



DEPARTMENT OF
ECOLOGY
State of Washington

Air Toxics Monitoring Quality Assurance Project Plan

Air Quality Program

March 2012

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Air Toxics Monitoring Quality Assurance Project Plan

Air Quality Program

Prepared by:
Stan Rauh and John Williamson
Washington State Department of Ecology
Air Quality Program

March 2012
Publication 04-02-018 (rev. 03/2012)

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1 QA Plan Identification and Approval

Title: Air Toxics Monitoring Quality Assurance Project Plan for the State of Washington
Department of Ecology Air Quality Program

The Air Toxics Monitoring Quality Assurance Project Plan for the Air Quality Program is recommended for approval and commits the Program to follow the elements described within.

Stu Clark, Air Quality Program Manager

Date: _____

Mike Ragan, Air Monitoring Coordinator

Date: _____

John Williamson, Air Toxics Project Manager

Date: _____

Stan Rauh, Quality Assurance Coordinator

Date: _____

William Kammin, Ecology QA Manager

Date: _____

EPA Region 10

Keith Rose, EPA Project Manager

Date: _____

Chris Hall, Air Program Oversight Manager

Date: _____

2 Distribution

A copy of the Air Toxics Monitoring Quality Assurance Project Plan is distributed to the following listed below:

Name	Position	Organization
Stu Clark	Air Quality Program Manager	Ecology
Nick Roach	Northwest Regional Office (NWRO) Regional Supervisor	Ecology
John Williamson	Air Toxics Monitoring Project Manager	Ecology
Mike Ragan	Air Monitoring Coordinator	Ecology
Stan Rauh	Air Monitoring QA Coordinator	Ecology
William Kammin	Ecology QA Officer	Ecology
Doug Knowlton	Air Monitoring Operator	Ecology
Keith Rose	Project Manager	USEPA Region 10
Chris Hall	Air Program QA Officer	USEPA Region 10
Roy Araki	Regional QA Manager	USEPA Region 10

3 Organization and Responsibilities

3.1 Roles and Responsibilities

Federal, State, Tribal and local agencies all have important roles in developing and implementing satisfactory air monitoring programs. As part of the planning effort, EPA is responsible for developing National Ambient Air Quality Standards (NAAQS), and identifying a minimum set of QC samples from which to judge data quality. The State and local organizations are responsible for taking this information and developing and implementing a quality system that will meet the data quality requirements. Then, it is the responsibility of both EPA and the State and local organizations to assess the quality of the data and take corrective action when appropriate. The responsibilities of each organization follow.

3.2 Washington State Department of Ecology Air Quality Program (Ecology)

40 CFR Part 58 defines a State Agency as “the air pollution control agency primarily responsible for the development and implementation of a plan under the Clean Air Act (CAA)”. Section 302 of

the CAA provides a more detailed description of the air pollution control agency.

40 CFR Part 58 defines the Local Agency as “any local government agency, other than the state agency, which is charged with the responsibility for carrying out a portion of the plan (SIP).”

The major responsibility of State and local agencies is the implementation of a satisfactory monitoring program, which includes the implementation of an appropriate quality control and quality assurance program. It is the responsibility of State and local agencies to implement quality assurance programs in all phases of the environmental data operation (EDO), including the field, their own laboratories, and in any consulting and contractor laboratories

The title and responsibilities of key personnel are:

Air Quality Program Manager – Stu Clark

- Management of the Air Quality Program

NWRO Regional Section Supervisor – Nick Roach

- Coordinate and Oversee Regional Monitoring Activities
- Supervise Regional Air Monitoring Station Operators

Air Toxics Monitoring Project Manager – John Williamson

- Air Toxics Monitoring Project Management
- Network Evaluation and Design
- Laboratory Contract Management
- Station Installation and Operation Management
- Air Toxics Data Management
- Final Reports

Air Monitoring Station Operators

- Station Installation, Operation, Sample Collection
- Sample Shipments to ERG
- Quality Control and Precision Checks
- First Level Data Validation
- Routine Maintenance and Repair

