and assistance. The monitoring firm will also perform the quarterly service and calibration of the SO₂ analyzer, routine and preventive maintenance, and troubleshooting procedures. Calibration procedures are presented below.

4.4.1 SO₂ Multi-Point Calibration

Multi-point calibrations for the SO₂ analyzer will be performed at least quarterly, and will consist of five test concentrations, including zero concentration, a span concentration (between 80% and 90% of the full scale (FS) of the analyzer under calibration), and the remaining test concentrations equally distributed between zero and span. The zero/span test concentrations are to be introduced directly to the back of the analyzer's sample inlet port and analyzer response adjusted to match zero/span test concentrations.

After the analyzer's zero/span has been adjusted, zero/span test concentrations shall again be repeated to verify analyzer response match the zero/span test gas concentrations. Multi-point calibrations are used to establish or verify the linearity of the analyzer upon initial installation, after major repairs, after failure of a zero/span or one-point QC check or performance audit, and at specified frequencies.

The analyzer has zero and span adjustment controls, which will be adjusted based upon zero and span test concentrations (80 – 90% FS), respectively, to provide the desired scale range within the analyzers specifications. For routine operation, unadjusted ("as is") analyzer zero and span response readings will be obtained and recorded prior to making any zero or span adjustments. Analyzer zero and span controls often interact with each other, so adjustments may have to be repeated to obtain the desired final adjustment.

Specific calibration procedures and calibration criteria will be developed and presented as SOP's. Table 4-2 presents the calibration verification methods and acceptable tolerance for the SO₂ monitoring equipment.

Table 4-2. Calibration Verification Methods and Acceptable Tolerances for SO₂ Monitoring Equipment

| Parameter | Calibration Method | Acceptable Tolerances |
|-----------------|-------------------------------------|---------------------------------------------------------------|
| SO ₂ | Dynamic Dilution of Calibration Gas | All points within $\pm 2\%$ full scale best-fit straight line |

4.4.2 SO₂ Analyzer Zero/Span/One-Point QC Checks

Level 1 zero and span calibrations are simplified, two-point calibrations used when adjustments may be made to the analyzer. When no adjustments are made to the analyzer, the Level 1 calibration is also called a zero/span check. Automatic Level 1 zero and span checks will be conducted daily and will be used to assess if the analyzer is operating properly and to assess if any drift in instrument response has occurred. The Level 1 check will not exceed ± 10 percent. If zero drift is internally adjusted by the analyzer, the zero check will be used to verify that the internal zero is working properly.

Automatic zero/span checks will be conducted by challenging each analyzer with zero air and a test atmosphere containing concentrations between 70 percent and 90 percent of the full measurement range in which the analyzer is operating. The challenge gas will be sampled through as much of the sampling inlet system as practical to mimic the actual sampling of ambient air. If the measured concentrations fall outside of the control limits, the accuracy of the mass flow controlled calibration system will be checked with a NIST-traceable flow standard. The site calibrator normally used for calibrations will be used for conducting the zero/span checks.

Before any adjustment is made to the analyzer's zero or span settings, the "unadjusted" or "as found" measurement will be recorded. Subsequent adjustment to the analyzers will then proceed. After completing analyzer adjustments, a post-adjusted (or "as left") zero/span measurement will be performed and recorded.

In addition, at least once every two weeks, one-point QC checks will be conducted by challenging each analyzer with a known concentration of a standard gas mixture to assess the ability of the analyzers to measure a gas under reproducible conditions. The one-point QC checks will be conducted by challenging each analyzer with a standard gas of known concentration in the 50 - 80 ppb range. The gas will be supplied through all filters, scrubbers, and other conditioners and through as much of the sample inlet system as possible. After completion of the one-point QC checks, the actual concentration of the working standard and the measured concentration indicated by the analyzer will be reported along with the percent difference between these values.

4.4.3 Routine Maintenance

Routine maintenance will be performed at the SO₂ monitoring station to ensure that equipment is operating properly and data are accurate. Table 4-3 presents the maintenance activities to be conducted and their frequency.

Table 4-3. Routine Maintenance for SO₂ Analyzer

| Item | Schedule |
|-------------------------|----------------|
| Pump rebuild | As needed |
| Particulate filter | As needed |
| Zero/span check | Weekly |
| Multi-point calibration | Every 3 months |
| Flow Orifices | As needed |

4.4.4 Emergency Visit

If remote data management quality control indicates that the SO₂ analyzer is operating outside of allowable tolerances or has failed all together, the first responder will travel to the site and troubleshoot and investigate the problem. If the site responder is not able to remedy the issue, then the monitoring firm's field technician will be deployed to the site as soon as possible – typically within 1 or 2 days.

4.4.5 Routine Data Management and Data Reporting

To ensure successful operation of the SO₂ monitoring station, procedures delineated in the QAPP will be strictly adhered to. A key performance criteria metric will be the data capture and validation rate. The QA program will be designed to ensure adherence to data capture requirements of 75% per quarter and 80% or better for the monitoring year for the SO₂ data and greater than 90% for the meteorological parameters.

4.4.6 Data Management

The monitoring firm will handle all data management tasks for the monitor including data collection and validation of the continuous SO₂ concentrations. To preserve data integrity and high rates of data recovery, data collection will be ongoing (7 days per week, 24 hours per day) including interrogation and download of the monitoring site's data to the primary contractor's central monitoring office and subsequent electronic and personal scanning of these data. This approach identifies problems quickly so that the local first responder or remote field technician can be dispatched promptly to repair or replace defective measurement systems, if necessary.

An internet communication platform will be used that will allow for the ability to assign a static IP address to the monitoring station. All access will be secure, requiring a password for entry. This configuration will allow for frequent data downloads from the site.

The monitoring firm's data management team will track the performance of the SO₂ analyzer, will compile quality-assured data sets that will be archived, will generate quarterly summaries, and will notify the local field technician of analyzer malfunctions so that corrective action can be initiated as soon as possible. Data management will follow established EPA procedures.

All SO₂ data will be stored on-site utilizing a recommended Campbell Scientific CR850 data acquisition system. The SO₂ data will be updated secondly and stored as five-minute and hourly averages.

The monitoring firm will have a password-protected project web site that will allow authorized users to select the date range and time span to view data allowing for inspection of not only current data but historical data. In addition, the site allows for the generation of data reports and pollutant wind roses. Figures 4-4 and 4-5 present examples of the type of graphics that will be posted on the web site. Access to the web site can be obtained via any standard web browser. In addition, this software has a note feature where field activities can be recorded by parameter, date and time. This note section will also assist with data validation.

The web site will allow the monitoring firm’s air quality specialists to quickly note and resolve any potential instrumentation problems. Any data anomalies would generate an automated e-mail message to the monitoring firm’s site technician, data and project managers.

Figure 4-4. Example SO₂ Strip Chart Display

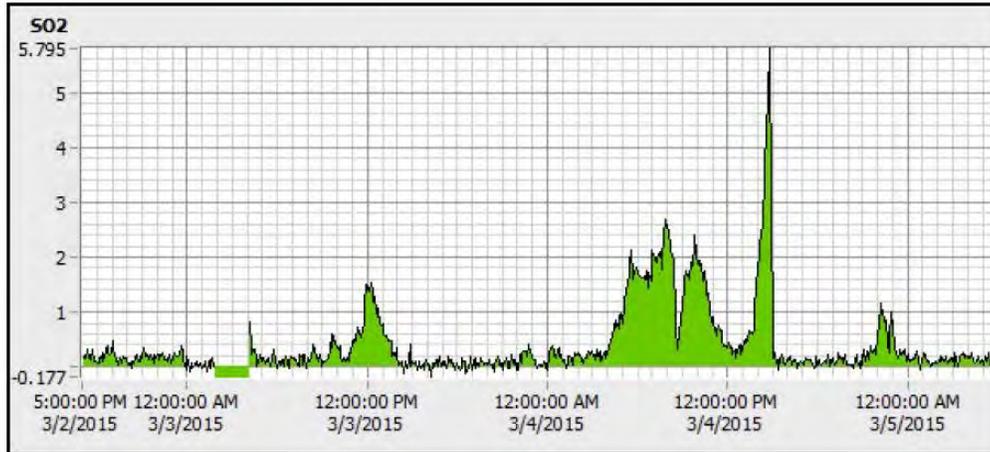
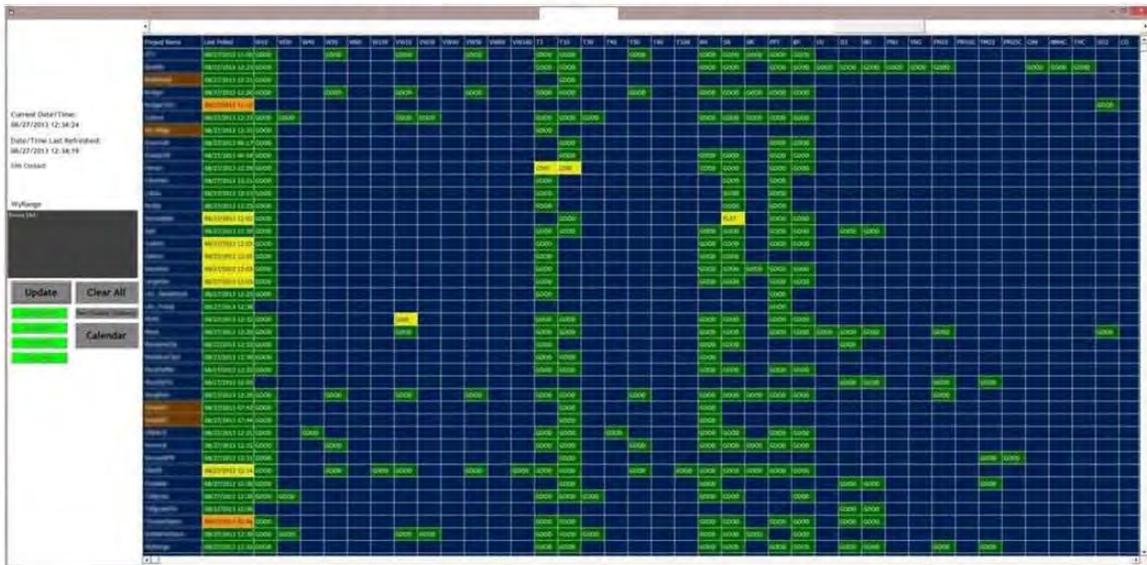


Figure 4-5. Example DSAS User Interface



4.4.7 Data Validation

Data validation is the process designed to ensure that reported values meet the quality goals of the project. A systematic approach will be used for data validation for the SO₂ monitoring station. Three levels (0 to 2) of data validation for the air quality and meteorological data will be carried out, defined as follows:

- Level 0: These data are obtained directly from the datalogger or analyzer in the field. Level 0 data are unedited and unreviewed. Level 0 data have not been edited for downtime nor have procedural adjustments for baseline and span changes been applied. The Level 0 process ascertains that the instrumentation is functioning properly.
- Level 1: Level 1 data features: (1) The removal of data values and replacement with -99 when monitoring instruments did not function within procedural tolerances; (2) flags samples when significant deviations from measurement assumptions have occurred; (3) verifies computer file entries against data sheets; (4) replacement of data from a backup data acquisition system in the event of failure of the primary system; (5) eliminates values for measurements which are known to be invalid because of instrument malfunctions; (6) adjusts values for quantifiable calibration interference biases; and (7) identification, investigation, and flagging of data that are beyond reasonable bounds or that are unrepresentative of the variable being measured.
- Level 2: Level 2 data validation takes place after data from various measurement methods have been assembled in a database. Level 2 data validation involves comparisons with other independent data sets. This includes inter-comparing collocated measurements or making comparison with other measurement systems or analyses.

Pre-programmed consistency and reliability tests will be applied to the data in Level 1. Consistency tests will be performed to verify that file naming conventions, data formats, site codes, variable names, reporting units, validation flags, and missing value codes are consistent with project conventions. Discrepancies will be recorded for further investigation. When the received files are consistent, reasonability tests are applied. These reasonability tests include: identification of data values outside of a specified maximum or minimum value, values that change by more than a specified amount from one sample to the next, and values that do not change over a specific period. These tests will be performed by the monitoring firm using its own quality control software.

The monitoring firm will use software that conducts live inspection of monitoring site data. This Data Scanning and Alert System (DSAS) will assist staff in identifying data outliers, problems with site equipment, or site communication issues. Once every minute, DSAS will scan all raw data files downloaded from the monitoring site to see if new data have arrived for interrogation. Data downloaded from the samplers are one-hour averages.

After the data collection, the DSAS will conduct a computerized inspection of the data using pre-defined quality control checks. The quality control checks will include data outliers, spikes in data, and data constancy. If parameters fail these tests, the parameter will be flagged in the software and staff will be alerted.

A user interface for the DSAS software will be used for visual and audio cues to alert staff when a parameter fails a quality control check. The user interface is displayed on a touchscreen monitor near the data management section. The user interface displays a matrix listing all the meteorological and air quality station monitors as well as associated parameters listed in columns. Each cell represents a parameter being measured at a monitoring site and will be colored with green, yellow, orange, or red depending on the severity of the failure. For example, a green cell indicates no problems were detected.

To analyze the failure indicated by the visual cue (red for example), staff are able to click on the indicated cell to get specific details of the error or double click the cell to look at plots of the data. Figure 4.5 presents a screen capture of the data software.

Table 4-4 presents example quality control checks performed by the quality control software. These limits may be adjusted. Based on the results of the investigations, others outliers may be invalidated or flagged.

Table 4-4. Quality Control Checks Imposed by Data Quality Control Program

| Air Quality and Meteorological Data |
|---------------------------------------------------------|
| SO ₂ concentration >50 ppb in five minutes |
| SO ₂ concentration >40 ppb in one hour |
| SO ₂ concentration <-5 ppb |
| Shelter temperature <5°C |
| Shelter temperature >40°C |
| Temperature change > 4°C in a 5-minute period |
| Time increments > 5 minutes between data records |
| Temperature unchanged for six or more 5-minute averages |

The outlier program does not invalidate data or erase file records on the basis of these outlier tests. It will be left to a qualified meteorologist to review the results of the outlier program in conjunction with the data parameter plots and initiate corrective actions if warranted (site visit or data invalidation).

To assist in data validation, a copy of the site logbook and the note section of the project site software will be examined to confirm periods when instrumentation may have been off-line due to power outages, maintenance or repair, audits, or other quality assurance activities. Continuous data will be reviewed by using time series plots. The graphs quickly reveal any data abnormalities due to power failure or instrument malfunction. Significant events will be checked against the graphs for consistency.

Calibration data will be reviewed to assess the precision of the data. If the calibrations indicate invalid or low precision, data values may be invalidated or adjusted as necessary and the appropriate flags will be applied. Means, maxima and minima for the month are computed. Especially high values will be checked to be sure that audit or calibration data were not inadvertently included. Suspect data will be reported but flagged as suspect.

4.4.8 Data Flags

Per EPA's Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, EPA recommends the use of flags or result qualifiers to identify potential problems with data (or a sample). According to EPA, a flag is an indicator of the fact and the reason that a data value (a) did not produce a numeric result, (b) produced a numeric result but it is qualified in some respect relating to the type or validity of the result, or (c) produced a numeric result but for administrative reasons is not to be reported outside the organization.

Thus, quality control flags, consisting of a letter will be assigned to each datum to indicate its quality. Multiple flags can be applied to each data point such as data invalid due to calibration (I, CA). It is preferred to assign multiple flags if problem is known. These data flags are presented in Table 4-5.

Data Quality Objectives (DQOs) are qualitative and quantitative statements that clarify the monitoring objectives, define the appropriate type of data, and specify the tolerable levels of measurement errors for the monitoring program. In Table 4-6, example DQO's for the proposed SO₂ monitoring station are listed with the realization that comments and input from KDAQ are needed to assure that they are commensurate with program goals.

Table 4-5. Data Flags

| Flag | Code | Description |
|------|------|-----------------------------------------------------------------------|
| V | 0 | Valid |
| C | 1 | Corrected or Estimated |
| S | 7 | Suspect: data appears to be a data spike or outside normal data range |
| I | 8 | Invalid data |
| M | 9999 | Missing data: measurement not taken |
| BC | 9995 | Calibration |
| AN | 9980 | Instrument Malfunction |
| AO | 9981 | Acts of Nature |
| BH | 9965 | Local Interference |
| BA | 9993 | Maintenance |
| BJ | 9963 | Operator Error |
| AZ | 9992 | Performance Audit |
| AX | 9990 | Precision Check |
| AV | 9988 | Power Failure |
| AQ | 9983 | Datalogger or Collection Failure |
| AM | 9979 | Miscellaneous Void |
| AY | 9991 | QA Control Points (zero/span) |
| AH | 9974 | Sample Flow Rate out of Limits |
| AE | 9971 | Shelter Temperature High |
| AE | 9971 | Shelter Temperature Low |
| TO | 9961 | Datalogger Time Off |
| BF | 9998 | Zero/span |
| AP | 9982 | Site Vandalism |

Table 4-6. Data Quality Objectives

| Requirement | Frequency | Acceptance Criteria |
|--------------------|-----------|------------------------------------------|
| SO ₂ | | |
| One point QC check | 1/2 weeks | ≤±10% percent difference |
| Zero/span check | Daily | Zero drift: ≤±3 ppb Span drift: ≤±10% |

The data validation criteria presented in Table 4-6 above will be incorporated into the QAPP and are subject to review and approval by the KDAQ.

At the end of each month, a data validation summary spreadsheet will be compiled. This spreadsheet is compiled using the following documents:

1. The Quality Assurance/Data Validation Log from the daily data reviews.
2. A copy of the site field logbook will be examined to confirm periods when instrumentation may have been off-line due to power outages, maintenance or repair, audits, or other quality assurance activities.
3. Any calibration, audit or maintenance forms from the site are reviewed. These activities are documented by the site technician on a Data Validation Site Activity Log form.

4.4.9 Routine Reporting

Routine reporting for the monitoring station will consist of quarterly reports that detail the operation of the station as well as any maintenance and service work performed.

These reports will contain data summaries, a summary of any problems encountered in the monitoring project and the status of any current problems, a summary of any meetings or correspondence dealing with the monitoring program, a synopsis of percent recovery including brief explanations of missing data, overall data recovery, quality control, and all quality assurance documentation. The quarterly reports will be available within thirty (30) days of each calendar quarter. The fourth quarter report will include all appropriate annual summaries.

4.5 PERFORMANCE AUDITS

The independent audit program for this monitoring station will consist of an annual quality assurance performance audit. The audit will be conducted by an outside firm or individuals who are independent of those responsible for routine site operations, i.e., installation, calibrations and maintenance. The audit reference standards used will be traceable to standard verification methods and/or NIST standards. The independent auditor will verify that the audit inputs and the resultant SO₂ analyzer responses are recorded and stored by the data acquisition system.

4.6 METEOROLOGICAL MONITORING

The monitoring firm will also provide and set up a meteorological monitoring station to provide continuous meteorological measurements to be used as part of the site SO₂ monitoring program to characterize the flow and temperature regimens of the area as well as to supplement analysis of impacts and probable contributions (if any). These data, collected at the same time as the SO₂ data, will provide a sound basis for determining source culpability over the course of the monitoring program.