Ecology Quality Assurance Officer – William Kammin

- Oversees Ecology QA Activities
- Reviews and Approves the QAPP

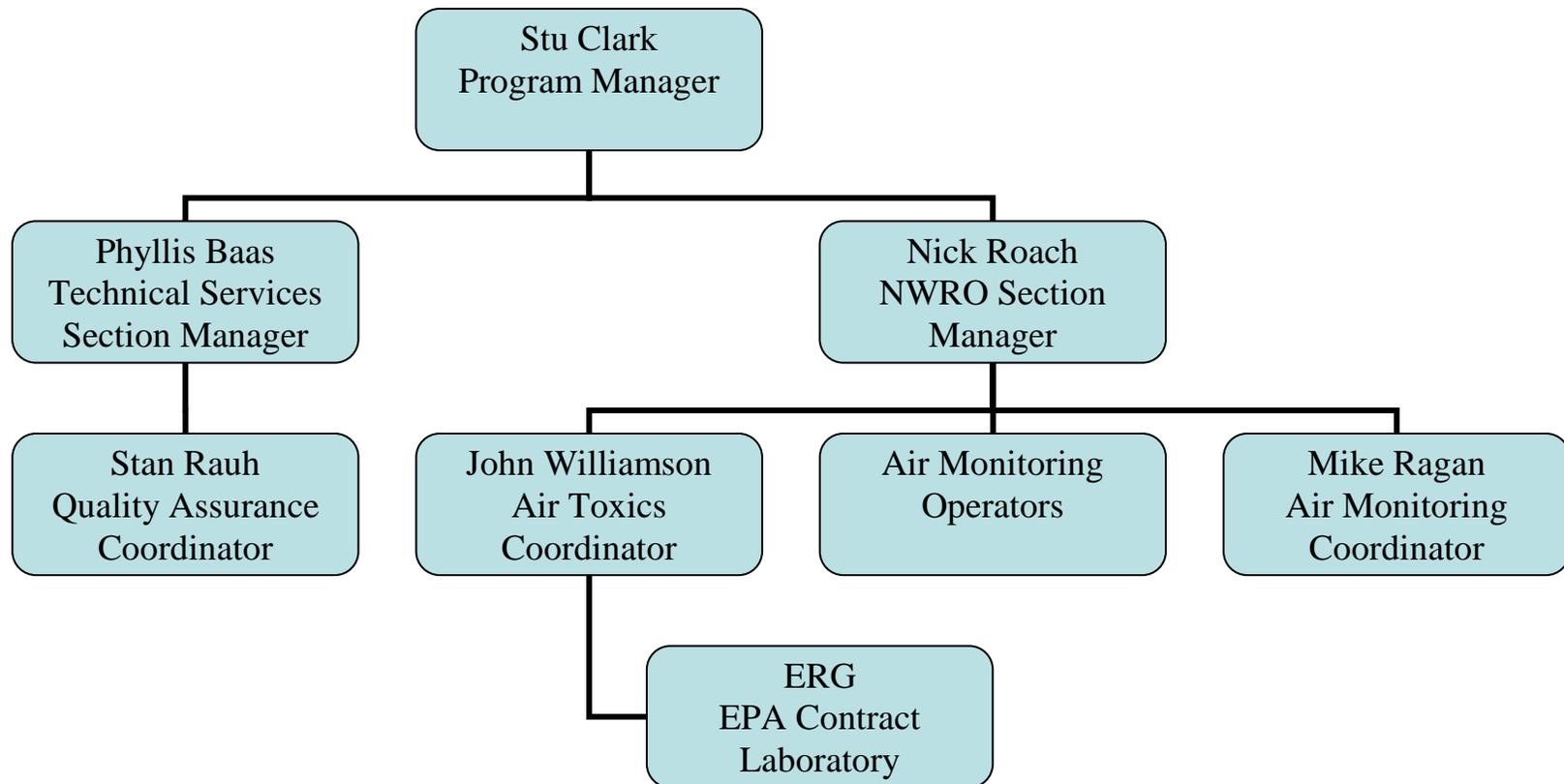
Air Quality Program Quality Assurance Coordinator – Stan Rauh

- Air Monitoring Procedures and Training
- Quality Assurance Policies, Plans, and Procedures
- Performance and System Audits

Eastern Research Group EPA National Contract Laboratory

- Laboratory Quality Assurance Policies, Plans, and Procedures
- Verifying All Laboratory QA Activities
- Canister and Tube Preparation and Certification
- Canister and Tube Shipping to Monitoring Sites
- Receipt, Inspection, Equilibration, Pre/post weighing and Shipment of PM₁₀ Filters
- Analysis of VOCs, Carbonyls, and Metals
- Assessing and Reporting Data Quality
- Data validation
- Inter and Intra Laboratory Testing
- Storage and Archive Laboratory Data and Documentation
- Delivery of Electronic Data Reports
- Flagging and Reporting Suspect Data
- Storage and Archive of Electronic Data
- Reporting results to AQS

Figure 1 represents the organizational structure of the areas of the Air Quality Program that are responsible for the activities defined above.



3.3 Eastern Research Group (ERG)

EPA's National Contract Laboratory, Eastern Research Group (ERG), is responsible for the analysis of all air toxics parameters, validating the data and submitting the results to EPA's AQS database.

3.4 EPA Office of Air Quality Planning and Standards (OAQPS)

OAQPS is the organization charged under the authority of the Clean Air Act (CAA) to protect and enhance the quality of the nation's air resources. OAQPS sets standards for pollutants considered harmful to public health or welfare and, in cooperation with EPA's Regional Offices and the States, enforces compliance with the standards through state implementation plans (SIPs) and regulations controlling emissions from stationary sources. OAQPS evaluates the need to regulate potential air pollutants, especially air toxics and develops national standards; works with State, Local and Tribal (S/L/T) agencies to develop plans for meeting these standards. In addition, OAQPS provides the funding, through the CAA Section 103 and 105 funds.

Within the OAQPS Emissions Monitoring and Analysis Division (EMAD), the Monitoring and Quality Assurance Group (MQAG) is responsible for the oversight of the NATTS. MQAG has the following responsibilities:

- Ensuring that the methods and procedures used in making air pollution measurements are adequate to meet the programs objectives and that the resulting data are of satisfactory quality;
- Evaluating the performance, through Technical Systems Audits (TSAs) and Management System Reviews (MSRs), of organizations making air pollution measurements;
- implementing satisfactory quality assurance programs over EPA's Ambient Air Quality Monitoring Network;
- Ensuring that national regional laboratories are available to support toxics and QA programs;
- Rendering technical assistance to the EPA Regional Offices and air pollution monitoring community.

3.5 EPA Region 10

The EPA Regional Offices will address environmental issues related to the States within their jurisdiction and to administer and oversee regulatory and congressionally mandated programs. The major quality assurance responsibilities of EPA's Regional Offices, in regards to the National Air Toxics Trends Sites (NATTS), are the coordination of quality assurance matters at the Regional levels with the State and local agencies. This is accomplished by the designation of EPA Regional Project Officers who are responsible for the technical aspects of the program including:

- Reviewing QAPPs by Regional QA Officers who are delegated the authority by the Regional Administrator to review and approve QAPPs for the Agency;

- Supporting the air toxics audit evaluation program;
- Evaluating quality system performance, through TSAs and network reviews whose frequency is addressed in the Code of Federal Regulations;
- Acting as a liaison by making available the technical and quality assurance information developed by EPA Headquarters and the Region to the State and local agencies including making EPA Headquarters aware of the unmet quality assurance needs of the State and local agencies.

4 Problem Definition and Background

4.1 Problem Statement and Background

4.1.1 Background

There are currently 188 hazardous air pollutants (HAPs), or air toxics, regulated under the CAA that have been associated with a wide variety of adverse health effects, including cancer, neurological effects, reproductive and developmental effects, as well as ecosystem effects. These air toxics are emitted from multiple sources, including major stationary, area, and mobile sources, resulting in population exposure to these air toxics. While in some cases the public may be exposed to an individual HAP, more typically people experience exposures to multiple HAPs and from many sources. Exposures of concern result not only from the inhalation of these HAPs, but also, for some HAPs, from multi-pathway exposures to air emissions.