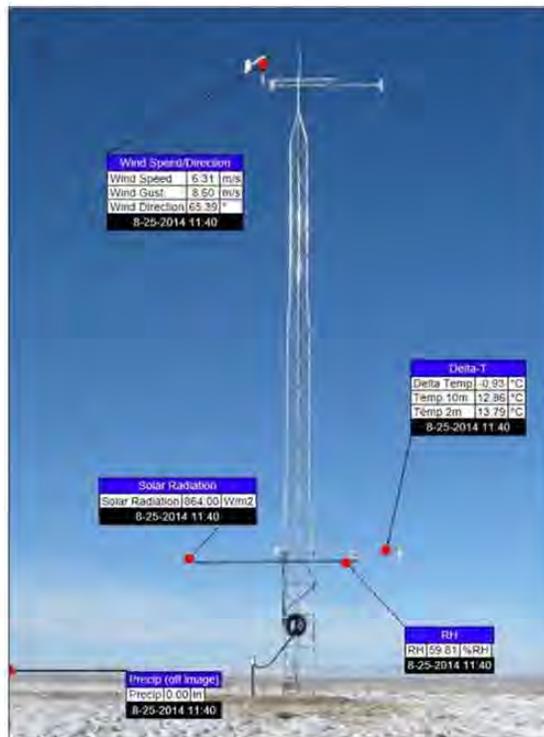
The meteorological monitoring station will be located at or near the same selected SO₂ monitor site as determined from the monitor site evaluation. Personnel from the monitoring firm's office will perform a siting trip to identify the best meteorological monitoring location on or around the selected SO₂ site to obtain representative meteorological measurements. The specific location chosen will meet the guidance presented in EPA's Meteorological Monitoring Guidance for Regulatory Modeling Applications. Meteorological sensors will be sited at a distance which is beyond the influence of obstructions such as buildings and trees. Availability of power and accessibility to the site will consider the same factors as that for the SO₂ monitor location.

Meteorological monitoring equipment selection, set up, and operations will be more specifically proposed when the meteorological station is confirmed for desired set up. The meteorological measurements obtained will meet State and Local Air Monitoring Station (SLAMS) monitoring requirements. At this time, the general proposed instruments and parameters considered will include:

- Wind speed
- Wind direction
- Temperature
- Delta-Temperature (temperature sensors at the 2- and 10-meter levels)
- Relative humidity
- Barometric pressure
- Solar radiation

All proposed meteorological sensors will be secured to a 10-meter guyed aluminum tower (similar to the UT30) with a mounting base secured in concrete. Lightning protection will be mounted to the tower. The tower will be capable of being tilted down to ground level, which eliminates the need to climb the tower for servicing. Figure 4- 6 presents a photograph of an instrumented 10-meter tower similar to that planned.

Figure 4-6. Photograph of an Example 10-Meter Instrumented Tower



In addition to the instruments and tower, a data acquisition system will be used to collect, analyze and archive the meteorological data collected. The same telecommunication system presented above will be utilized for the meteorological measurements.

With assistance from the monitoring firm, the site will be prepared for tower installation followed by the installation of the ten-meter meteorological tower. The aluminum tower utilizes a platform base staked and guyed into the ground. The tower can be folded down to access instrumentation for service or audits. The tower system will be lightning protected with grounding equipment and signal cables will pass through surge-protecting spark gaps mounted in the data logger itself. The meteorological sensors will be secured to the tower to provide the necessary data acquisition system connections. To optimize the quality of the data collected, a cellular telecommunications system (also recommended for SO₂ monitoring system above) will be utilized to allow personnel to access the site's measurement systems at any time.

After sensors have been secured to the tower and the necessary data acquisition system connections have been made, calibrations of the sensors will be performed using certified (NIST traceable) calibration equipment. The calibration of the wind speed sensor will be verified by applying known revolutions per minute using a variable speed motor drive. The shaft of the synchronous motor will be attached to the bearing shaft of the anemometer with the prop removed. Synchronous motor speeds will be translated into calculated wind speeds in meters per second using manufacturer's specifications. The sensor response will be compared to the calculated wind speeds. Wind speed sensor shaft rotational torque will be measured with a torque disc to evaluate starting threshold. The orientation of the wind direction sensor will be checked using a professional magnetic compass. The compass will be positioned using a magnetic declination predetermined by a software program using site latitude and longitude coordinates (magnetic north is not true north). In addition, the wind direction sensor linearity will be verified by checking the sensor output at 30 degree increments throughout the entire 0 to 360 degree range in both clockwise and counterclockwise directions. The sensor starting torque will be determined by measuring shaft rotational torque with a vane torque gauge.

Temperature sensor calibration will be verified by direct comparison of sensor outputs to a collocated calibrated reference standard thermometer at three different temperatures over the measurement range. The 2- and 10-meter temperatures will be checked simultaneously in the same medium so that the Δ temperature function can be verified. The relative humidity sensor will be calibrated by comparison of station sensor outputs with a collocated relative humidity reference sensor. The barometric pressure sensor output will be verified by comparing the output of a certified reference barometer with sensor outputs recorded on the data acquisition system. The solar radiation pyranometer will be verified by collocating a certified reference pyranometer adjacent to the system sensor. The reference pyranometer will be interfaced with a separate data logger synchronized with the station data logger. Readings from the pyranometers will be compared manually over a several-hour period to verify conformance with acceptable calibration tolerances.

Table 4-7 presents a summary of the calibration verification methods and acceptable tolerances for the proposed meteorological equipment.

Table 4-7. Calibration Verification Methods and Acceptable Tolerances for Meteorological Equipment

| Parameter | Calibration Verification Method | Acceptable Tolerances |
|---------------------|-------------------------------------------------------------|----------------------------------------------------|
| Wind Direction | Orientation Plus Linearity Starting Threshold | $\pm 5^\circ$ <0.5 m/s |
| Wind Speed | Synchronous Motor Starting Threshold | ± 0.20 m/s <0.5 m/s |
| Temperature | Collocated Reference Comparison ΔT between 2-10m | $\pm 0.5^\circ\text{C}$ $\pm 0.1^\circ\text{C}$ |
| Relative Humidity | Certified Reference Collocation | ± 7 %RH |
| Barometric Pressure | Collocated Reference Comparison | ± 3 millibars |
| Solar Radiation | Certified Reference Standard Collocation | $\pm 10\%$ of mean observed interval |

Like the SO₂ measurements, the same level of quality control and quality assurance will be placed on the meteorological measurements. The meteorological measurements will be incorporated into a password-protected project web site that can be accessed by the monitoring firm as well as BREC and Century personnel. Meteorological data will be validated, flagged, managed and reported in the same manner as the SO₂ data, as discussed previously. Quality assurance audits by an independent auditor will be performed annually.

APPENDIX A: PROPOSED SOURCE ORIENTED SO₂ MONITOR STATION

Sebree, KY



MSA: Evansville, IN-KY MSA

401 KAR 50:020 Air Quality Region: Evansville(IN)-Owensboro-Henderson(KY) Interstate (077)

Site Name: Alcan Road

AQS Site ID: 21-101-1011

Location: Alcan Aluminum Road 1.0 mile south of Moss and Moss Road, Robards, KY 42452

County: Henderson

GPS Coordinates: 37.654381° -87.511427°

Date Established: January 1, 2017

The monitoring site has a sulfur dioxide monitor. It is located near the beginning of a coal truck access road that runs perpendicular to Alcan Aluminum Road in Robards, Kentucky. This intersection is approximately 1 mile south of Moss and Moss Road (State Route 2678) and ½ mile north of Quinns Landing Road (State Route 2097), which also run perpendicular to Alcan Aluminum Road. The air monitoring site meets the criteria established by 40 CFR Part 58, Appendices C, D, E and G.

Monitoring Objective:

The purpose of the proposed monitoring station is to characterize the ambient SO₂ concentrations in the immediate area (within approximately 4 km) of the Century Aluminum Sebree, LLC (Century) and Big Rivers Electric Corporation (BREC) facilities near Sebree, Kentucky, in accordance with provisions under 40 CFR 51, Subpart BB. A Neighborhood Scale plot of the area is shown in Figure A-1.

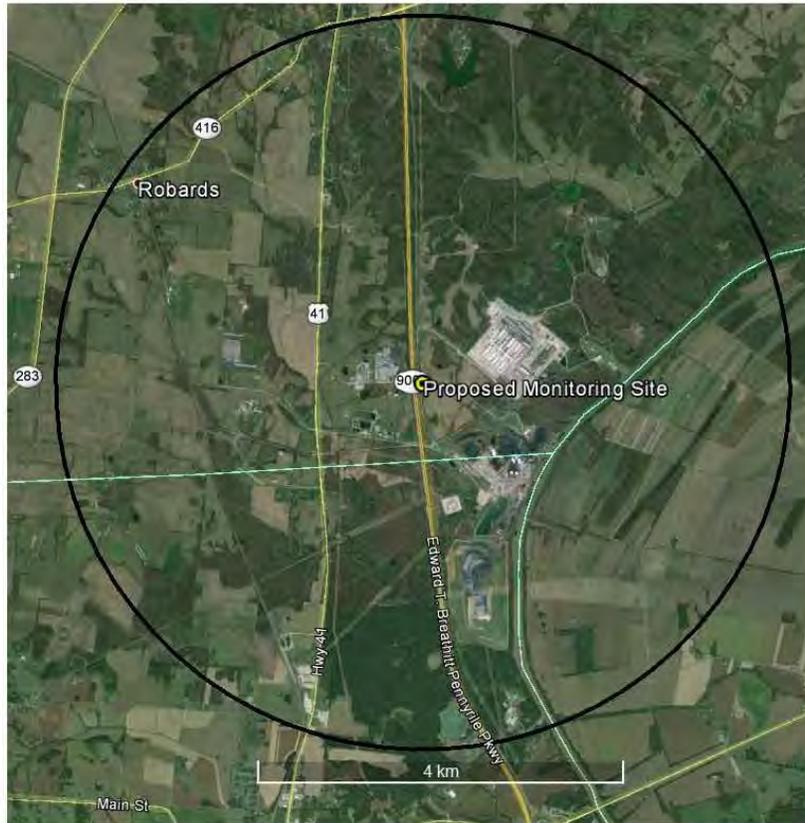
The monitor station site has been chosen to capture the expected highest concentration SO₂ in the area surrounding the Century and BREC facilities due to direct emissions of SO₂ from these two facilities. Once three years of data has been collected, the results will be used for designating the area with respect to the SO₂ NAAQS.

Upon satisfaction of these objectives and once all criteria under 40 CFR 1203(c)(3) and 40 CFR 58.14 governing provisions for shutdown of a monitoring site have been met, the operation of this monitoring site will be discontinued.

Monitors:

| Monitor Type | Inlet Height (meters) | Designation | Analysis Method | Frequency of Sampling |
|----------------|-----------------------|-------------|----------------------------------------------------------------------------|-----------------------|
| Sulfur Dioxide | 10 | SLAMS | Automated equivalent method utilizing trace level UV fluorescence analysis | Continuously |

Figure A-1: Neighborhood Scale (4km Radius): Sulfur Dioxide



APPENDIX B: PLANNED SO₂ MONITORING EQUIPMENT SPECIFICATIONS



Model T100 UV Fluorescence SO₂ Analyzer

The Model T100 uses the proven UV fluorescence principle, coupled with a state of the art user interface to provide easy, accurate, and dependable measurements of low level SO₂.

Exceptional stability is achieved with the use of an optical shutter to compensate for PMT drift and a reference detector to correct for changes in UV lamp intensity. A hydrocarbon 'kicker' and advanced optical design combine to prevent inaccuracies due to interferences.

All T Series instruments offer an advanced color display, capacitive touch screen, intuitive user interface, flexible I/O, and built-in data acquisition capability. All instrument set up, control and access to stored data and diagnostic information is available through the front panel, or via RS232, Ethernet, or USB com ports either locally or by remote connection using the included APlcom™ software.

- » Ranges: 0-50 ppb to 0-20 ppm, user selectable
- » Dual ranges and auto ranging
- » Large, vivid, and durable color graphics display with touch screen interface
- » Ethernet, RS-232, and (optional) USB com ports
- » Front panel USB connections for peripheral devices and firmware upgrades
- » 8 analog inputs (optional)
- » Adaptive signal filtering optimizes response time
- » Temperature & pressure compensation
- » Internal zero & span check (optional)
- » Comprehensive internal data logging with programmable averaging periods
- » Ability to log virtually any operating parameter
- » Two-year warranty

Free Customer Support by telephone and email for the life of the instrument

Model T100 UV Fluorescence SO₂ Analyzer

Specifications

General

| | |
|-------------------------|---------------------------------------------------------------------------------------------------------------|
| Ranges: | Min: 0-50 ppb Full scale Max: 0-20,000 ppb Full scale (selectable, dual ranges and auto ranging supported) |
| Measurement Units: | ppb, ppm, µg/m ³ , mg/m ³ (selectable) |
| Zero Noise: | < 0.2 ppb (RMS) |
| Span Noise: | < 0.5% of reading (RMS) above 50 ppb |
| Lower Detectable Limit: | 0.4 ppb |
| Zero Drift: | < 0.5 ppb/24 hours |
| Span Drift: | < 0.5% of full scale/24 hours |
| Lag Time: | 20 seconds |
| Rise and Fall Time: | < 100 seconds to 95% |
| Linearity: | 1% of full scale |
| Precision: | 0.5% of reading above 50 ppb |
| Sample Flow Rate: | 650 cm ³ /min ±10% |

Electrical Specifications

| | |
|-----------------------|--------------------------------|
| Power Requirements: | 100V-120V, 220V-240V, 50/60 Hz |
| Analog Output Ranges: | 10V, 5V, 1V, 0.1V (selectable) |
| Recorder Offset: | ±10% |

Communication Specifications

| | |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Included I/O: | 1 x Ethernet: 10/100Base-T 2 x RS232 (300-115,200 baud) 2 x USB device ports 8 x opto-isolated digital outputs 6 x opto-isolated digital inputs 4 x analog outputs |
| Optional I/O: | 1 x USB com port 1 x RS485 8 x analog inputs (0-10V, 12-bit) 4 x digital alarm outputs Multidrop RS232 3 x 4-20mA current outputs |

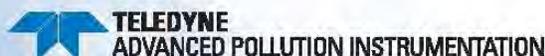
Physical Specifications

| | |
|------------------------------|---------------------------------------|
| Operating Temperature Range: | 5 - 40°C (with EPA Equivalency) |
| Dimensions (HxWxD): | 7" x 17" x 23.5" (178 x 432 x 597 mm) |
| Weight: | 35.7 lbs (16.2 kg) |

Certifications

| | |
|-----------|-------------------|
| US EPA: | EQSA-0495-100 |
| MCERTS: | Sira MC 050067/04 |
| EN 14212: | TÜV Rheinland |

The values expressed above are in accordance with EPA definitions. All error specifications are based on constant conditions. Specifications exceed US EPA and Eignungsgeprüft requirements. Specifications subject to change without notice. Printed documents are uncontrolled. SAL000039C (DCN 8582) T100/01.23.13



9480 Carroll Park Drive ■ San Diego, CA 92121-5201
Ph. 858-657-9800 Fax 858-657-9816
Email api-sales@teledyne.com

How to Order

Model T100 includes:

- Two year warranty
- Internal pump or external pump (optional)
- Dual ranges and auto ranging
- 47mm diameter particulate filter
- 8 isolated digital outputs
- 6 isolated digital inputs
- RS-232 ports
- Ethernet port
- USB ports for peripheral devices
- APIcom™ remote control software
- Select AC input voltage
 - 100V - 120V 50Hz
 - 220V - 240V 60Hz
- Select DC output voltage
 - 10V 5V
 - 1V 0.1V

Calibration Options:

- Ambient zero and ambient span
- Zero scrubber and pressurized span
- Zero scrubber and internal span source (I2S)

Mounting Options:

- Rack mount brackets with chassis slides
- Rack mount brackets only
- Handle

I/O Options:

- 4-20mA outputs (up to three channels)
- USB com port
- 8 Analog inputs
- Multi-drop RS232
- RS485

Other Options:

- NO optical filter (Recommended for high NO_x applications. Required for EN14212 approved configuration.)
- Concentration alarm relays
- Expendables kit

For more information about the Teledyne API family of monitoring instrumentation products, call us or visit our website at

www.teledyne-api.com

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Model T700 Dynamic Dilution Calibrator

The Model T700 is a microprocessor based calibrator for precision gas analyzers. Using highly accurate mass flow controllers combined with compressed sources of standard gases, calibration standards are provided for multipoint span and zero calibrations using up to 4 gas sources.

The Model T700 can be equipped with an optional UV ozone generator for accurate, dependable ozone calibrations, and to enable production of NO₂ when blended with NO gas in the included, internal gas phase titration (GPT) chamber. An optional photometer allows even more precise control of the ozone generator giving accurate and dependable ozone calibrations and enhanced GPTs. To ensure the highest accuracy of NO₂ output, the T700 with the photometer option can measure the ozone concentration prior to performing a GPT. A nearly unlimited number of calibration sequences may be programmed into the non-volatile memory of the Model T700, covering time periods up to a year.

All T Series instruments offer an advanced color display, capacitive touch screen, intuitive user interface, flexible I/O, and built-in data acquisition capability. All instrument set up, control and access to stored data and diagnostic information is available through the front panel, or via RS232, Ethernet, or USB com ports either locally or by remote connection using the included APCom™ software.

- » Generates precise calibration gases for SO₂, H₂S, NO, NO₂, CO, O₃, and others
- » Large, vivid, and durable color graphics display with touch screen interface
- » Ethernet, RS-232, and (optional) USB com ports
- » Front panel USB connections for peripheral devices and firmware upgrades
- » 12 independent timers for sequences
- » Nested sequences (up to 5 levels)
- » Software linearization of mass flow controllers (MFC)
- » 4 calibration ports (configurable for single or multi-blend gases)
- » 3rd MFC for wide dynamic range (optional)
- » Gas phase titration chamber (GPT) (optional)
- » Ozone generator and photometer allow use as a primary or transfer standard (optional)
- » Inlets for external ozone reference sources
- » Two-year warranty

Free Customer Support by telephone and email for the life of the instrument

Model T700 Dynamic Dilution Calibrator

Specifications

Dilution System

| | |
|---------------------------------|---------------------------------|
| Flow Measurement Accuracy: | ± 1% of full scale |
| Repeatability of Flow Control: | ± 0.2% full scale |
| Linearity of Flow Measurements: | ± 0.5% full scale |
| Flow Range of Dilution Air: | 0 to 10 SLPM |
| Optional Ranges: | 0 to 20 SLPM, 0 to 5 SLPM |
| Flow Range of Cylinder Gases: | 0 to 100 cc/min |
| Optional Ranges: | 0 to 50 cc/min, 0 to 200 cc/min |
| Zero Air Requirements: | 10 SLPM @ 30 psj |
| Optional: | 20 SLPM @ 30 psj |
| Input Pressure: | 20-40 psj |
| Calibration Gas Input Ports: | 4 (configurable) |
| Diluent Gas Input Ports: | 1 |

Ozone Generator Module

| | |
|-------------------|--------------------|
| Maximum Output: | 6 ppm LPM |
| Minimum Output: | 100 ppb LPM |
| Response Time: | 180 seconds to 98% |
| Optical Feedback: | Standard |

UV Photometer Option

| | |
|-----------------|--------------------------------------|
| Range: | 0-100 ppb to 0-10 ppm (selectable) |
| Precision: | 1.0 ppb |
| Linearity: | 1.0% of reading |
| Rise/Fall Time: | <20 seconds (photometer response) |
| Response Time: | 180 seconds to 95% (system response) |
| Zero Drift: | < 1.0 ppb/24 hours |

Electrical Specifications

| | |
|--------------------------------------|--------------------------------|
| Power Requirements: | 85V-264V, 47Hz-63Hz |
| Analog Output Ranges (Test Channel): | 10V, 5V, 1V, 0.1V (selectable) |

Communication Specifications

| | |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Included I/O: | 1 x Ethernet: 10/100Base-T 2 x RS232 (300-115,200 baud) 2 x USB device ports 8 x digital control outputs 12 x digital control inputs 8 x digital status outputs |
| Optional I/O: | 1 x USB com port 1 x RS485 Multidrop RS232 |

Physical Specifications

| | |
|------------------------------|------------------------------------------------------------------------------------------------|
| Operating Temperature Range: | 5 - 40°C |
| Dimensions (HxWxD): | 7" x 17" x 24" (178 x 432 x 609 mm) |
| Weight: | 31 lbs (14.06 kg) 39.2 lbs (17.78 kg) with photometer, GPT, and O ₃ generator |

The values expressed above are in accordance with EPA definitions.
All error specifications are based on constant conditions.
Specifications subject to change without notice.
Printed documents are uncontrolled. SAL0000620 (DCN 6107) T700/06.13.11



9480 Carroll Park Drive ■ San Diego, CA 92121-5201
Ph. 858-657-9800 Fax 858-657-9816
Email api-sales@teledyne.com

For more information about the Teledyne API family of monitoring instrumentation products, call us or visit our website at

www.teledyne-api.com

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How to Order

Model T700 includes:

- Two year warranty
- 4 calibration gas inlet ports
- 1 diluent gas inlet port
- 8 digital control outputs
- 12 digital control inputs
- 8 digital status outputs
- RS-232 ports
- Ethernet port
- USB ports for peripheral devices
- APicom™ remote control software
- Select AC input voltage
 - 100V - 120V 50Hz
 - 220V - 240V 60Hz
- Select DC output voltage
 - 10V 5V
 - 1V 0.1V

Mounting Options:

- Rack mount brackets with chassis slides
- Rack mount brackets only
- Handle

I/O Options:

- USB com port
- Multi-drop RS232
- RS485
- 12V external valve driver
- 24V external valve driver

Other Options:

- O₃ generator with optical feedback and GPT mixing chamber
- UV photometer module
- NO_y output valve
- Photometer certifications





Model T701 Zero Air System

The T701 adds Modbus TCP/IP connectivity to the proven reliability and performance of our zero air systems. This allows remote monitoring of key instrument functions including dewpoint status, scrubber temperature, box temperature, and output pressure. Additionally, this digital access provides the ability to remotely disable the internal pump, allowing longer service intervals and less power consumption. The user can also remotely start instrument warm-up prior to arrival at the site.

The T701 is a fully self-contained source of clean, dry air for dilution calibrators. It can also be used to create purge air for permeation tube ovens or burner air for FID analyzers. The T701 includes a dewpoint sensor, an oil and diaphragm-free pump, and scrubbers to remove SO₂, NO, NO₂, O₃, and H₂S. Optional high performance scrubbers are available to remove CO and Hydrocarbons.

The regenerative, heatless dryer removes water and produces output with a dewpoint of less than -20°C (up to 15 SLPM flow rate). The system's pressure, temperature, and dew point values are all continuously monitored, which allows a microcontroller to adjust the pump cycling frequency, valve timing, and heater power for optimal performance.

- » **Modbus Connectivity**
- » **Dewpoint Sensor**
- » **Once/year maintenance interval**
- » **Regenerative, heatless dryer for maintenance-free water removal**
- » **Long-life scrubbers for SO₂, NO, NO₂, O₃ and H₂S**
- » **Optional CO or CO/Hydrocarbon scrubber**
- » **Automatic water drain**
- » **Automatic pump control with demand tank**
- » **Two-year warranty**

Free Customer Support by telephone and email for the life of the instrument

Model T701 Zero Air System

Specifications

General

| | |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Output: | 20 SLPM at 30 psig |
| Max Delivery Pressure: | 35 psig |
| Dewpoint: | -20°C up to 16 SLPM / -10°C above 16 SLPM |
| Dryer: | Regenerative heatless dryer with lifetime of greater than 5 years |
| Output Concentration: | SO ₂ and H ₂ S <0.5 ppb NO <0.5 ppb NO ₂ <0.5 ppb O ₃ <0.5 ppb CO <0.025 ppm HC <0.2 ppm |
| Compressor: | Dual-cylinder, internal long life, oil-less piston pump |

Electrical Specifications

| | |
|---------------------|--------------------------------|
| Power Requirements: | 115V, 60 Hz 220-240V, 50 Hz |
|---------------------|--------------------------------|

Physical Specifications

| | |
|------------------------------|--------------------------------------------------|
| Operating Temperature Range: | 5 - 40°C |
| Dimensions (HxWxD): | 8.75" x 17" x 28" (22.2 cm x 43.2 cm x 71.12 cm) |
| Weight: | 56 lbs. (25.4 kg) |

Mounting

| | |
|-----------------------|--|
| Bench type (standard) | |
| Rack mount (optional) | |

How to Order

Model T701 includes:

- Two year warranty
- RS-232 port
- Ethernet port
- Dewpoint sensor

Options:

- Rack mount brackets (19")
- Rack mount with slides
- CO Scrubber
- Hydrocarbon & CO Scrubber
- 13 SLPM flow restriction

The values expressed above are in accordance with EPA definitions. All error specifications are based on constant conditions. Specifications exceed US EPA and Eignungsgeprüft requirements. Specifications subject to change without notice. Printed documents are uncontrolled. SA1D00083A (DON 6814) T701/12.16.13



9480 Carrol Park Drive ■ San Diego, CA 92121-6201
Ph. 858-667-9800 Fax 858-667-9816
Email api-sales@teledyne.com

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CR800 Series

Measurement and Control Datalogger

*Rugged, Reliable, and Ready
for any Application*



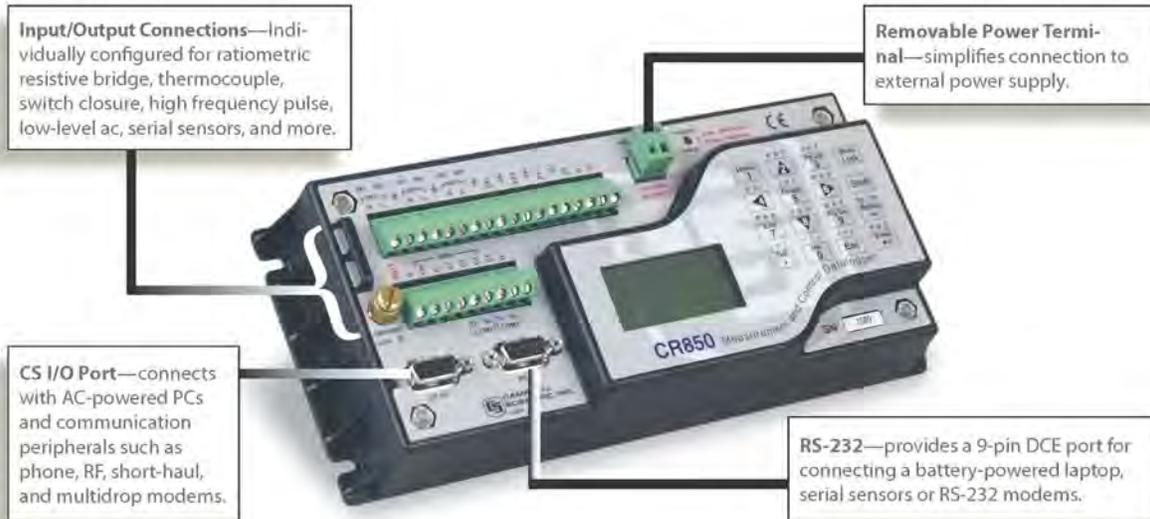
More info: 435.227.9000

campbellsci.com/cr800-series



CR800 and CR850 Measurement and Control Systems

The CR800 and CR850 dataloggers provide precision measurement capabilities in a rugged, battery-operated package. Both models consist of measurement electronics encased in a plastic shell and an integrated wiring panel. The standard operating range is -25° to +50°C. An extended range of -55° to +85°C for the CR800 or -30° to +80°C for the CR850 is also available.



Benefits and Features

- 4 MB* of battery-backed SRAM
- Program execution rate of up to 100 Hz
- CS I/O and RS-232 serial ports
- 13-bit analog to digital conversions
- 16-bit microcontroller with 32-bit internal CPU architecture
- Temperature compensated real-time clock
- Background system calibration for accurate measurements over time and temperature changes
- Single DAC used for excitation and measurements to give ratiometric measurements
- Gas Discharge Tube (GDT) protected inputs
- Data values stored in tables with a time stamp and record number
- Battery-backed SRAM and clock that ensure data, programs, and accurate time are maintained while datalogger is disconnected from the main power source
- One program-status LED
- Serial communications with serial sensors and devices supported via I/O port pairs
- PakBus, Modbus, and DNP3 protocols supported

Model Descriptions

The models differ in their keyboard display. The CR800 uses an external keyboard display, the CR1000KD, which connects to the CR800 via its CS I/O port. The CR850 includes an on-board keyboard display as part of its integrated package.

Operating System/Logic Control

The on-board operating system includes measurement, processing, and output instructions for programming the datalogger. The programming language, CRBasic, uses a BASIC-like syntax. Measurement instructions specific to bridge configurations, voltage outputs, thermocouples, and pulse/frequency signals are included. Processing instructions support algebraic, statistical, and transcendental functions for on-site processing. Output instructions process data over time and control external devices.

Storage Capacity*

The CR800 series has 2 MB of flash memory for the Operating System, and 4 MB of battery-backed SRAM for CPU usage, program storage, and data storage. Data is stored in a table format.

*Campbell Scientific is increasing the data storage memory from 2 MB to 4 MB. Dataloggers with a serial number greater than or equal to 3605 will have a 4 MB memory. The 4 MB dataloggers will also have a sticker on the canister stating "4M Memory".

Communication Options

To determine the best option for an application, consider the accessibility of the site, availability of services (e.g., cellular phone or satellite coverage), quantity of data to collect, and desired time between data-collection sessions. Some communication options can be combined—increasing the flexibility, convenience, and reliability of the communications.

External Data Storage Device

The CR800 and CR850 can use the SC115 2 GB Flash Memory Drive to augment onsite data storage or to transport data between the datalogger and PC.



The SC115 is a light-weight, portable instrument that fits in a pocket allowing easy transport between the datalogger and PC.

Keyboard Display

Keyboard displays are used to program the datalogger, manually initiate data transfer, and display data. Both the CR850's integrated keyboard display and the CR1000KD can show 8 lines by 21 characters (64 by 128 pixels). Their keyboard includes 16 characters. Custom menus are supported allowing customers to set up choices within the datalogger program that can be initiated by a simple "toggle" or "pick list".

Mountable Displays

The CD100 and CD295 can be mounted in an enclosure lid. The CD100 has the same functionality and operation as the CD1000KD, allowing both data entry and display without opening the enclosure. The CD295 displays real-time data only.

iOS Devices and Android Devices

An iOS device or Android device can be used to view and collect data, set the clock, and download programs. To use an iOS or Android device, go to the Apple Store or Google Play and purchase our LoggerLink Mobile Apps.

Direct Links

AC-powered PCs connect with the datalogger's CS I/O port via an SC32B or SC-USB interface. These interfaces provide optical isolation. A battery-powered laptop can be attached to the datalogger's RS-232 port via an RS-232 cable; no interface required.

Internet and IP Networks

The NL240 or NL201 interfaces enable the CR800-series datalogger to communicate with a PC via TCP/IP.

Multidrop Interface

The MD485 intelligent RS-485 interface permits a PC to address and communicate with one or more dataloggers over the CABLE2TP two-twisted pair cable. Distances up to 4000 feet are supported.

Radios

Radio frequency (RF) communications are supported via narrow-band UHF, narrow-band VHF, spread spectrum, or meteor burst radios. Line-of-sight is required for all of our RF options.

Telephone Networks

The CR800 series can communicate with a PC using landlines, cellular CDMA, or cellular GPRS transceivers. A voice synthesized modem enables anyone to call the datalogger via phone and receive a verbal report of real-time site conditions.

Short Haul Modems

The SRM-5A RAD Short Haul Modem supports communications between the datalogger and a PC via a four-wire unconditioned line (two twisted pairs).

Satellite Transmitters

Satellite transmitters offered by Campbell Scientific include a NESDIS-certified GOES transmitter, an Argos transmitter, and an Iridium transmitter. Satellite telemetry offers an alternative for remote locations where phone lines or RF systems are impractical.



Our GOES transmitters are used for stream stage (shown), water quality, and rainfall applications.

Channel Expansion

4-Channel Low Level AC Module

The LLAC4 is a small peripheral device that allows customers to increase the number of available low-level AC inputs by using control ports. This module is often used to measure up to four anemometers, and is especially useful for wind profiling applications.

Multiplexers

Multiplexers increase the number of sensors that can be measured by a datalogger by sequentially connecting each sensor to the datalogger. Several multiplexers can be controlled by a single datalogger. The CR800 and CR850 are compatible with the AM16/32B and AM25T multiplexers.

Synchronous Devices for Measurement (SDMs)

SDMs are addressable peripherals that expand the datalogger's measurement and control capabilities. For example, SDMs are available to add control ports, analog outputs, pulse count channels, interval timers, or even a CANbus interface to the system. Multiple SDMs, in any combination, can be connected to one datalogger.



The SDM-SIO1 Serial Input/Output Module is fully compliant with the RS-232 standards. It allows a CR800 or CR850 to communicate with up to 17 serial devices.

Software

Starter Software

Our easy-to-use starter software is intended for first time users or applications that don't require sophisticated communications or datalogger program editing. SCWin Short Cut generates straight-forward datalogger programs in four easy steps. PC200W allows customers to transfer a program to, or retrieve data from a CR800 or CR850 via a direct communications link.

At www.campbellsci.com/downloads, the starter software can be downloaded at no charge. Our Resource DVD also provides this software as well as PDF versions of our brochures and manuals.

Datalogger Support Software

Our datalogger support software packages provide more capabilities than our starter software. These software packages contains program editing, communications, and display tools that can support an entire datalogger network.

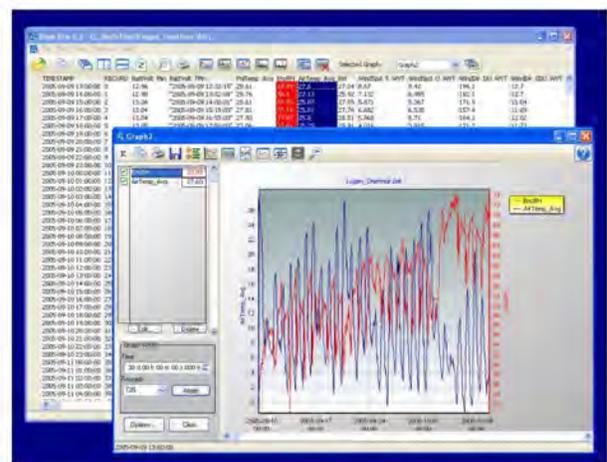


RTMC, a program for displaying the datalogger's data, is bundled with LoggerNet and RTDAQ. Customers may also purchase the RTMCRT and RTMC Web Server clients, which use forms created in the developer mode of RTMC.

PC400, our mid-level software, supports a variety of telemetry options, manual data collection, and data display. For programming, it includes both Short Cut and the CRBasic program editor. PC400 does not support combined communication options (e.g., phone-to-RF), PakBus® routing, and scheduled data collection.

RTDAQ is an ideal solution for industrial and real-time users desiring to use reliable data collection software over a single telecommunications medium, and who do not rely on scheduled data collection. RTDAQ's strength lies in its ability to handle the display of high-speed data.

LoggerNet is Campbell Scientific's full-featured datalogger support software. It is referred to as "full-featured" because it provides a way to accomplish almost all the tasks you'll need to complete when using a datalogger. LoggerNet supports combined communication options (e.g., phone-to-RF) and scheduled data collection.



Both LoggerNet and RTDAQ use View Pro to display historical data in a tabular or graphical format.

Applications

The measurement precision, flexibility, long-term reliability, and economical price of the CR800 and CR850 make them ideal for scientific, commercial, and industrial applications.

Meteorology

The CR800 series is used in long-term climatological monitoring, meteorological research, and routine weather measurement applications.



Meteorological conditions affecting marine larvae distribution are monitored at Exuma Cay, Bahamas.

Sensors the CR800 series can measure include:

- › cup, propeller, and sonic anemometers
- › tipping bucket rain gages
- › wind vanes
- › pyranometers
- › ultrasonic ranging sensor
- › thermistors, RTDs, and thermocouples
- › barometers
- › RH probes

Data is output in a choice of units (e.g., wind speed in miles per hour, meters per second, or knots). Standard outputs include wind vector averaging, sigma, theta, and histograms.

Agriculture and Agricultural Research

The versatility of the CR800 and CR850 allows measurement of agricultural processes and equipment in applications such as:

- › plant water research
- › canopy energy balance
- › plant pathology
- › machinery performance
- › frost prediction
- › crop management decisions
- › food processing/storage
- › integrated pest management
- › irrigation scheduling

Wind Profiling

Our data acquisition systems can monitor conditions at wind assessment sites, at producing wind farms, and along transmission lines. The reliability of these systems ensures data collection, even under adverse conditions. Wide operating temperature ranges and weatherproof enclosures allow our systems to operate reliably in harsh environments.

The CR800 or CR850 makes and records measurements, controls electrical devices, and can function as PLCs or RTUs. Because the datalogger has its own power supply (batteries, solar panels), it can continue to measure and store data and perform control during power outages.

Typical sensors for wind assessment applications include, but are not limited to:

- › cup, propeller, and sonic anemometers (up to 10 anemometers can be measured by using two LLAC4 peripherals)
- › wind vanes
- › thermistors, RTDs, and thermocouples
- › barometers
- › pyranometers

For turbine performance applications, the CR800 series monitors electrical current, voltage, wattage, stress, and torque.