4.1.2 The National Air Toxics Trends Stations and the Role of the AQP

EPA finalized the Urban Air Toxics Strategy (UATS) in the Federal Register on July 19, 1999. The UATS states that emissions data are needed to quantify the sources of air toxics impacts and aid in the development of control strategies, while ambient data are needed to understand the behavior of air toxics in the atmosphere after being emitted. Since ambient measurements cannot practically be made everywhere, modeled estimates are needed to extrapolate our knowledge of air toxics impacts into locations without monitors. Exposure assessments, together with health effects information, are then needed to integrate all of these data into an understanding of the implications of air toxics impacts and to characterize air toxics risks. The EPA proposed the National Air Toxics Assessment (NATA) to meet this need. There are four activities which are key to the success of the NATA.

- Source-specific standards and sector-based standards, including section 112 standards, i.e., Maximum Achievable Control Technology (MACT), Generally Achievable Control Technology (GACT), residual risk standards, and section 129 standards.
- National, regional, and community-based initiatives to focus on multi-media and; cumulative risks, such as the Integrated UATS, Great Waters, Mercury initiatives, Persistent Bio-accumulative Toxics (PBT) and Total Maximum Daily Load (TMDL) initiatives, and Clean Air Partnerships;
- NATA activities that will help EPA identify areas of concern, characterize risks and track

progress. These activities include expanded air toxics monitoring, improving and periodically updating emissions inventories, national- and local scale air quality and exposure modeling, and continued research on effects and assessment tools, leading to improved characterizations of air toxics risk and reductions in risk resulting from ongoing and future implementation of air toxics emissions control standards and initiatives;

- Education and outreach.

The success of the NATA critically depends on our ability to quantify the impacts of air toxics emissions on public health and the environment. All of these activities are aimed at providing the best technical information regarding air toxics emissions, ambient concentrations, and health impacts to support the development of sound policies for NATA. Specifically, these activities include:

- The measurement of air toxics emission rates from individual pollution sources;
- The compilation of comprehensive air toxics emission inventories for local, State, and national domains;
- The analysis of patterns and trends in ambient air toxics measurements;
- The estimation of ambient air toxics concentrations from emission inventories using dispersion modeling;
- The estimation of human and environmental exposures to air toxics, and;
- The assessment of risks due to air toxics;
- The measurement of ambient concentrations of air toxics at trends monitoring sites throughout the nation.

Analysis was performed by OAQPS to ascertain the size and features of a national trends network that would satisfy the goals as stated above. This analysis illustrated that a number urban and rural locations would provide the needed coverage for estimates of national trends. Ecology was contacted by the EPA to support one of these national trends sites. Ecology has agreed to provide the support to this network known as the National Toxics Air Trends Sites or NATTS. Ecology will support an air toxics monitoring station as agreed through the Section 103 and 105 funds received from the Regional Office.

This QAPP focuses on the Quality Assurance (QA) and Quality Control (QC) that will be instituted by Ecology to fulfill its obligation. In order to better focus the data collection activities on the final use of the data, a DQO process was performed in Chapter 6 of this QAPP.

4.2 List of Pollutants

There are 33 HAPs identified in the draft Integrated Urban Air Toxics Strategy (UATS). They are a subset of the 188 toxics identified in Section 112 of the CAA which are thought to have the greatest impact on the public and the environment in urban areas. Ecology staff reviewed the 33 HAPs list and consulted with EPA staff. After several consultations, final lists of compounds were selected. The list is based on:

- The EPA's Concept Paper;

- A major portion of the 33 Unified Air Toxics Strategy (UATS) HAPs can be measured with 3 field and lab systems;
- The limitations of the State-of-the-Science instruments.

A number of compounds on the UATS list are difficult to characterize or the methods have not been developed yet. These compounds will not be included in the pollutant list. If at some time in the future methods are developed for these compounds, Ecology may, include these compounds. ERG will report to the national Air Quality System (AQS) as many compounds as possible listed in the “Core” section of Table 4.1. However, EPA is only requiring Ecology to report to the national Air Quality System (AQS) compounds that are listed in the Required Section of Table 4-1. Since the collection and analysis of samples will also provide data on other compounds, Ecology will report values to AQS that can be quality assured and accepted by the procedures detailed in this QAPP.