A Campbell Scientific datalogging system monitors this offshore wind farm located between Rhyl and Prestatyn in North Wales at about 7 to 8 km out to sea.

Air Quality

The CR800 series can monitor and control gas analyzers, particle samplers, and visibility sensors. The datalogger can also automatically control calibration sequences and compute conditional averages that exclude invalid data (e.g., data recorded during power failures or calibration intervals).

Water Resources/Aquaculture

Our CR800 series is well-suited to remote, unattended monitoring of hydrologic conditions. Most hydrologic sensors, including SDI-12 probes, interface directly to the datalogger.



The CR800-series dataloggers are ideal for monitoring water quality and level at reservoirs, springs, canals, pipelines, and culinary sites.

Typical hydrologic measurements:

- **Water level** is monitored with incremental shaft encoders, double bubblers, ultrasonic ranging sensors, resistance tapes, strain gage pressure transducers, or vibrating wire pressure transducers. Vibrating wire transducers require an CDM-VW300-series, AWW200-series or another vibrating wire interface.
- **Well draw-down tests** use a pressure transducer measured at logarithmic intervals or at a rate based on incremental changes in water level.
- **Ionic conductivity measurements** use one of the switched excitation ports from the datalogger.
- **Samplers** are controlled by the CR800 or CR850 as a function of time, water quality, or water level.
- **Alarm and pump actuation** are controlled through digital I/O ports that operate external relay drivers

Vehicle Testing

This versatile, rugged datalogger is ideally suited for testing cold and hot temperature, high altitude, off-highway, and cross-country performance. The CR800 and CR850 are compatible with our SDM-CAN interface, GPS16X-HV5 receiver.

Vehicle monitoring includes not only passenger cars, but airplanes, locomotives, helicopters, tractors, buses, heavy trucks, drilling rigs, race cars, and motorcycles.



Soil Moisture

The CR800 and CR850 are compatible with the following soil moisture measurement technologies:

- **Soil moisture blocks** are inexpensive sensors that estimate soil water potential.
- **Matric water potential sensors** also estimate soil water potential but are more durable than soil moisture blocks.
- **Time-Domain Reflectometry Systems (TDR)** use a reflectometer controlled by the datalogger to accurately measure soil water content. Multiplexers allow sequential measurement of a large number of probes by one reflectometer.
- **Self-contained water content reflectometers** are sensors that emit and measure a TDR pulse.
- **Tensiometers** measure the soil pore pressure of irrigated soils and calculate soil moisture.

Other Applications

- Wireless sensor/datalogger networks
- Avalanche forecasting, snow science, polar, high altitude.
- Fire weather
- Geotechnical
- Historic preservation

Data measured by this weather station near Aspen, Colorado is used in avalanche forecasting.



CR800-Series Specifications

Electrical specifications are valid over a -25° to +50°C, non-condensing environment, unless otherwise specified. Recalibration recommended every three years. Critical specifications and system configuration should be confirmed with Campbell Scientific before purchase.

PROGRAM EXECUTION RATE

10 ms to one day @ 10 ms increments

ANALOG INPUTS (SE1-SE6 or DIFF1-DIFF3)

3 differential (DIFF) or 6 single-ended (SE) individually configured input channels. Channel expansion provided by optional analog multiplexers.

RANGES and RESOLUTION: Basic resolution (Basic Res) is the resolution of a single A/D conversion. A DIFF measurement with input reversal has better (finer) resolution by twice than Basic Res.

| Range (mV) ¹ | DIFF Res (µV) ² | Basic Res (µV) |
|-------------------------|----------------------------|----------------|
| ±5000 | 667 | 1333 |
| ±2500 | 333 | 667 |
| ±250 | 33.3 | 66.7 |
| ±25 | 3.33 | 6.7 |
| ±7.5 | 1.0 | 2.0 |
| ±2.5 | 0.33 | 0.67 |

¹Range overhead of ~9% on all ranges guarantees that full-scale values will not cause over range.

²Resolution of DIFF measurements with input reversal.

ACCURACY³:

±(0.06% of reading + offset), 0° to 40°C
 ±(0.12% of reading + offset), -25° to 50°C
 ±(0.18% of reading + offset), -55° to 85°C (-XT only)

³Accuracy does not include sensor and measurement noise. Offsets are defined as:

Offset for DIFF w/input reversal = 1.5·Basic Res + 1.0 µV
 Offset for DIFF w/o input reversal = 3·Basic Res + 2.0 µV
 Offset for SE = 3·Basic Res + 3.0 µV

ANALOG MEASUREMENT SPEED:

| Integra- tion Type/ Code | Integra- tion Time | Settling Time | Total Time ⁴ | |
|--------------------------------|-----------------------|------------------|-------------------------|----------------------|
| | | | SE w/ No Rev | DIFF w/ Input Rev |
| 250 | 250 µs | 450 µs | ~1 ms | ~12 ms |
| 60 Hz ⁵ | 16.67 ms | 3 ms | ~20 ms | ~40 ms |
| 50 Hz ⁵ | 20.00 ms | 3 ms | ~25 ms | ~50 ms |

⁴Includes 250 µs for conversion to engineering units.

⁵AC line noise filter.

INPUT NOISE VOLTAGE: For DIFF measurements with input reversal on ±2.5 mV input range, digital resolution dominates for higher ranges.

250 µs Integration: 0.34 µV RMS
 50/60 Hz Integration: 0.19 µV RMS

INPUT LIMITS: ±5 V

DC COMMON MODE REJECTION: >100 dB

NORMAL MODE REJECTION: 70 dB @ 60 Hz when using 60 Hz rejection

INPUT VOLTAGE RANGE W/O MEASUREMENT

CORRUPTION: ±8.6 Vdc max.

SUSTAINED INPUT VOLTAGE W/O DAMAGE: ±16 Vdc max.

INPUT CURRENT: ±1 nA typical, ±6 nA max. @ 50°C;
 ±90 nA @ 85°C

INPUT RESISTANCE: 20 GΩ typical

ACCURACY OF BUILT-IN REFERENCE JUNCTION

THERMISTOR (for thermocouple measurements):
 ±0.3°C, -25° to 50°C
 ±0.8°C, -55° to 85°C (-XT only)

ANALOG OUTPUTS (VX1-VX2)

2 switched voltage outputs sequentially active only during measurement.

RANGE AND RESOLUTION:

| Channel | Range | Resolution | Current Source/Sink |
|----------|----------|------------|---------------------|
| (VX 1-2) | ±2.5 Vdc | 0.67 mV | ±25 mA |

Voltage outputs programmable between ±2.5 V with 0.67 mV resolution.

ANALOG OUTPUT ACCURACY (VX):

±(0.06% of setting + 0.8 mV), 0° to 40°C
 ±(0.12% of setting + 0.8 mV), -25° to 50°C
 ±(0.18% of setting + 0.8 mV), -55° to 85°C (-XT only)

Vx FREQUENCY SWEEP FUNCTION: Switched outputs provide a programmable swept frequency, 0 to 2500 mV square waves for exciting vibrating wire transducers.

PERIOD AVERAGE

Any of the 6 SE analog inputs can be used for period averaging. Accuracy is ±(0.01% of reading + resolution), where resolution is 136 ns divided by the specified number of cycles to be measured.

INPUT AMPLITUDE AND FREQUENCY:

| Voltage Gain | Input Range (x.mV) | Input Signal (peak to peak) | | Min Pulse Width (µV) | Max ⁸ Freq (kHz) |
|--------------|--------------------|-----------------------------|----------------------|----------------------|-----------------------------|
| | | Min (mV) ⁶ | Max (V) ⁷ | | |
| 1 | 250 | 500 | 10 | 2.5 | 200 |
| 10 | 25 | 10 | 2 | 10 | 50 |
| 33 | 7.5 | 5 | 2 | 62 | 8 |
| 100 | 2.5 | 2 | 2 | 100 | 5 |

⁶Signal centered around Threshold (see PeriodAvg0 instruction).

⁷Signal centered around datalogger ground.

⁸Maximum frequency is 1/(twice minimum pulse width) for 50% of duty cycle signals.

RATIOMETRIC MEASUREMENTS

MEASUREMENT TYPES: Provides ratiometric resistance measurements using voltage excitation. Three switched voltage excitation outputs are available for measurements of 4- and 6-wire full bridges, and 2-, 3-, and 4-wire half bridges. Optional excitation polarity reversal minimizes dc errors.

RATIOMETRIC MEASUREMENT ACCURACY^{9,10,11}

±(0.04% of voltage measurement + offset)

⁹Accuracy specification assumes excitation reversal for excitation voltages < 1000 mV. Assumption does not include bridge resistor errors and sensor and measurement noise.

¹⁰Estimated accuracy, ΔX (where X is value returned from the measurement with Multiplier =1, Offset = 0):

BrHalf() instruction: ΔX = ΔV/V_{EX}

BrFull() instruction: ΔX = 1000·ΔV/V_{EX}, expressed as mV·V⁻¹

ΔV¹ is calculated from the ratiometric measurement accuracy. See Resistance Measurements Section in the manual for more information.

¹¹Offsets are defined as:

Offset for DIFF w/input reversal = 1.5·Basic Res + 1.0 µV
 Offset for DIFF w/o input reversal = 3·Basic Res + 2.0 µV
 Offset for SE = 3·Basic Res + 3.0 µV

Excitation reversal reduces offsets by a factor of two.

PULSE COUNTERS (P1-P2)

2 inputs individually selectable for switch closure, high frequency pulse, or low-level ac. Independent 24-bit counters for each input.

MAXIMUM COUNTS PER SCAN: 16.7 x 10⁸

SWITCH CLOSURE MODE:

Minimum Switch Closed Time: 5 ms
 Minimum Switch Open Time: 6 ms
 Max. Bounce Time: 1 ms open w/o being counted

HIGH FREQUENCY PULSE MODE:

Maximum Input Frequency: 250 kHz
 Maximum Input Voltage: ±20 V
 Voltage Thresholds: Count upon transition from below 0.9 V to above 2.2 V after input filter with 1.2 µs time constant.

LOW LEVEL AC MODE: Internal ac coupling removes dc offsets up to ±0.5 V.

Input Hysteresis: 12 mV @ 1 Hz

Maximum ac Input Voltage: ±20 V

Minimum ac Input Voltage: ±20 mV

| Sine Wave (mV RMS) | Range(Hz) |
|--------------------|---------------|
| 20 | 1.0 to 20 |
| 200 | 0.5 to 200 |
| 2000 | 0.3 to 10,000 |
| 5000 | 0.3 to 20,000 |

DIGITAL I/O PORTS (C1-C4)

4 ports software selectable, as binary inputs or control outputs. Provide on/off, pulse width modulation, edge timing, subroutine interrupts/wake up, switch closure pulse counting, high-frequency pulse counting, asynchronous communications (UARTs), SDI-12 communications, and SDM communications.

LOW FREQUENCY MODE MAX: <1 kHz

HIGH FREQUENCY MAX: 400 kHz

SWITCH CLOSURE FREQUENCY MAX: 150 Hz

EDGE TIMING RESOLUTION: 540 ns

OUTPUT VOLTAGES (no load): high 5.0 V ±0.1 V; low <0.1

OUTPUT RESISTANCE: 330 Ω

INPUT STATE: high 3.8 to 16 V; low -8.0 to 1.2 V

INPUT HYSTERESIS: 1.4 V

INPUT RESISTANCE:

100 kΩ with inputs <6.2 Vdc

220 Ω with inputs >6.2 Vdc

SERIAL DEVICE / RS-232 SUPPORT: 0 to 5 Vdc UART

SWITCHED 12 V (SW12)

One independent 12 Vdc unregulated source is switched on and off under program control. Thermal fuse hold current = 900 mA @ 20°C, 650 mA @ 50°C, 360 mA @ 85°C.

CE COMPLIANCE

STANDARD(S) TO WHICH CONFORMITY IS DECLARED IEC61326:2002

COMMUNICATIONS

RS-232 PORTS:

DCE 9-pin: (not electrically isolated) for computer connection or connection of modems not manufactured by Campbell Scientific.

COM1 to COM2: Two independent TX/Rx pairs on control ports (non-isolated); 0 to 5 Vdc UART

Baud Rate: selectable from 300 bps to 115.2 kbps.

Default Format: 8 data bits; 1 stop bit; no parity

Optional Formats: 7 data bits; 2 stop bits; odd, even parity

CS I/O PORT: Interface with telecommunication peripherals manufactured by Campbell Scientific

SDI-12: Digital control ports C1 or C3 are individually configurable and meet SDI-12 Standard version 1.3 for datalogger mode. Up to 10 SDI-12 sensors are supported per port.

PROTOCOLS SUPPORTED: PakBus, AES-128 Encrypted PakBus, Modbus, DNP3, FTP, HTTP, XML, HTML, POP3, SMTP, Telnet, NTCIP, NTR, Web API, SDI-12, SDM

SYSTEM

PROCESSOR: Renesas H8S 2322 (16-bit CPU with 32-bit internal core running at 7.4 MHz)

MEMORY: 2 MB of flash for operating system; 4 MB of battery-backed SRAM for CPU usage, program storage and final data storage

RTC CLOCK ACCURACY: ±3 min. per year. Correction via GPS optional.

RTC CLOCK RESOLUTION: 10 ms

SYSTEM POWER REQUIREMENTS

VOLTAGE: 9.6 to 16 Vdc

INTERNAL BATTERIES: 1200 mA h lithium battery for clock and SRAM backup, typically provides 3 years of backup

EXTERNAL BATTERIES: Optional 12 Vdc nominal alkaline and rechargeable available. Power connection is reverse polarity protected.

TYPICAL CURRENT DRAIN @ 12 Vdc:

Sleep Mode: 0.7 mA typical; 0.9 mA max.

1 Hz Sample Rate (1 fast SE measurement): 1 mA

100 Hz Sample Rate (1 fast SE measurement): 16.2 mA

100 Hz Sample Rate (1 fast SE meas w/RS-232 communication): 28 mA

Active external keyboard display adds 7 mA (100 mA w/ill backlight on).

PHYSICAL

DIMENSIONS: 24.1 x 10.4 x 5.1 cm (9.5 x 4.1 x 2 in); additional clearance required for cables and leads.

WEIGHT: 0.7 kg (1.5 lb)

WARRANTY

3-years-against defects in materials and workmanship.



Campbell Scientific, Inc. | 815-W 1800 N | Logan, UT 84321-1784 | (435) 227-9000 | www.campbellsci.com
 USA | AUSTRALIA | BRAZIL | CANADA | CHINA | COSTA RICA | ENGLAND | FRANCE | GERMANY | SOUTH AFRICA | SPAIN

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 November 12, 2014

CradlePoint ARC MBR1400 Series

INTEGRATED MOBILE BROADBAND ROUTER

Wireless WAN connectivity for distributed business locations



Keep your business network online with high-speed wireless broadband

WIRELESS WAN CONNECTIVITY

CradlePoint ARC MBR1400 Series routers enable easy-to-install wireless connectivity in fixed-business locations. Ideal for distributed enterprises such as branch offices, retail POS locations, restaurants, and small businesses, the MBR1400 provides wired Ethernet and 3G/4G wireless WAN connectivity to keep your business up and running.

BUSINESS CONTINUITY

As businesses increasingly depend on cloud computing and remote applications, reliable Internet connectivity becomes mission-critical for business success. CradlePoint's integrated business series routers combine the power and flexibility of our flagship router with an embedded business-grade wireless WAN modem for a fully-integrated business continuity solution.

ENTERPRISE PERFORMANCE

The ARC MBR1400 Series routers offer the latest in high-speed 3G/4G wireless connectivity to deliver the continuous uptime and bandwidth needed to support growth in cloud computing and ensure against loss of productivity and business opportunity.

The MBR1400 now supports these enterprise routing protocols:* BGP, OSPF, and RIP; VRRP for router redundancy; and STP.

FLEXIBLE

- Use the integrated 3G/4G wireless modem as the primary connection or as failover from a wired connection.
- Create secondary networks to simplify PCI compliance, video surveillance, digital signs, kiosks, etc.
- Load balance across multiple wired and wireless connections when additional bandwidth is required.

*BGP, OSPF, RIP, VRRP, and STP require hardware version 2.0.

SECURE AND RELIABLE

- LAN connections are protected with advanced WiFi encryption, LAN Segmentation, and VLAN capabilities.
- Main office access and POS transactions are protected by VPN capability and other security features to ensure your network stays secure.
- Designed for PCI compliant network architectures.
- Engineered for day-in, day-out 24/7 Internet connectivity, CradlePoint integrated business series routers ensure reliable connections when you need them.

WIPIPE CENTRAL: CLOUD-ENABLED MANAGEMENT

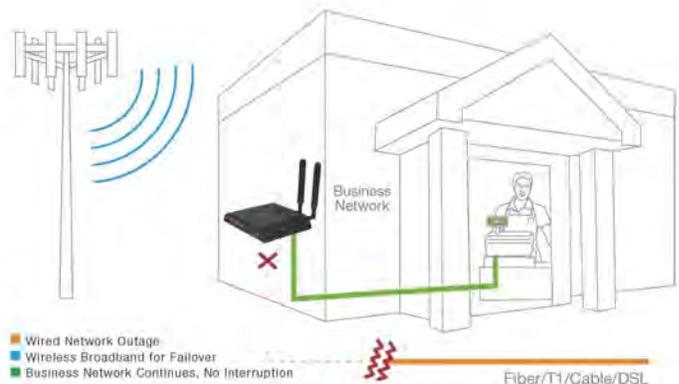
Rapidly deploy and dynamically manage networks at geographically distributed stores and branch locations with WiPipe Central, a cloud-enabled application and security platform. WiPipe Central integrates cloud management with your CradlePoint devices to improve productivity, increase reliability, reduce costs, and enhance the intelligence of your network and business operations.

Subscription required. See cradlepoint.com/wipipe for details.

CRADLECARE SERVICES

The MBR1400 comes with a standard 1 year warranty. For extended warranties and other enhanced services including enterprise-level support, site surveys, and expert installation, check out CradlePoint's CradleCare suite of services.

Subscription required. See cradlepoint.com/cradlecare for details.



www.cradlepoint.com/ARCMBR1400

ARC MBR1400 Integrated Mobile Broadband Router

Key Features and Benefits

Internet Access and Device Connectivity

- Integrated high-speed 3G/4G modem – see attached specifications
- 5 Ethernet 10/100/1000 LAN/WAN ports for Ethernet-enabled devices or landline Internet
- Wireless LAN – WiFi (802.11 a/b/g/n) supports up to 128 connections at a time

Business Continuity: Failover/Failback

- Automatic failover to wireless WAN connection when wired WAN disruption occurs, automatic failback when wired WAN connection is restored
- Load balancing across multiple wired and wireless WANs for more bandwidth
- Proactive alerts when failover occurs through WiPipe Central™
- VRRP for enterprise router redundancy (hardware version 2.0 only)

Flexibility

- First-time and advanced setup wizards for easy, swift, and secure setup
- One-page dashboard to view router status and configuration
- Remote management with WiPipe Central™, SNMP v1/2c/3, and CLI over SSH
- Four SSIDs, with individual security and QoS settings, to separate critical traffic or create a public WiFi hotspot with a captive portal (terms of service, ads, etc.)
- *WiFi as WAN* mode enables use as a WiFi repeater, WiFi Bridge, or as a WiFi-to-Ethernet adapter for Ethernet-enabled devices
- Multiple Ethernet ports can be configured to “WAN Mode” to provide wireless and wired failover and load balancing
- Data Usage management and alerts to monitor data usage and avoid overages
- LAN/WAN Affinity to assign specific LAN traffic to a WAN
- Serial console available for out-of-band management of another device (with USB-to-serial cable)
- Enterprise routing protocols: BGP, OSPF, RIP (hardware version 2.0 only)
- Advanced diagnostics tools including: topdump, netfilter, traceroute

Security

- IPsec VPN (up to 20 concurrent sessions) with GRE Tunneling option, also supports passthrough VPN connections (IPsec, L2TP, PPTP)
- WEP, WPA, WPA2, and AES encryption for secure WiFi
- SPI (stateful packet inspection) firewall and NAT (network address translation) to prevent unwanted access to connected computers
- Advanced security mode and reporting to facilitate PCI-DSS compliance
- Variety of security features (URL filtering, IP & traffic filtering, DMZ, port forwarding) for safer Internet access
- 802.1Q VLAN support to isolate, segment, and secure your network

Service, Support, and Warranty

- CradleCare Premier 1, 2, and 3 year Enterprise Support Agreements available with 24/7 technical support, software upgrades, and advanced hardware exchange
- Limited 1 year warranty included, access to software updates and hardware repair or replacement – 2 and 3 year warranty extensions available
- CradleCare Site Survey and Installation services offered for rapid deployment

Specifications

- WAN** Wireless WAN modems, 10/100/1000 Ethernet ports (cable/DSL/T1/satellite modems), WiFi (as WAN) 3x3 MIMO *N* 2.4 GHz or 5 GHz (802.11 a/b/g/n)
- LAN** WiFi (802.11 a/b/g/n), five 10/100/1000 Ethernet ports (WAN/LAN switchable), serial console support w/ USB-to-serial adapter
- TEMPERATURE** 0°C to 40°C (32°F to 104°F) operating, -20°C to 70°C (-4°F to 158°F) storage
- RELATIVE HUMIDITY** (non-condensing) 10% to 85%, operating 5% to 90%, storage
- SIZE** 9x5.1x1.8 in (230x130x40 mm) or 9x7.25x1.6 in (230x185x40 mm)
- CERTIFICATIONS** FCC, WiFi Alliance, CE, IC, carrier certifications
- WIFI POWER** Transmit power: 25 dBm typ for all modes; receive sensitivity: -89 dBm typ (11n), -72 dBm typ (11g), -84 dBm typ (11b)

What's In The Box

- ARC MBR1400 with integrated business-class wireless WAN modem
- External 3G or 4G mobile broadband modem antennas (2) (SMA) w/ multiplexing for GPS (on some models), finger tighten only
- External high-gain WiFi antennas (3) reverse SMA (2 dB), 2.4 GHz, finger tighten only
- 12V / 1.5A power supply
- Quick Start Guide with warranty information

Requirements

- Internet Service** Active mobile broadband plan with cellular provider or Ethernet-based Internet connection (DSL, Cable, T1)
- Browser** (to configure router) Minimum of Firefox v2.0, Internet Explorer v7.0, Chrome, or Safari v1.0

Router Details

- WAN Security** NAT, SPI, ALG, inbound filtering of IP addresses, port blocking, service filtering (FTP, SMTP, HTTP, RPL, SNMP, DNS, ICMP, NNTP, POP3, SSH), protocol filtering, WAN ping (allow/ignore)
- Redundancy and Load Balancing** Failover/failback with 4G, 3G, Ethernet with rule selection, advanced load balancing options (round robin, spillover, data usage, rate), WAN failure detection, VRRP*
- Intelligent Routing** UPnP, DMZ, virtual server/port forwarding, routing rules, NAT-less routing, wired or wireless WAN-to-LAN IP passthrough, route management, per-interface routing, content filtering, IP filtering, website filtering, per-client Web filtering, local DHCP server, DHCP client, DHCP relay, DNS, DNS proxy; ALGs: PPTP, L2TP, PPPoE passthrough, IPsec passthrough, FTP (passive), FTP (active), SIP, TFTP, IRC, MAC address filtering, Dynamic DNS, LAN/WAN affinity, VLAN support (802.1Q), STP,* enterprise routing protocols:* BGP/OSPF/RIP, multicast proxy support,* IP setting overrides
- Management** WiPipe Central™ cloud-enabled management and application platform (subscription-based); web-based GUI (local management), optional RADIUS or TACACS+ username/password; remote WAN web-based management w/ access control (HTTP, HTTPS); SNMP v1, v2c, & v3; CLI over SSH, SSH to serial, SSH to telnet; API; one-button firmware upgrade; modem configuration, update, and management; modem data usage w/ alerts, per-client data usage; custom AT scripting to modems
- Performance & Health Monitoring** WiPipe™ advanced CoS with traffic shaping, with DSCP/DiffServe QoS, Modem Health Management (MHM) improves connectivity of modem, SSID-based priority, WAN port speed control, several levels of basic and advanced logging for troubleshooting
- VPN** (IPsec) Tunnel, NAT-T, and transport modes; connect to CradlePoint, Cisco/Linksys, CheckPoint, Watchguard, Juniper, SonicWall, Adtran and others; certificate support; Hash (MD5, SHA128, SHA256, SHA384, SHA512), Cipher (AES, 3DES, DES); support for 20 concurrent connections, GRE tunneling, multiple networks supported in a single tunnel, site-to-site dynamic VPN with NHRP*
- GPS** Standalone GPS supported on most models (see attached); GUI mapping as well as local (LAN) or remote (WAN) server logging

*Requires hardware version 2.0



One-year limited hardware warranty only available in the US and Canada. Product specifications are subject to change without notice. This product requires either an active subscription from a wireless service provider or Ethernet-based broadband service from an Internet service provider to receive Internet service. Check with your broadband provider for service coverage, fees, and other charges. © 2013 CradlePoint, Inc. All rights reserved. CradlePoint, WiPipe™, and the WiPipe logo are trademarks of CradlePoint, Inc. in the US and other countries. Other trademarks are the property of their respective owners.

Ordering information

| ARC MBR1400 Integrated Business Series Routers | |
|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| ARC MBR1400LE-VZ | Business series router with dual-mode, high-performance 4G LTE / EVDO wireless WAN connection for the Verizon network (802.11 a/b/g/n WiFi) |
| ARC MBR1400LP-AT | Business series router with dual-mode, high-performance 4G LTE / HSPA+ wireless WAN connection for the AT&T network (802.11 a/b/g/n WiFi) |
| ARC MBR1400W | Business series router with high-performance WiMAX wireless WAN connection for the Sprint or CLEAR networks (802.11 a/b/g/n WiFi) |

| Cloud-Enabled Management and Application Platform | |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WiPipe Central | <p>Rapidly deploy and dynamically manage networks at geographically distributed stores and branch locations with WiPipe Central, a cloud-enabled application and security platform. WiPipe Central integrates cloud management with your CradlePoint devices to improve productivity, increase reliability, reduce costs, and enhance the intelligence of your network and business operations.</p> <ul style="list-style-type: none"> • Deployment – configure devices by groups or individually, and update firmware easily with a few clicks. • Management – monitor device statuses and set proactive alerts for optimized 3G/4G data usage and network uptime. • Intelligence – view network analytics, manage security and PCI compliance, and measure mobile customer traffic using WiFi analytics. <p>Annual and multi-year licenses available. See cradlepoint.com/wipipe for details.</p> |

| Enterprise Support Agreements | |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CradleCare Premium | <p>When your applications are mission critical, you need the assurance that only the CradleCare Premier plan can provide: 24-hour coverage every day, all year – including holidays. As a CradleCare Premier customer, you will be assigned an account engineer* for consistency and follow-up on all your cases, with periodic case reviews provided.</p> <ul style="list-style-type: none"> • Complete technical support, 24/7 coverage; unlimited 24-hour technical support center assistance; extended warranty; next-day parts replacement; assigned account engineer*; guaranteed response times; online video-based training sessions; software bug fixes and upgrades; advanced replacement; access to CradlePoint Enterprise Advanced Services Knowledge Base and online documentation. <p>*Account engineer for customers with 50+ sites.</p> |
| CradleCare Warranty Extension | <p>This plan represents an extension of the standard 1-year CradlePoint warranty to 2 or 3 years.</p> <ul style="list-style-type: none"> • One-time enterprise technical support; software bug fixes; access to CradlePoint Enterprise Advanced Services Knowledge Base and online documentation; hardware repair/replacement. |

| Accessories (see CradlePoint's antenna ordering and installation guide for more information) | |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Part # 170587-000 | Directional Patch antennas for external (outside) mounting |
| Part # 170588-000 | Directional Yagi (Log-Periodic) antennas for external (outside) mounting |
| Part # 170586-000 | Omni-directional antennas for external (outside) mounting |
| Part # 170605-000 | 12" Mag-mount antenna |
| Part # 170606-000 | 4" Mini mag-mount antenna |

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One-year limited hardware warranty only available in the US and Canada. Product specifications are subject to change without notice. This product requires either an active subscription from a wireless service provider or Ethernet-based broadband service from an Internet service provider to receive Internet service. Check with your broadband provider for service coverage, fees, and other charges. © 2013 CradlePoint, Inc. All rights reserved. CradlePoint, WiPipe™, and the WiPipe logo are trademarks of CradlePoint, Inc. in the US and other countries. Other trademarks are the property of their respective owners.

BUSINESS-GRADE MODEM SPECIFICATIONS:

| ARC MBR1400LE-VZ | 4G LTE/EVDO for Verizon |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Technology: LTE, EVDO Rev A | |
| Downlink Rates: LTE 100 Mbps, EVDO 3.1 Mbps (theoretical) | |
| Uplink Rates: LTE 50 Mbps, EVDO 1.8 Mbps (theoretical) | |
| Frequency Bands: <ul style="list-style-type: none"> • LTE Band 13 (700 MHz) • CDMA EVDO Rev A/1xRTT (800/1900 MHz) | |
| Power: LTE 23 +/- 1 dBm, EVDO 24 +/- 1 dBm (typical conducted) | |
| Module: Sierra Wireless MC7750 | |
| Antennas: two SMA male (plug), 1 dBi (LTE), 2 dBi (Cellular/PCS) gain; finger tighten only; maximum torque spec is 7 kgf-cm | |
| GPS: standalone GPS support | |
| Industry Standards & Certs: FCC, Verizon | |
| Modem Part Number: MC200LE-VZ | |

| ARC MBR1400LP-AT | 4G/3G LTE/HSPA+ for AT&T |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Technology: LTE, HSPA+ | |
| Downlink Rates: LTE 100 Mbps, HSPA+ 21.1 Mbps (theoretical) | |
| Uplink Rates: LTE 50 Mbps, HSPA+ 5.76 Mbps (theoretical) | |
| Frequency Bands: <ul style="list-style-type: none"> • LTE Band 17 (700 MHz), Band 4 (AWS) • HSPA+/UMTS (850/1900/2100 MHz) • GSM/GPRS/EDGE (850/900/1800/1900 MHz) | |
| Power: LTE 23 +/- 1 dBm, UMTS 23 +/- 1 dBm (typical conducted) | |
| Module: Sierra Wireless MC7700 | |
| Antennas: two SMA male (plug), 1 dBi (LTE), 2 dBi (Cellular/PCS) gain; finger tighten only; support for GPS on aux connection | |
| GPS: standalone GPS support | |
| Industry Standards & Certs: PTCRB, FCC, IC, AT&T | |
| Modem Part Number: MC200LP-AT | |

| ARC MBR1400W | 4G WiMAX for Sprint or CLEAR |
|--------------------------------------------------------------------------------------------------------|------------------------------|
| Technology: WiMAX 802.16e Wave 2 | |
| Downlink Rates: 10 Mbps peak, 6 Mbps average | |
| Uplink Rates: 5 Mbps peak, 1.2 Mbps average | |
| Frequency Band: 2500 MHz band | |
| Power: 23.5 +/- 0.5 dBm (RSU/CPE) | |
| Module: Beceem 250 chipset | |
| Antennas: two SMA male (plug), 5 dBi gain; finger tighten only; maximum torque spec is 7 kgf-cm | |
| GPS: no GPS support | |
| Industry Standards & Certs: FCC, Sprint, CLEAR | |
| Modem Part Number: MC100W | |

Customers for over 35 years include:

- Commercial industries domestic and overseas
- State and Federal governments domestic and overseas
- Oil refineries
- Power generating stations
- Chemical industries
- Communication system providers
- Military, domestic and foreign
- Off-shore installations

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Standard Industrial Estates
83 Eagle Drive
P.O. Box 448
Sawford, ME 04073 USA
Tel: 207-334-4427
Fax: 207-334-4867
E-mail: info@ekto.com
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Your required shelter is custom designed with many options:

Available sizes: 2' x 2' x 2' up to 10' x 12' (W x H) and double wide units up to 24' W

STRUCTURAL

Concentrated load framing
Designs and anchors
Clear heights
Staircases, catwalks, steel ladders
Interior materials: aluminum (od);
insulation: polyurethane or other
Partitions: with or without door

FINISHES

Size and location
Lining: enamel, stainless steel, etc.
Interior materials: aluminum (od);
insulation: polyurethane or other
Partitions: with or without door

FLUORING

Industrial: ammonia, cyanide or non-alkali
Aluminum: hexachloro
Chemical: lithium

ELECTRICAL

Power: entrance hardwired or plug-in
Power distribution panel
Switches & lights, meter and meter
Cable tray
Lighting: incandescent or
energy-efficient power supply
Wiretrunking
Wiretrunking voltage

CLIMATE CONTROL

Air conditioning, air or water cooled
Heating
Humidification
Dehumidification
Exhaust areas

DESIGN OPTIONS

For site use
Special skid or beam frame
Jackets for transport building
Landing pads
Walkways, stairs or
other site infrastructure
Capacities to suit

8000 2017 2008 2007 2006 2005 2004 2003 2002 2001 2000 1999 1998 1997 1996 1995 1994 1993 1992 1991 1990 1989 1988 1987 1986 1985 1984 1983 1982 1981 1980 1979 1978 1977 1976 1975 1974 1973 1972 1971 1970 1969 1968 1967 1966 1965 1964 1963 1962 1961 1960 1959 1958 1957 1956 1955 1954 1953 1952 1951 1950 1949 1948 1947 1946 1945 1944 1943 1942 1941 1940 1939 1938 1937 1936 1935 1934 1933 1932 1931 1930 1929 1928 1927 1926 1925 1924 1923 1922 1921 1920 1919 1918 1917 1916 1915 1914 1913 1912 1911 1910 1909 1908 1907 1906 1905 1904 1903 1902 1901 1900 1899 1898 1897 1896 1895 1894 1893 1892 1891 1890 1889 1888 1887 1886 1885 1884 1883 1882 1881 1880 1879 1878 1877 1876 1875 1874 1873 1872 1871 1870 1869 1868 1867 1866 1865 1864 1863 1862 1861 1860 1859 1858 1857 1856 1855 1854 1853 1852 1851 1850 1849 1848 1847 1846 1845 1844 1843 1842 1841 1840 1839 1838 1837 1836 1835 1834 1833 1832 1831 1830 1829 1828 1827 1826 1825 1824 1823 1822 1821 1820 1819 1818 1817 1816 1815 1814 1813 1812 1811 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FINISHED AND CUSTOM DESIGNS
Custom design shelter is custom designed with many options:
Available sizes: 2' x 2' x 2' up to 10' x 12' (W x H) and double wide units up to 24' W



STRUCTURAL
Concentrated load framing
Designs and anchors
Clear heights
Staircases, catwalks, steel ladders
Interior materials: aluminum (od);
insulation: polyurethane or other
Partitions: with or without door

FINISHES
Size and location
Lining: enamel, stainless steel, etc.
Interior materials: aluminum (od);
insulation: polyurethane or other
Partitions: with or without door

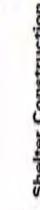
FLUORING
Industrial: ammonia, cyanide or non-alkali
Aluminum: hexachloro
Chemical: lithium

ELECTRICAL
Power: entrance hardwired or plug-in
Power distribution panel
Switches & lights, meter and meter
Cable tray
Lighting: incandescent or
energy-efficient power supply
Wiretrunking
Wiretrunking voltage

CLIMATE CONTROL
Air conditioning, air or water cooled
Heating
Humidification
Dehumidification
Exhaust areas

DESIGN OPTIONS
For site use
Special skid or beam frame
Jackets for transport building
Landing pads
Walkways, stairs or
other site infrastructure
Capacities to suit

Materials can be substituted (Strength, corrosion, lead, etc.)
Specialized & environmental design leads to suit application



Shelter Construction

LET US HELP YOU ENGINEER YOUR NEXT STATION

Ambient Air Monitoring
Communications



Continuous Emission Monitoring



EKTO Equipment Shelters:
Custom Designed for Optimal Performance



EKTO Manufacturing Corporation
Mobile Industrial Equipment Shelters

**FIELD PROVEN:
THOUSANDS IN
WORLDWIDE SERVICE**

The design of ECD light weight, highly insulated enclosures are developed for the military for worldwide deployment in any terrain. The basic construction consists of vacuum epoxy laminated sheller panels, using aluminum or fiberglass top parts separated by structural foam. This configuration along with structural members embedded with the core provides a highly efficient panel structure for light weight, insulation and stiffness properties. Panels are fastened together by corner angles and corner weldments. Openings are framed either precast or easily cut-out after assembly. Due to the high insulation factor of the structure, air conditioning and heating loads are minimized.

Shelter materials are selected for its intended use and exposure. Aluminum alloys are chosen for many applications. For severe corrosive climates, condenser, fiberglass panel skins with stainless steel trim and fasteners are provided. Doors are made of the same construction as the shelter, fully gasketed to obtain an air and rain tight enclosure. The supplied skids and lift-in-down rings facilitate handling by bucket, crane, carry or winged aircraft.

- Stationary or Mobile Shelters for:
 - Instrument Enclosures
 - Air Monitoring Stations
 - Continuous Emissions Monitoring Sites
 - Communication Earth Stations
 - In-Process Monitoring Field Laboratory

Ambient Air Monitoring

Stationary or mobile light weight equipment shelters for air monitoring applications in monitoring stations.

ACCESSORIES:

- Mechanical, pneumatic or automatic operated doors or generator powered.
- Ramp access.
- Separate trailer mounted or skid mounted or non light vehicle.
- Climate control for inside-site equipment.
- Preparation for field mounting of air flow or PM samples.
- Exterior gas built skid mount.
- Air fans.



Communication Shelters

Designed specifically for earth stations. Highly insulated lightweight structure facilitates world wide shipment as a complete station. Power, air conditioning and cable tray configuration analyzed out to your specific requirements. Optional features include lightning protection, on-site heat sensors, fire suppression and intrusion alarm.