Table 4.1 List of Air Toxics

Required	Core	Max
Benzene, chromium, acrolein, and formaldehyde	Benzene, 1,3-butadiene, carbon tetrachloride, chloroform, 1,2-dichloropropane, dichloromethane, tetrachloroethylene, trichloroethylene, vinyl chloride, arsenic, beryllium, cadmium, chromium, lead, manganese, formaldehyde and acrolein	Acrylonitrile, benzene, 1,3-butadiene, carbon tetrachloride, chloroform, 1,2-dibromomethane, 1,3-dichloropropene, 1,2-dichloropropane, ethylene dichloride, ethylene oxide, dichloromethane, tetrachloro ethane, tetrachloroethylene, trichloroethylene, vinyl chloride, arsenic, beryllium, cadmium, chromium, lead, mercury, manganese, nickel, acetaldehyde, formaldehyde and acrolein, 2,2,7,8 tetrachlorobenzo-p-dioxin, coke oven emissions, hexachlorobenzene, hydrazine, polycyclic organic matter, polychlorinated biphenyls, quinoline

As can be seen from Table 4-1, there are a number of additional HAPs in the Core and Max lists. Many of these are HAPs that the current analytical systems can measure. ERG will report the compounds that are on the Core and Max list if these can be detected and analyzed while collecting the data on the required list.

4.3 Locations of Interest for HAPS

The main objective for the NATTS is to provide data for the national trends, as determined in

Chapter 6 of this QAPP. However, Ecology may also operate other air toxics monitoring stations to characterize general exposure and temporal and spatial variability. Further information on air toxics is needed from other cities and both industrial/downtown and suburban areas within Washington. Ecology has decided to target these areas in addition to the NATTS for future monitoring as funding becomes available.

5 Project/Task Description

5.1 Description of Work to be Performed

The measurement goal of the NATTS is to estimate the concentration, in units of micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) and parts per billion/volume (ppbv) of air toxic compounds of particulates and gases. This is accomplished by using five separate collection media:

- PM_{10} metals via high volume sampling on an 8 x 10" quartz glass filter
- VOC Canister sampling with passivated canisters
- Carbonyls with 2,4-Dinitro-phenyl hydrazine (DNPH) coated cartridges
- Hexavalent chrome with 47 mm filters
- PAHs with poly urethane foam (PUF) filters

5.2 Field Activities

Table 5.1, 5.2, 5.3, 5.4, 5.5, and 5.6 summarizes some of the critical performance requirements.

Table 5.1 Design/Performance Specifications - PM_{10} - Toxic Metals

Equipment	Frequency	Acceptance Criteria
Filter Design Specs. Size Medium Filter thickness Collection efficiency	1 in 6 days	8.5" x 11" Quartz Glass Fiber Filter 0.50 mm 99.95%
Sampler Performance Specs. Sample Flow Rate Flow Regulation Flow Rate Precision Flow Rate Accuracy Clock/Timer	1 in 6 days	1.13 m^3/min . 0.1 m^3/min . $\pm 7\%$ $\pm 7\%$ 24 hour ± 2 min accuracy

Table 5.2 Design/Performance Specifications - Air Canister Sampler - Volatile Organic Compounds

Equipment	Frequency	Acceptance Criteria
Canister Design Specs. Size Medium Max Pressure Max. pressure drop Collection efficiency Lower Detection Limit	1 in 6 days	6 liters spherical Passivated SUMMA electro-polished Stainless Steel Canister 30 psig 14 psig. 99% compound specific, usually >0.1 ppbv
Sampler Performance Specs. Sample Flow Rate Flow Regulation Flow Rate Precision Flow Rate Accuracy External Leakage Internal Leakage	1 in 6 days	7 cc/min. 1.0 cc/min. ±10% ±10% Vendor specs Vendor specs 24 hour ± 2 min accuracy

Table 5.3 Design/Performance Specifications - Carbonyl Sampler - Aldehyde and Ketone Compounds

Equipment	Frequency	Acceptance Criteria
Filter Design Specs. Size Medium	1 in 6 days	360 mg Short body 2,4-Dinitro-phenyl hydrazine (DNPH) coated silica gel
Sampler Performance Specs. Sample Flow Rate Flow Regulation Flow Rate Precision Flow Rate Accuracy External Leakage Internal Leakage Clock/Timer	1 in 6 days	500 cc/min. 1 cc/min. ±10% ±10% Vendor specs Vendor specs 24 hour ± 2 min accuracy