Trailer

A specially designed ECD trailer (2 or 3 axle) is used to transport shelters by regular hauling trailer or separate trailer or barge mounted.



Customized Shelter Interior Configuration

Interior layout of the shelter is custom engineered to suit your specific requirement.

FEATURES AVAILABLE:

- Pre-wired equipment racks - computer desk - lab furniture
- Workbench, bins and tool chest cabinets - electrical distribution
- air conditioning and heating - sink, showers and toilets
- compressor compartment, etc.



Partial List of Customers

- AT&T
- Bechtel
- Bell Atlantic
- Bermuda Electric Light
- B.F. Goodrich
- Boise Cascade
- Ciba Geigy Corporation
- Comstar/RSI
- Detroit Edison
- Dow Chemical Co.
- Eastman Kodak
- Exxon
- Ford Motor Co.
- General Motors
- General Electric Co.
- Georgia Pacific
- Goodyear
- IBM Corp.
- Kuwait Univ.
- Lockheed Martin
- Mexico Air Pol. Control
- Monasanto
- NASA - Langley Research
- Naval Research Labs
- Philippine APC
- Rockwell Inter.
- Saudi Arabia
- Shell Oil Co.
- Suez Canal Port Authority
- Surpoco
- Taiwan Air Pol. Control
- Texas Instruments
- SM Co.
- ITW
- TVA
- U.S. Air Force
- U.S. Army
- U.S. Coast Guard
- U.S. Dept. of Energy
- U.S. EPA
- U.S. Steel Corp.
- Union Carbide
- USSR Air Pol. Control
- Venezuela APC



APPENDIX C: PLANNED METEOROLOGICAL TOWER EQUIPMENT SPECIFICATIONS

wind

*High Performance Wind Sensor
for Air Quality Applications*



Model 05305
Wind Monitor-AQ

The Wind Monitor-AQ is a high resolution wind sensor designed specifically for air quality applications. It combines simple, corrosion-resistant construction with low threshold, fast response and excellent fidelity.

The Wind Monitor-AQ meets the requirements of the following regulatory agencies:

U.S. Environmental Protection Agency – Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD).

U.S. Nuclear Regulatory Agency – NRC Regulatory Guide 1.23 Meteorological Programs in Support of Nuclear Power Plants.

American Nuclear Society – Standard for Determining Meteorological Information at Power Plants.



Wind speed is sensed by a lightweight, carbon fiber thermoplastic (CFT), helicoid propeller. Propeller rotation produces an AC sine wave voltage signal with frequency directly proportional to wind speed. Slip rings and brushes are not used.

The wind direction sensor is a lightweight vane with performance characteristics that assure excellent fidelity in fluctuating wind conditions. Vane position is sensed by a precision potentiometer. Output is a DC voltage directly proportional to vane angle.

The instrument body is UV stabilized plastic with stainless steel and anodized aluminum fittings. Precision grade, stainless steel ball bearings are used throughout. Transient protection and cable terminations are located in a convenient junction box. The instrument mounts on standard 1 inch pipe.

The Wind Monitor-AQ is available with two additional output signal options. **Model 05305V** offers calibrated voltage outputs, convenient for use with many dataloggers. **Model 05305L** provides a calibrated 4-20 mA current signal for each channel, useful in high noise areas or for long cables (up to several kilometers). Signal conditioning electronics are integrated into the sensor junction box.

Specifications

Range:
Wind speed: 0-60 m/s (112 mph)
Azimuth: 360° mechanical, 355° electrical (5° open)

Accuracy:
Wind speed: ±0.2 m/s (0.4 mph) or 1% of reading
Wind direction: ±3 degrees

Threshold:
Propeller: 0.4 m/s (0.9 mph)
Vane: 0.5 m/s (1.0 mph) at 10° displacement

Dynamic Response:
Propeller distance constant (63% recovery) 2.1 m (6.9 ft)
Vane delay distance (50% recovery) 1.2 m (3.9 ft)
Damping ratio: 0.45
Damped natural wavelength: 4.9 m (16.1 ft)
Undamped natural wavelength: 4.4 m (14.4 ft)

Signal Output:
Wind speed: magnetically induced AC voltage, 3 pulses per revolution, 1800 rpm (30 Hz) = 9.2 m/s (20.6 mph)
Azimuth: analog DC voltage from conductive plastic potentiometer – resistance 10K Ω, linearity 0.25%, life expectancy – 50 million revolutions

Power Requirement:
Potentiometer excitation: 15 VDC maximum

Dimensions:
Overall height: 38 cm (15.0 in)
Overall length: 66 cm (25.6 in)
Propeller: 20 cm (7.9 in) diameter
Mounting: 34 mm (1.34 in) diameter (standard 1 inch pipe)

Weight:
Sensor weight: 0.7 kg (1.5 lbs)
Shipping weight: 2.3 kg (5 lbs)

**Nominal values, determined in accordance with ASTM standard procedures. Shielded bearings lubricated with Type LO-1 light General Purpose Instrument Oil.*

MODEL 05305V Voltage outputs

Power Requirement:
8-24 VDC (5 mA @ 12 VDC)

Operating Temperature:
-50 to 50°C

Output Signals:
WS: 0-2.5 VDC (0-60 m/s)
WD: 0-5 VDC (0-360°)

MODEL 05305L 4-20 mA outputs

Power Requirement:
8-30 VDC (40 mA max.)

Operating Temperature:
-50 to 50°C

Output Signals:
4-20 mA full scale

CE Complies with applicable CE directives. Specifications subject to change without notice.

Ordering Information

MODEL

| | |
|---------------------------------------|---------------|
| WIND MONITOR-AQ | 05305 |
| WIND MONITOR-AQ VOLTAGE OUTPUTS | 05305V |
| WIND MONITOR-AQ 4-20mA OUTPUTS | 05305L |



R. M. YOUNG COMPANY
2801 Aero Park Drive
Traverse City, Michigan 49686 USA
TEL: (231) 946-3980 FAX: (231) 946-4772
E-mail: met.sales@youngusa.com
Web Site: www.youngusa.com

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MODEL 41342VC/VF
PLATINUM TEMPERATURE PROBE 0-1V Output

INSTRUCTION SHEET 41342V-90
REV 09-97

INTRODUCTION

The Model 41342VC/VF Platinum Temperature Probe is an accurate 1000 ohm Platinum RTD temperature sensor and low power voltage interface circuit mounted in a weatherproof junction box. The probe is available in Celsius or Fahrenheit calibration. Output signal is 0-1 VDC full scale. The probe is designed for easy installation in YOUNG Multi-plate and Aspirated Radiation Shields.

INSTALLATION

For accurate measurements, the temperature probe should be installed in a protective radiation shield. Use of the probe without a radiation shield may result in large errors due to solar heating. For best performance, the probe and shield should be placed in a location with good air circulation clear of large masses (buildings, pavement, solar panels...), exhaust vents, electrical machinery, motors, water fountains and sprinklers.

MAINTENANCE

The temperature probe is designed to offer years of service with minimal maintenance. Temperature calibration should be accurate for the life of the probe. If necessary, the probe may be periodically checked or recalibrated using normal bath calibration methods. NIST traceable calibration is available from YOUNG at nominal cost.

WARRANTY

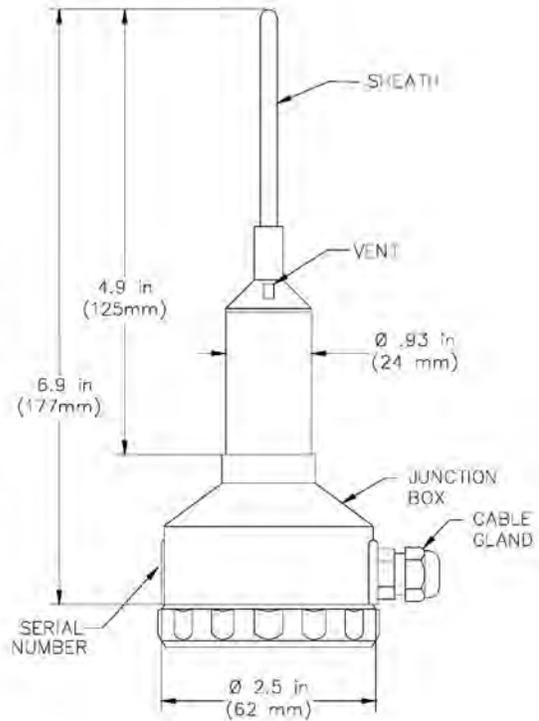
This product is warranted to be free of defects in materials and construction for a period of 12 months from date of initial purchase. Liability is limited to repair or replacement of defective item. A copy of the warranty policy may be obtained from R. M. Young Company.

CE COMPLIANCE

This product has been tested and shown to comply with European CE requirements for the EMC Directive. Please note that shielded cable must be used.

SPECIFICATIONS

| | |
|--------------------------------|-----------------------------------|
| Power Required: | 8 - 24 VDC, 5 mA |
| Calibrated measuring range: | -50 to +50°C -50 to +150°F |
| Accuracy at 0°C: | ±0.3°C (differential measurement) |
| Time Constant: | 42 seconds in 43408 shield. |
| Sensor type: | 1000Ω Platinum RTD |
| Output signal: | 0-1 VDC |
| Recommended Cable: | 2 pair shielded, 22 AWG (#18723) |
| Recommended Radiation Shields: | |
| Model 43408P | Gill Aspirated Radiation Shield |
| Model 41002P | Gill Multi-Plate Radiation Shield |



Declaration of Conformity

Application of Council Directives:
89/336/EEC

Standards to which Conformity is Declared:
EN 50082-1 (IEC 801-2, 3, 4)

Manufacturer's Name and Address:
R. M. Young Company
Traverse City, MI, 49686, USA

Importer's Name and Address:
See Shipper or Invoice

Type of Equipment:
Meteorological Instruments

Model Number / Year of Manufacture:
41342 (V, L)/1996

I, the undersigned, hereby declare that the equipment specified conforms to the above Directives and Standards.

Date / Place: Traverse City, Michigan, USA February 19, 1996

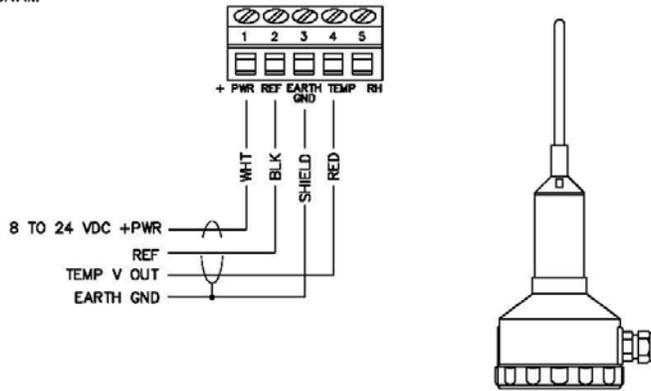
David Poinsett

David Poinsett
R & D Manager, R. M. Young Company

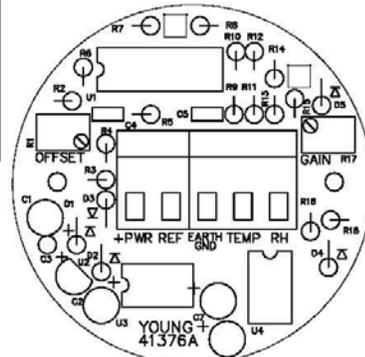
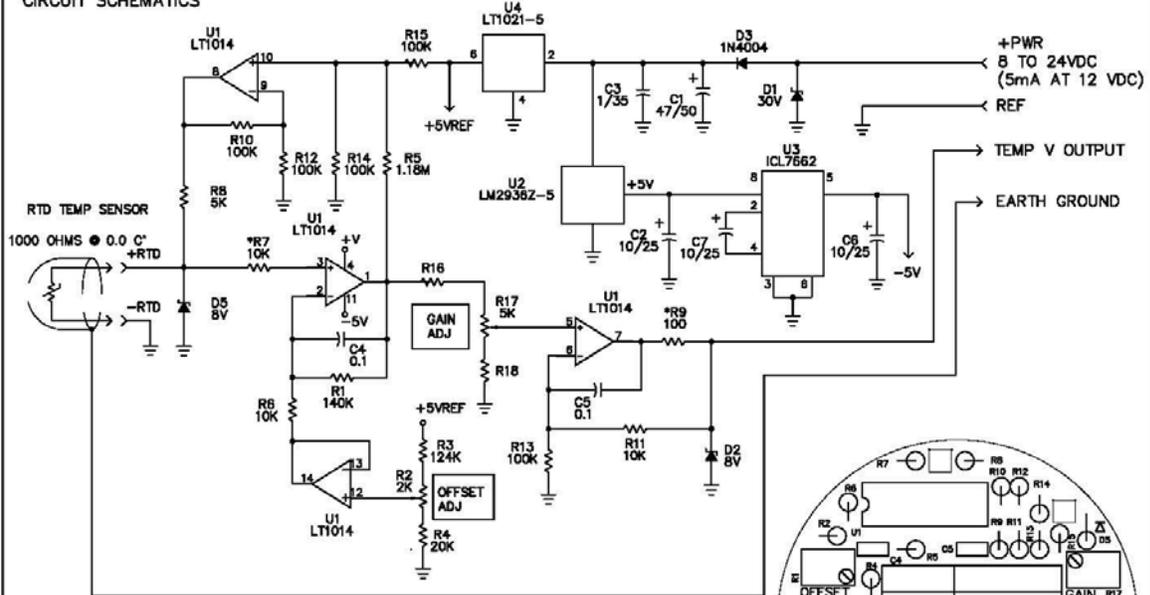
R. M. YOUNG COMPANY 2801 AeroPark Drive , Traverse City, Michigan 49686 USA
 TEL (231) 946-3980 FAX (231) 946-4772



WIRING DIAGRAM



CIRCUIT SCHEMATICS



| | RESISTOR VALUES | |
|--------|------------------------|----------------------------|
| MODEL | 41342VC | 41342VF |
| RANGE | CELSIUS (-50° TO +50°) | FAHRENHEIT (-50° TO +150°) |
| OUTPUT | 0 TO 1.000V | 0 TO 1.000V |
| R16 | 95.3K | 100K |
| R18 | 20K | 17.7K |

NOTES:

1. ALL RESISTORS ARE 5ppm, 0.1% UNLESS OTHERWISE NOTED.
2. RESISTORS MARKED WITH "*" ARE 100ppm
3. ALL CAPACITORS ARE IN uF OR uF/WV, UNLESS OTHERWISE NOTED.

| RTD TEMP SENSOR CALIBRATION POINTS: | |
|-------------------------------------|---------------|
| -50° C | 807.873 OHMS |
| 0° C | 1000.000 OHMS |
| +50° C | 1189.005 OHMS |
| -50° F | 825.093 OHMS |
| 0° F | 932.069 OHMS |
| +150° F | 1247.192 OHMS |

| | | | |
|-------|------------------------------------------------------------|--------|------------|
| MODEL | 41342V TEMP SENSOR INTERFACE | DWG B | PRD 12/96 |
| | WITH VOLTAGE OUTPUTS | DWN KL | DWN 09/97 |
| | COMPONENT LAYOUT & CIRCUIT SCHEMATIC | CHK | C41342V(B) |
| | R.M. YOUNG CO. TRAVERSE CITY, MI 49686 U.S.A. 231-946-3980 | | |

HC2S3

Temperature and RH Sensor



The HC2S3 is a rugged, accurate temperature/RH probe that is ideal for long-term, unattended applications. The probe uses a Rotronic's IN1 capacitive sensor to measure RH and a 100 ohm PRT to measure temperature. For optimum results, the HC2S3 should be recalibrated annually.

The HC2S3 comes with a polyethylene filter that protects its sensor from fine dust and particles and minimizes water absorption and retention. Alternatively, a teflon filter is available for marine environments. The response time is slower when using the teflon filter.

Sensor Mounts

The 41003-5 radiation shield should be used when the HC2S3 is exposed to sunlight. The 41003-5 can attach directly to a mast or tower leg or to a CM202, CM204, or CM206 crossarm.

Ordering Information

Air Temperature and Relative Humidity Probe

HC2S3-L Rotronics Temperature/RH Probe with user-specified cable length. Enter cable length, in feet, after the -L. Maximum cable length is 1000 ft (300 m) with 12 V power, or 10 ft (3 m) with 5 V power. Must choose a cable termination option (see below).

Cable Termination Options (choose one)

- PT Cable terminates in stripped and tinned leads for direct connection to a datalogger's terminals.
- PW Cable terminates in connector for attachment to a prewired enclosure.
- CWS Cable terminates in a connector for attachment to a CWS900-series interface. Connection to a CWS900-series interface allows this sensor to be used in a wireless sensor network.
- C Cable terminates in a connector for attachment to a CS110 Electric Field Meter or ET107 weather station.
- RQ Cable terminates in a connector for attachment to a RAWS-P Permanent Remote Automated Weather Station.

Common Accessories

- 41003-5** 10-Plate Gill Radiation Shield to house the HC2S3
- 27755** Teflon Filter for marine environments.

Recommended Cable Lengths

| 2-m Height | | A top a tripod or tower via a 2-ft crossarm such as the CM202 | | | | | | | | |
|------------|-------|---------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Mast/Leg | CM202 | CM6 | CM106 | CM10 | CM110 | CM115 | CM120 | UT10 | UT20 | UT30 |
| 9 ft | 11 ft | 11 ft | 14 ft | 14 ft | 14 ft | 19 ft | 24 ft | 14 ft | 24 ft | 37 ft |

Note: Add two feet to the cable length if mounting the enclosure to the leg base of a CM106, CM110, CM115, or CM120 tripod.



Specifications

Electronics

Operating Limits: -40° to +100°C

Storage Temperature: -50° to +100°C

Dimensions

Diameter: 15 mm (0.6 in.)

Length w/o connector: 85 mm (3.3 in.)

Length w/connector: 183 mm (7.25 in.)

Weight: 10 g (0.35 oz)

Filter

Standard: Polyethylene
Optional: Teflon (ordered separately; see Ordering Information)

Current Consumption: <4.3 mA @ 5 Vdc
 <2.0 mA @ 12 Vdc

Supply Voltage: 5 to 24 Vdc

Startup Time: 1.5 s typical¹

Maximum Startup Current: <50 mA for 2 μs

Analog Outputs

Offset at 0 V: ±3 mV (maximum)

Deviation for Digital Signal: <±1 mV (0.1°C, 0.1% R. H.)

Temperature

Temperature Sensor: PT100 RTD, IEC 751 1/3 Class B

Measurement Range: -50° to +100°C
 (default to -40° to +60°C)

Output Signal Range: 0 to 1 V

Accuracy at 23°C: ±0.1°C with standard configuration settings

Long Term Stability: <0.1°C/year

Sensor Time Constant [63% step change (1 m/s air flow at sensor)]

Standard PE Filter: ≤ 22 s

Optional Teflon Filter: ≤ 30 s

Temperature Accuracy: see graph at top right

Relative Humidity (RH)

Sensor: ROTRONIC Hygromer® IN-1

Measurement Range: 0 to 100% RH, non-condensing

Output Signal Range: 0 to 1 Vdc

Accuracy at 23°C: ±0.8% RH with standard configuration settings

Long-Term Stability: <1% RH per year

Sensor Time Constant [63% of a 35 to 80% RH step change (1 m/s air flow at sensor)]

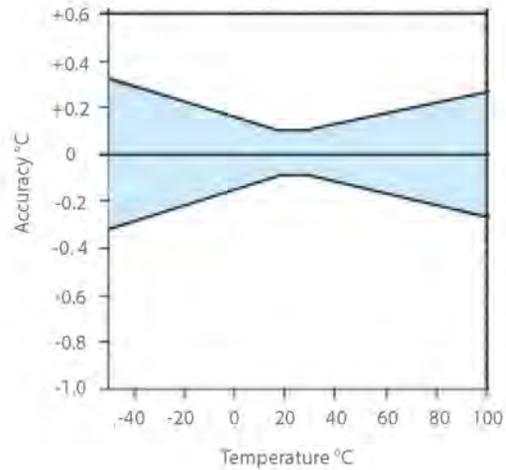
Standard PE Filter: ≤ 22 s

Optional Teflon Filter: ≤ 30 s

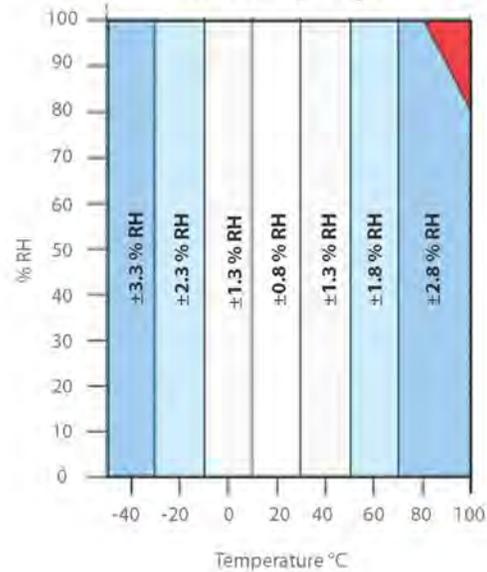
RH Accuracy over Temperature:

see graph at bottom right

Temperature Accuracy Graph



RH Accuracy Graph



Notes:

¹The startup time is Rotronics specification. Campbell Scientific recommends 2 s at 60°C, 3 s at 0°C, and 4 s at -40°C.

²The black outer jacket of the cable is Santoprene® rubber. This compound was chosen for its resistance to temperature extremes, moisture, and UV degradation. However, this jacket will support combustion in air. It is rated as slow burning when tested according to U.L. 94 H.B. and will pass FM-VSS302. Local fire codes may preclude its use inside buildings.



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PTB110 Barometer for Industrial Use



The Vaisala BAROCAP® Barometer PTB110 offers outstanding long-term stability.

Features/Benefits

- Vaisala BAROCAP® sensor
- Several pressure ranges
- Accuracy ± 0.3 hPa at +20 °C
- Long-term stability
- On/off control with external trigger
- Output voltage 0 ... 2.5 or 0 ... 5 VDC
- Current consumption less than 4 mA
- Mountable on a (35 mm wide) DIN rail
- NIST traceable (certificate included)

PTB110

The Vaisala BAROCAP® Barometer PTB110 is designed both for accurate barometric pressure measurements at a room temperature and for general environmental pressure monitoring over a wide temperature range.

Vaisala BAROCAP® technology

The PTB110 barometer uses the Vaisala BAROCAP® Sensor, a silicon capacitive absolute pressure sensor developed by Vaisala for barometric pressure measurement applications.

The sensor combines the outstanding elasticity characteristics and mechanical stability of single-crystal silicon with the proven capacitive detection principle.

Accuracy and stability

The excellent long-term stability of the barometer minimizes or even removes the need for field adjustment in many applications.

Applications

The PTB110 is suitable for a variety of applications, such as environmental pressure monitoring, data buoys, laser interferometers, and in agriculture and hydrology.

The compact PTB110 is especially ideal for data logger applications as it has low power consumption. Also an external On/Off control is available. This is practical when the supply of electricity is limited.

Technical data

Operating range (1 hPa=1mbar)

| | |
|-------------------|----------------------------------|
| Pressure ranges | 500 ... 1100 hPa |
| | 600 ... 1100 hPa |
| | 800 ... 1100 hPa |
| | 800 ... 1060 hPa |
| | 600 ... 1060 hPa |
| Temperature range | -40 ... +60 °C (-40 ... +140 °F) |
| Humidity range | non-condensing |

General

| | |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Supply voltage | 10 ... 30 VDC |
| Supply voltage control | with TTL level trigger |
| Supply voltage sensitivity | negligible |
| Current consumption | less than 4 mA |
| in shutdown mode | less than 1 µA |
| Output voltage | 0 ... 2.5 VDC |
| | 0 ... 5 VDC |
| Output frequency | 500 ... 1100 Hz |
| Resolution | 0.1 hPa |
| Load resistance | minimum 10 kohm |
| Load capacitance | maximum 47 nF |
| Settling time | 1 s to reach full accuracy after power-up |
| Response time | 500 ms to reach full accuracy after a pressure step |
| Acceleration sensitivity | negligible |
| Pressure connector | M5 (10-32) internal thread |
| Pressure fitting | barbed fitting for 1/8" |
| Minimum pressure limit | 0 hPa abs |
| Maximum pressure limit | 2000 hPa abs |
| Electrical connector | removable connector for 5 wires (AWG 28 ... 16) |
| Terminals | Pin 1: external triggering Pin 2: signal ground Pin 3: supply ground Pin 4: supply voltage Pin 5: signal output |
| Housing material, plastic cover | ABS/PC blend |
| Housing classification | IP32 |
| Metal mounting plate | Al |
| Weight | 90 g |
| Electromagnetic compatibility | Complies with EMC standard EN 61326-1, Electrical equipment for measurement, control and laboratory use - EMC requirements - for use in industrial locations |

Accuracy

| | |
|---------------------------|-----------|
| Linearity* | ±0.25 hPa |
| Hysteresis* | ±0.03 hPa |
| Repeatability* | ±0.03 hPa |
| Calibration uncertainty** | ±0.15 hPa |
| Accuracy at +20 °C*** | ±0.3 hPa |

* Defined as ±2 standard deviation limits of end-point non-linearity, hysteresis error or repeatability error.

** Defined as ±2 standard deviation limits of inaccuracy of the working standard including traceability to NIST.

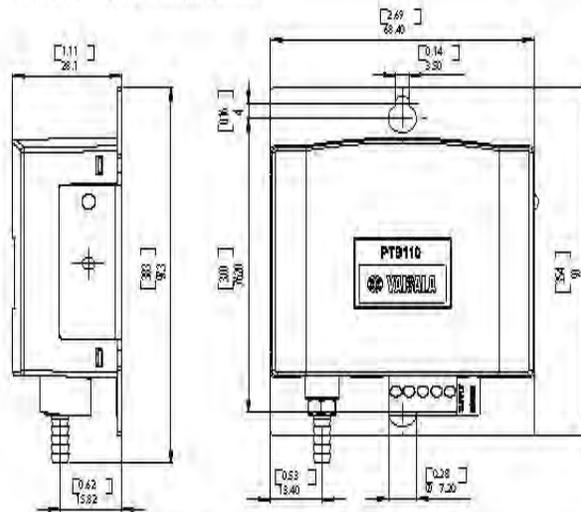
*** Defined as the root sum of the squares (RSS) of end-point non-linearity, hysteresis error, repeatability error and calibration uncertainty at room temperature.

TOTAL ACCURACY AT

| | |
|----------------------------------|---------------|
| +15 ... +25 °C (+59 ... +77 °F) | ±0.3 hPa |
| 0 ... +40 °C (+32 ... +104 °F) | ±0.6 hPa |
| -20 ... +45 °C (-4 ... +113 °F) | ±1.0 hPa |
| -40 ... +60 °C (-40 ... +140 °F) | ±1.5 hPa |
| Long-term stability | ±0.1 hPa/year |

Dimensions

Dimensions in mm (inches)



BAROCAP® is a registered trademark of Vaisala.



For more information, visit www.vaisala.com or contact us at sales@vaisala.com

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LP02-L

Solar Radiation Sensor



Hukseflux's LP02-L* is an ISO second-class pyranometer that measures solar radiation with a high-quality blackened thermopile protected by a dome. The blackened thermopile provides a flat spectral response for the full solar spectrum range, which allows the LP02 to be used under plant canopies or lamps, when the sky is cloudy, and for reflected radiation measurements.

The LP02 produces a millivolt signal that is measured directly by a Campbell Scientific datalogger. Please note that the LP02 is not compatible with the CR200-series dataloggers.

Mounting

The LP02 includes a bubble level and three adjusting leveling screws, which allows the sensor to be leveled without using a leveling base. The CM225 Solar Sensor Mounting Stand is used to attach the sensor to a mast, crossarm, or pole (1.0" to 2.1" OD). The CM225 consists of rectangular plate, mounting bracket, u-bolts, lock washers, and nuts.

Customers can mount two LP02s back-to-back to make a low-cost albedometer; contact Campbell Scientific for more information.



The LP02 includes a bubble level, three adjusting screws, and a cable gland. The bubble level and adjusting screws allow the sensor to be leveled without the use of a leveling base. The gland allows the user to change cables.

Ordering Information

| Model | Description |
|--------------|-------------------------------------------------------------------------------------------------------------------------|
| LP02-L | Hukseflux pyranometer with user-specified lead length. Enter lead length, in feet, after the -L. |
| -PW | Optional cable connector for prewired enclosures. |
| Mount | |
| CM225 | Solar Sensor Mounting Stand for attaching the sensor to a tripod or tower mast or to a CM202, CM204, or CM206 crossarm. |



To attach the CM225 to a CM202, CM204, or CM206 crossarm, place the u-bolt in the holes on the bottom of the bracket.

*Second-class pyranometers are acceptable for providing the solar radiation data used in stability estimations (EPA Meteorological Monitoring Guidance for Regulatory Modeling Applications, pages 2-10).

Specifications

Light Spectrum Waveband: 305 to 2800 nm

Maximum Irradiance: 2000 W m⁻²

Sensitivity (nominal): 15 μV W⁻¹ m²

Operating Temperature: -40° to +80°C

Temperature Dependence: <0.15%/°C

Dimensions

Width: 3.1" (7.8 cm)

Height: 2.3" (5.9 cm)

Dome Diameter: 1.2" (3.0 cm)

Weight (with 15 ft cable): 0.8 lbs (363 g)

ISO Classification: Second Class



If the CM225 is attached to a mast, place the u-bolt in the holes in the side of the bracket.



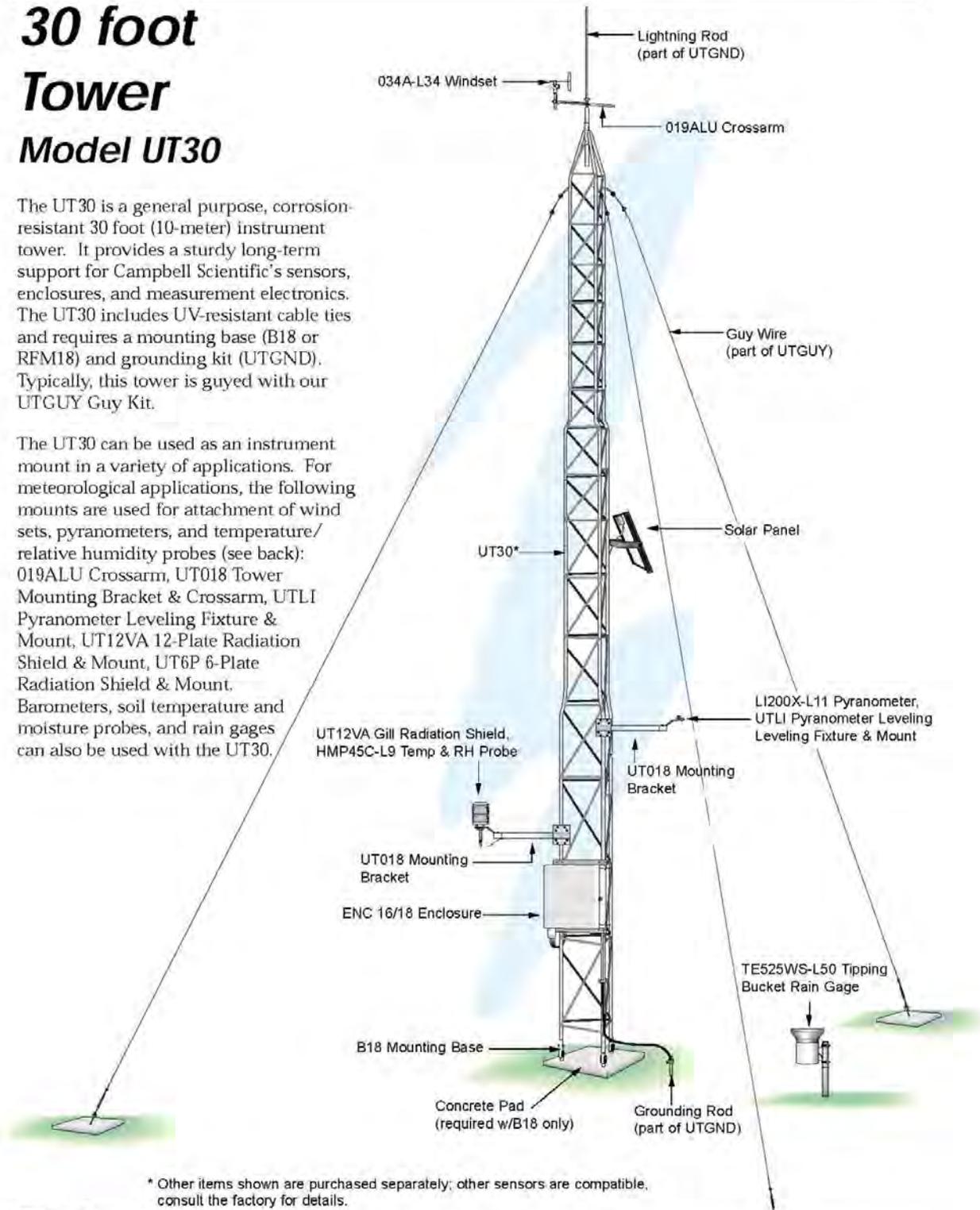
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Australia | Brazil | Canada | England | France | Germany | South Africa | Spain | USA [headquarters]

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30 foot Tower Model UT30

The UT30 is a general purpose, corrosion-resistant 30 foot (10-meter) instrument tower. It provides a sturdy long-term support for Campbell Scientific's sensors, enclosures, and measurement electronics. The UT30 includes UV-resistant cable ties and requires a mounting base (B18 or RFM18) and grounding kit (UTGND). Typically, this tower is guyed with our UTGUY Guy Kit.

The UT30 can be used as an instrument mount in a variety of applications. For meteorological applications, the following mounts are used for attachment of wind sets, pyranometers, and temperature/relative humidity probes (see back): 019ALU Crossarm, UT018 Tower Mounting Bracket & Crossarm, UTLI Pyranometer Leveling Fixture & Mount, UT12VA 12-Plate Radiation Shield & Mount, UT6P 6-Plate Radiation Shield & Mount. Barometers, soil temperature and moisture probes, and rain gages can also be used with the UT30.



* Other items shown are purchased separately; other sensors are compatible, consult the factory for details.



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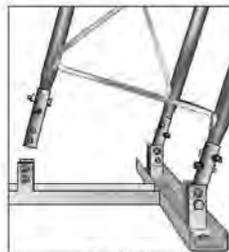
Specifications

| | |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Crossarm measurement height: | 33 ft (10 m) |
| Shipping weight: | 65 lbs (29 kg) |
| Material: | Hardened Drawn 6063-T832 aluminum |
| OD of vertical pipe: | 1" (2.5 cm) |
| OD of cross support pipes: | 0.375" (0.953 cm) |
| Guyed tower area requirements: | ~34 ft diameter |
| Required concrete pad dimensions (B18 base only): | 36" L x 36" W x 48" D (91 x 91 x 122 cm) This assumes heavy soil; light shifting, or sandy soils require a larger concrete pad. |

UT30 Accessories



B18



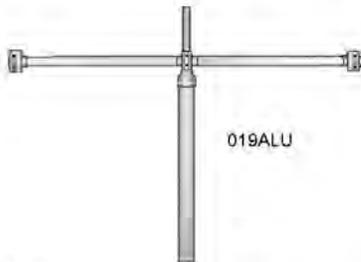
RFM18



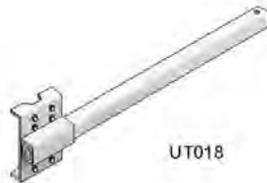
UTDUK



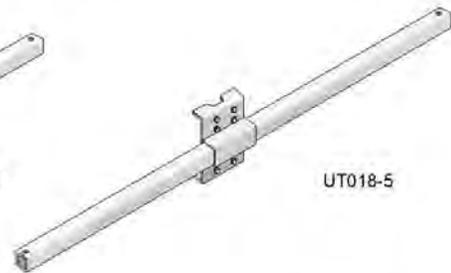
UTEYE



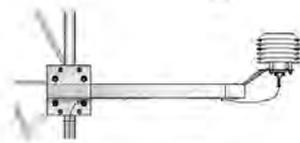
019ALU



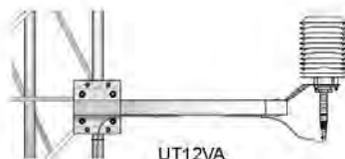
UT018



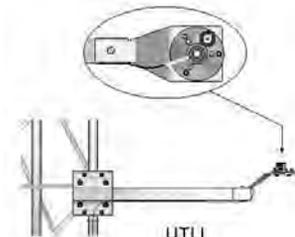
UT018-5



UT6P



UT12VA



UTLI



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**APPENDIX D: PHOTOS LOOKING TOWARD PLANNED
SO₂ MONITORING SITE (21-101-1011)**