Table 5.4 Hexavalent Chromium

Equipment	Frequency	Acceptance Criteria
Sampler Performance Specs. Sample Flow Rate Size Medium Timer Power Temperature Range	1/6	15 l/pm. ±10% 47 mm Sodium bicarbonate impregnated cellulose .24 hr ± 2 min 500w/110vac 10 – 30 deg. C

Table 5.5 Polycyclic Aromatic Hydrocarbons

Equipment	Frequency	Acceptance Criteria
Sampler Performance Specs. Flow rate Size, PUF Medium, PUF Size, Filter Medium, Filter Power Elapsed time meter Sampler on/off	1/6	200 l/min \pm 10% 60mm dia. Polyether type (0.022 g/cm ³) 100 mm dia. Quartz microfibre 960 watts/ 110VAC + 30 min/24 hr _± + 30 min/24 hr _±

Ecology assumes the sampling instruments to be adequate for the sampling for air toxics. All of the instruments operated in the field are vendor supplied. The descriptions of the samplers are similar to the instruments described in the references noted above.

5.2.1 Field Measurements

Tables 5.1, 5.2, 5.3, 5.4, 5.5, and 5.6 represent the field measurements that will be collected. These tables are presented in the “Compendia of Organic and Inorganic Methods.”

5.3 Laboratory Activities

All laboratory activities in support of the Air Toxics Monitoring will be provided by EPA’s National Contract Lab (ERG). See ERG’s Quality Assurance Project Plan for details.

5.3.1 Pre-sampling Preparation

- **PM₁₀** - High purity quartz microfibre filters for use in PM₁₀ samplers will be shipped by EPA to the AQP and then onto ERG. Prior to shipment EPA will have their contractors determine metal residue on each lot (30 filters selected at random, acid extraction with microwave heating, analysis by ICP). AQP personnel will visually inspect each filter for defects prior to use. See ERG’s QAPP for specific calibration and quality assurance protocols.
- **Hexavalent Chromium** – ERG will prepare the hexavalent chrome filters per ERG’s QAPP, specifically section 10.9 “Hexavalent Chromium Analytical System” and ERG-MOR-063 “Standard Operating Procedure for the Analysis of Ambient Air for Hexavalent Chromium by IC”.
- **VOC** - Sampling canisters purchased from commercial suppliers will be sent to ERG for cleaning and evacuation prior to field deployment. Cleaning and certification procedures are performed in accordance with ERG-MOR-062 “Standard Operating Procedure for UATMP and NMOC Canister Cleaning”. Canisters are shipped in secured boxes by Federal Express. Canisters are stored at ERG when waiting to be

analyzed and after cleaning prior to field deployment. In the field pressure measurements prior to and following sample collection are made to check sample integrity. Post sample canister pressures are confirmed when they arrive at ERG.

- **Carbonyls** - Silica cartridges pre-coated with DNPH are shipped by the vendor directly to ERG. Each cartridge is individually wrapped and marked with a Lot number. Three cartridges from each Lot are shipped to ERG for certification. Formaldehyde and acetaldehyde levels on the blank cartridges must be below levels described in method TO-11A. After deployment in the field samplers, the capped cartridges are placed in screw top bottles to which has been added a filter strip impregnated with DNPH. The exposed cartridges are shipped to ERG for analysis.
- **PAHs** – PUF filters and their associated sample cartridges are prepared by ERG as described in their QAPP section 10.0 “Hexavalent Chromium Analytical System”.

Shipping/Receiving

Shipping of filters, canisters and carbonyl cartridges between the ERG analytical laboratory and NWRO is accomplished via UPS. Samples collected in the field are labeled individually and recorded in a logbook. A photocopy of the field log accompanies each sample during transit. Upon arrival at ERG, the samples are logged in and stored for analysis per ERG “Standard Operating Procedure for Sample Receipt at the ERG Chemistry Laboratory”.