Photo D-1. Site 21-101-1011 Looking West



Photo D-2. Site 21-101-1011 Looking North



Photo D-3. Site 21-101-1011 Looking East



Photo D-4. Site 21-101-1011 Looking South

**APPENDIX E: PHOTOS LOOKING OUTWARD
FROM PLANNED SO₂ MONITORING SITE (21-101-1011)**



Photo E-1. From Site 21-101-1011 Looking South

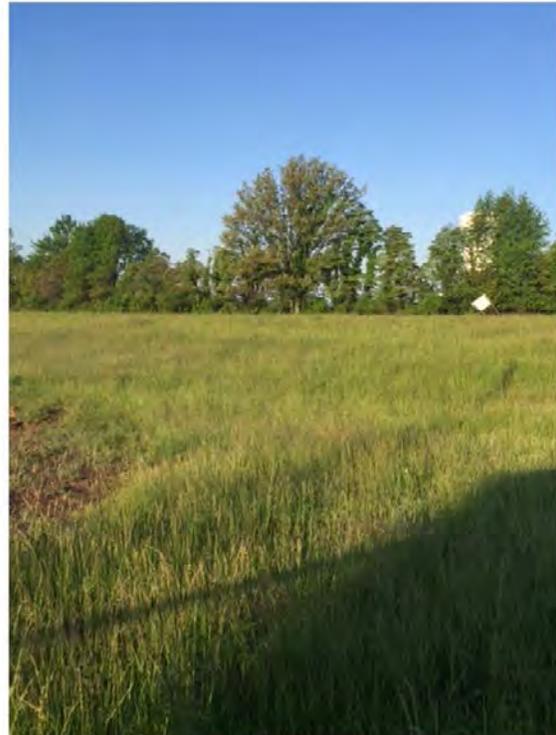


Photo E-2. From Site 21-101-1011 Looking Southwest

Century Aluminum & Big Rivers Electric Corporation - Sebree, Kentucky
SO₂ Monitor Siting Evaluation - Revision 1

E-2



Photo E-3. From Site 21-101-1011 Looking West



Photo E-4. From Site 21-101-1011 Looking Northwest

Century Aluminum & Big Rivers Electric Corporation - Sebree, Kentucky
SO₂ Monitor Siting Evaluation - Revision 1

E-3



Photo E-5. From Site 21-101-1011 Looking North

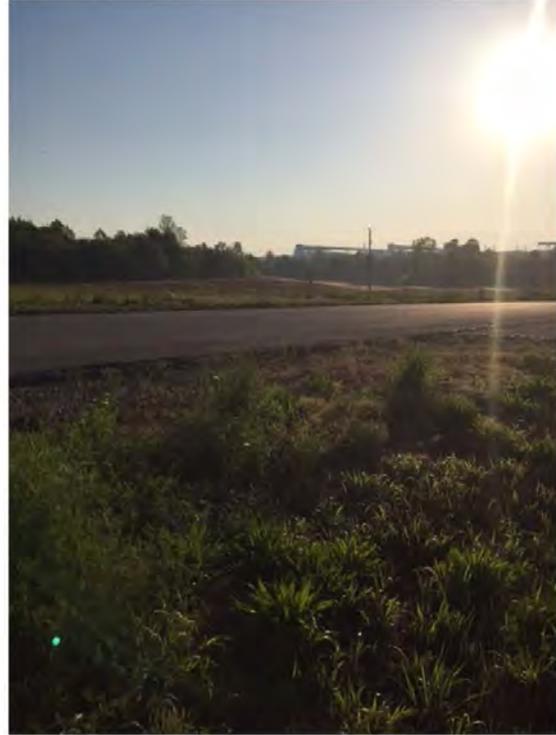


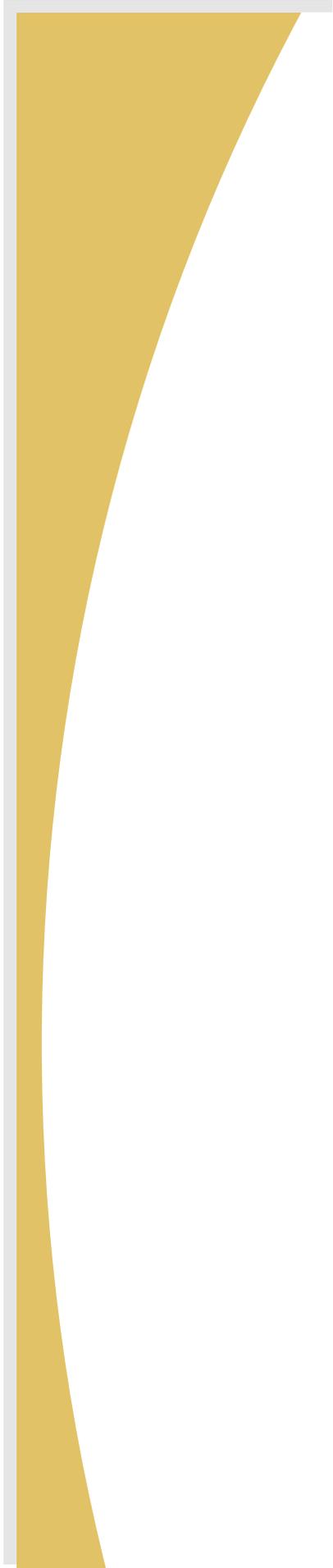
Photo E-6. From Site 21-101-1011 Looking Northeast



Photo E-7. From Site 21-101-1011 Looking East



Photo E-8. From Site 21-101-1011 Looking Southeast



APPENDIX I

KENTUCKY SO₂ PWEI VALUES

Appendix I
Kentucky SO₂ PWEI Values

40 CFR 58, Appendix D, requires that a minimum number of SO₂ monitors be operated based upon a Population Weighted Emissions Index (PWEI) values. This index, which is calculated for each Core Based Statistical Area (CBSA), is calculated by multiplying the population of each CBSA and the total amount of SO₂, in tons per year, that is emitted within the CBSA, based upon aggregated county level emissions data from the National Emissions Inventory (NEI). The result is then divided by one million to provide the PWEI value, which is expressed in a unit of million persons-tons per year.

The minimum number of monitors required are:

- 3 monitors in CBSAs with index values of 1,000,000 or more;
- 2 monitors in CBSAs with index values less than 1,000,000 but greater than 100,000; and
- 1 monitor in CBSAs with index values greater than 5,000.

Additionally, the EPA Regional Administrator may, at their discretion, require additional monitors beyond the minimum required by PWEI calculations. However, Kentucky currently does not have any Regional Administrator required SO₂ monitors.

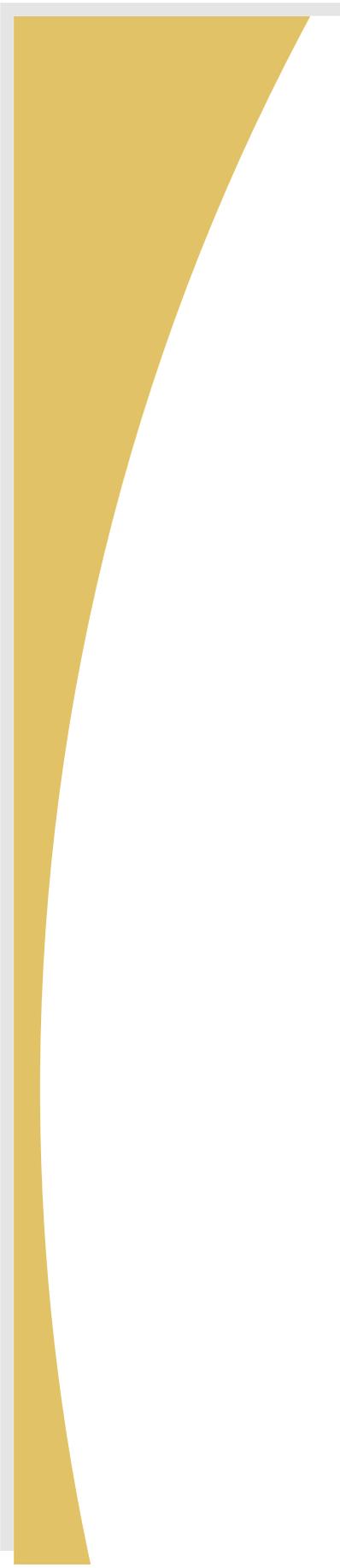
Based upon Kentucky's calculated PWEI values, the following CBSAs require SO₂ monitors:

| Kentucky CBSAs | 2015 PWEI* (million persons -tons per year) | Number of SO ₂ Monitors Required | Number of SO ₂ Monitors Present | Kentucky Site Name | Kentucky AQS ID |
|------------------------------------|---------------------------------------------------|---------------------------------------------------|--------------------------------------------------|-----------------------|--------------------|
| Cincinnati, OH-KY-IN | 380,617 | 2 | 6** | NKU | 21-037-3002 |
| Evansville, IN-KY | 7,771 | 1 | 1 | Baskett | 21-101-0014 |
| Huntington-Ashland, WV-KY-OH | 4,553 | 1 | 2 | Ashland Primary | 21-019-0017 |
| | | | | Worthington | 21-089-0007 |
| Lexington-Fayette, KY | 3,522 | 1 | 2 | Lexington Primary | 21-067-0012 |
| | | | | Nicholasville | 21-113-0001 |
| Louisville-Jefferson County, KY-IN | 60,030 | 1 | 3*** | Watson Lane | 21-111-0051 |
| | | | | Cannons Lane | 21-111-0067 |
| | | | | Firearms Training | 21-111-1041 |
| Paducah, KY-IL | 5,514 | 1 | 1 | Jackson Purchase | 21-145-1024 |

*2015 PWEI calculated from 2013 USCB Population Estimates and 2011 NEI.

** Monitoring requirement partially fulfilled via MOA.

***Monitors operated by the Louisville Metro Air Pollution Control District



APPENDIX J

EPA CASTNET STATIONS IN KENTUCKY

Appendix J
EPA CASTNET Stations in Kentucky

The Clean Air Status and Trends Network (CASTNET) is a nation-wide, long-term monitoring network designed to measure acidic pollutants and ambient ozone concentrations in rural areas. CASTNET is managed collaboratively by the Environmental Protection Agency – Clean Air Markets Division (EPA), the National Park Service – Air Resources Division (NPS), and the Bureau of Land Management – Wyoming State Office (BLM-WSO). In addition to EPA, NPS, and BLM-WSO, numerous other participants provide network support including tribes, other federal agencies, States, private land owners, and universities. More information about CASTNET can be found at: <https://www.epa.gov/castnet>

KDAQ does not operate nor serve as the Primary Quality Assurance Organization for any site in the CASTNET network. However, KDAQ does maintain a cooperative relationship with the staff of Mammoth Cave National Park. At the request of KDAQ, the NPS has designated the ozone monitor as the “Maximum O₃ Concentration” site for the Bowling Green, KY MSA. More information about the Mammoth Cave site can be found in the site detail pages of the Annual Network Plan.

KDAQ requested that EPA designate the CASTNET ozone monitor at the Cadiz site (21-221-9991) as the “Maximum O₃ Concentration” site for the Clarksville, TN-KY MSA. EPA agreed to the change and has since updated the metadata for the monitor in AQS.

Clean Air Status & Trends Network (CASTNET)

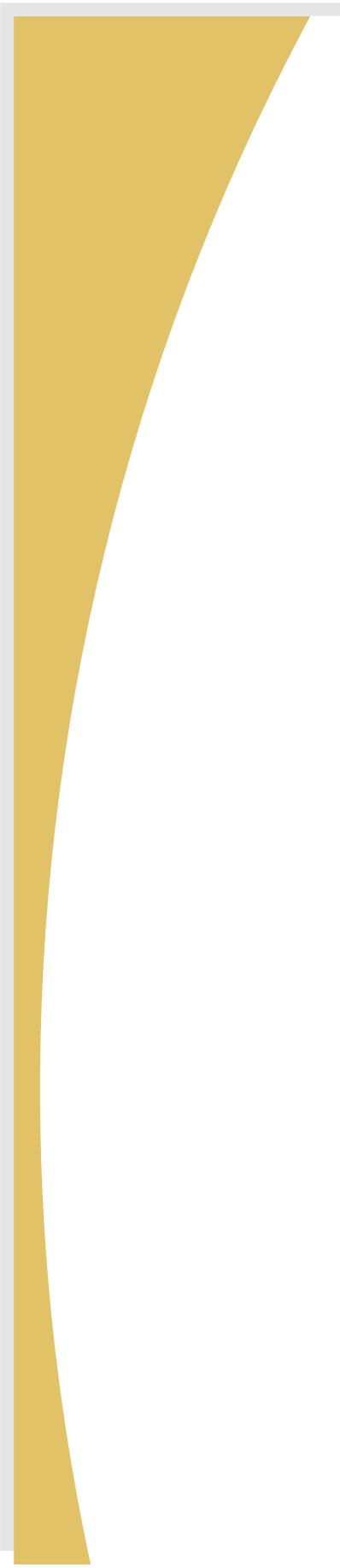
Kentucky Ozone Monitors

| Monitor ID | Monitor Name | County/ Metropolitan Statistical Area | Designation | Monitoring Scale |
|-------------|---------------------------------|------------------------------------------|---------------------------------------------------------------------|------------------|
| 21-061-0501 | Mammoth Cave National Park | Edmonson/ Bowling Green, KY MSA | CASTNET Non-EPA Federal Maximum O ₃ Concentration* | Regional |
| 21-175-9991 | Crockett | Morgan/ Not in a MSA | CASTNET EPA | Regional |
| 21-221-9991 | Cadiz | Trigg/ Clarksville, TN-KY MSA | CASTNET EPA Maximum O ₃ Concentration** | Regional |
| 21-229-9991 | Mackville (POC 1) | Washington/ Not in a MSA | CASTNET EPA | Regional |
| 21-229-9991 | Mackville Collocated (POC 2) | Washington/ Not in a MSA | CASTNET- QA Collocated*** EPA | Regional |

* Maximum Ozone Concentration Site for the Bowling Green, KY MSA

** Maximum Ozone Concentration site for the Clarksville, TN-KY MSA

***Not usable for NAAQS comparisons



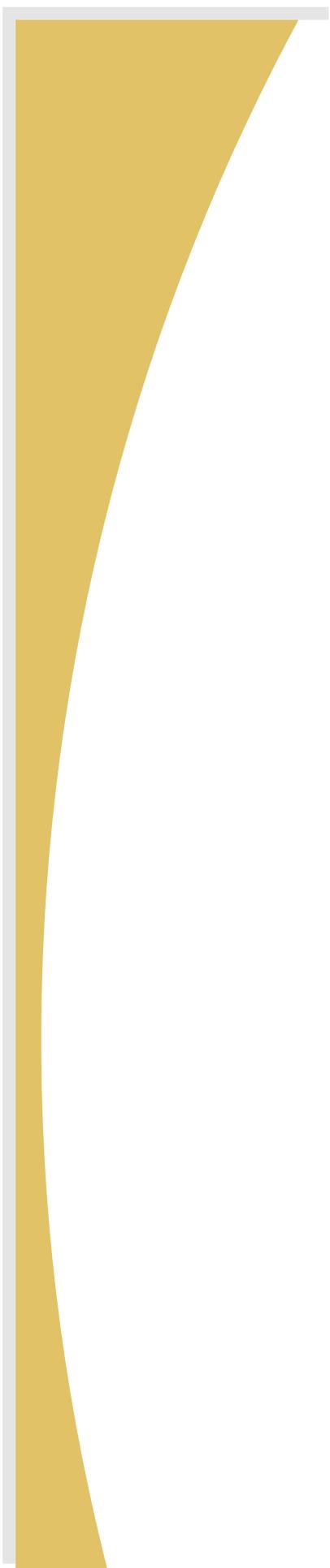
APPENDIX K

**WEST JEFFERSON COUNTY AIR TOXICS
MONITORING STATIONS**

Appendix K
West Jefferson County Air Toxics Monitoring Stations

West Jefferson County Air Toxics Monitoring Stations
Volatile Organic Compounds (Method TO-15)

| Site ID | Established | Location | Purpose | Frequency of Sampling |
|----------------|--------------------|----------------------------------------|-----------------------|------------------------------|
| 21-111-1041 | 1999 | 4201 Algonquin Parkway | Maximum Impact | 24-hrs every twelfth day |
| 21-111-0054 | 1999 | 4211 Campground Road | Maximum Impact | 24-hrs every twelfth day |
| 21-111-0058 | 1999 | Farnsley Middle School, 3400 Lees Lane | Neighborhood Exposure | 24-hrs every twelfth day |
| 21-111-0060 | 1999 | Chickasaw Park | Neighborhood Exposure | 24-hrs every twelfth day |
| 21-111-0062 | 1999 | Cane Run Elementary | Neighborhood Exposure | 24-hrs every twelfth day |
| 21-111-0067 | 2009 | Cannons Lane | Neighborhood Exposure | 24-hrs every twelfth day |



APPENDIX L

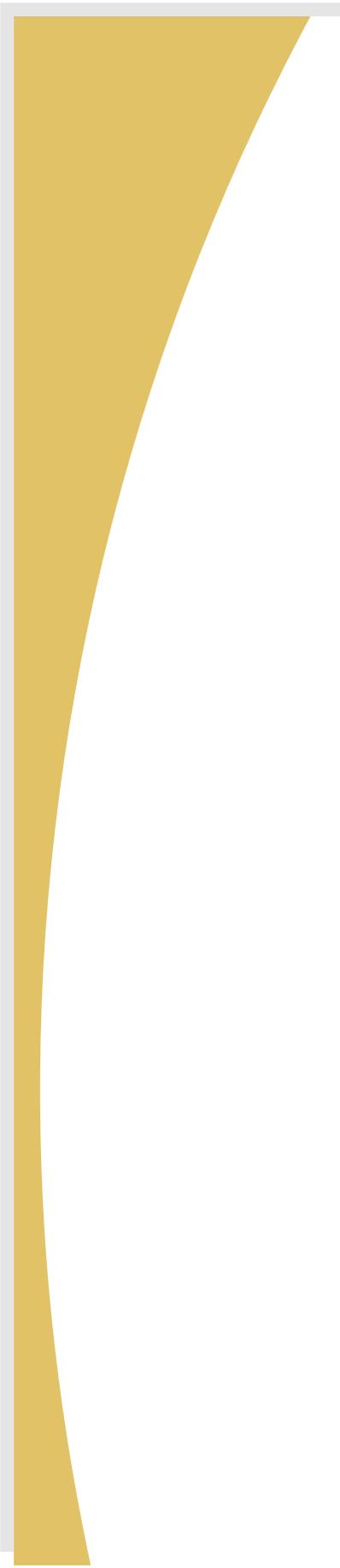
PUBLIC COMMENTS

**KENTUCKY DIVISION FOR AIR QUALITY
AMBIENT AIR MONITORING NETWORK
Comments Received 6/20/2016**

Energy and Environment Cabinet
Department for Environmental Protection
Division for Air Quality

A public comment period on the KENTUCKY DIVISION FOR AIR QUALITY AMBIENT AIR MONITORING NETWORK PLAN 2016 was held from May 19, 2016, through June 18, 2016.

No comments were received during the public comment period.



INDEX

**KDAQ AIR MONITORING STATIONS
BY
REGIONAL OFFICE**

KDAO MONITORING STATIONS BY REGIONAL OFFICE

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| 21-195-0002 | Pikeville Primary | Pike | 110 |
| Region 2 - Frankfort Regional Office (Bluegrass Area) | | | |
| 21-067-0012 | Lexington Primary | Fayette | 56 |
| 21-113-0001 | Nicholasville | Jessamine | 58 |
| 21-151-0003 | Mayfield Elementary | Madison | 96 |
| 21-151-0005 | EKU | Madison | 98 |
| Region 3 - Florence Regional Office | | | |
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| Region 4 - Owensboro Regional Office | | | |
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| 21-199-0003 | Somerset | Pulaski | 100 |