Post-Sampling:

- **PM₁₀ filters** - Upon arrival at ERG, each filter will be logged in and examined for physical defects. Filters then will be cut into strips in preparation for metals analysis. All handling, cutting, and metals analysis will be performed as described in the Compendium Method IO-3.5 “Determination of Metals in Ambient Particulate Matter Using Inductively Coupled Plasma Mass Spectrometry (ICP/MS)”, and more specifically ERG-MOR-084 “Standard Operating Procedure for the Preparation of PM₁₀ or TSP Filters for Metals Analysis by ICP-MS”.
- **Hexavalent Chromium** - Hexavalent Chrome analysis will be performed as generally described in the modified CARB Method 039 for TSP hexavalent chromium. ERG will use their adaptation of the procedure ERG-MOR-063 “Standard Operating Procedure for the Analysis of Ambient Air for Hexavalent Chromium by IC”.
- **VOCs** - VOC determinations will be performed at ERG using the EPA Compendium Method TO-15 “Determination of Volatile organic Compounds (VOCs) in Air Collected In Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)” and ERG-MOR-005 “Standard Operating Procedure for the Concurrent GC/FID/MS Analysis of Canister Air Toxics Samples”.
- **Carbonyls** - The DNPH derivatives of formaldehyde and acetaldehyde will be eluted from the carbonyl cartridges and analyzed as described in EPA’s Compendium Method

TO-11A “Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPLC)”, more specifically ERG-MOR-024 “Standard Operating Procedure for Preparing Aldehyde Derivatizing Reagents and Extracting Derivatized Samples”.

- **PAHs** – PAH analysis will be performed as described in EPA’s Compendium Method TO-13A “Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS)”, more specifically ERG-MOR-049 “Standard Operating Procedure for Analysis by EPA Compendium Method TO-13A”.
- **Data Management and Validation** – ERG will provide the post analysis data management and validation. Data management (recording, transformation, transmittal, reduction, summary, tracking, storage and retrieval) and validation (review, verification, and analysis) will be performed using the protocols specified in ERG’s April 2007 QAPP.
- **Data Reporting** – ERG will submit the resulting data and associated quality assurance information to EPA’s Air Quality System (AQS) no later than 120 days following the end of each calendar quarter. ERG will submit data as is, including values below the calculated MDL.

5.4 Project Assessment Techniques

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: performance evaluation (PE), MSRs, TSAs, peer review, inspection, or surveillance. Section 18 discusses the details of the assessment activities. Table 5-4 presents a schedule of these assessments.

Table 5-4 Assessment Schedule

Agency	Type of Assessment	Agency Assessed	Frequency
NAREL	TSA and PEs, round robin inter-laboratory samples	ERG	Annually
ERG	PEs	Ecology	Annually
OAQPS-EMAD	MSRs, TSAs	ERG, NAREL, EPA Regional and Ecology	As needed by EMAD determination
EPA Region 10	Network Reviews	Ecology	Once every 5 years
EPA Region 10	TSAs and IPAs	Ecology	Once every 3 years

5.5 Schedule of Activities

Table 5-5 contains a list of activities required to plan, implement, and assess the Project.

Table 5-5 Schedule of Activities

Activity	Anticipated Completion Date
Network Development	Complete
Sampler Order	Complete
Personnel Requirements	Ongoing
QAPP Development	12/2000; revised 9/2004; revised 11/2008; revised 3/2012
Final Network Design	Complete
Sampler Arrival	Complete
Sampler Siting	Ongoing
Routine Sampling	Ongoing
Sample Analysis	Ongoing
Data Validation	Ongoing
Data Assessment	Ongoing
AQS Submittals	Performed by EPA contract laboratory (ERG)
Final Report	Annually by ERG

5.6 Project Records

The Air Quality Program's Quality Assurance Policy and Procedure Manual establish procedures for the timely preparation, review, approval, issuance, use, control, revision and maintenance of documents and records.

6 Data Quality Objectives

The DQO process described in EPA's QA/G-4 document provides a general framework for ensuring that the data collected meets the needs of the intended decision makers and data users. The process establishes the link between the specific end use(s) of the data with the data collection process and the data quality and quantity needed to meet a program's goals. This process was applied to one of the primary goals of the National Air Toxics Trends Network, namely to establish trends and evaluate the effectiveness of HAP reduction strategies. This section describes the results of the DQO process for the local monitoring data requirements for: benzene, 1,3-butadiene, arsenic, chromium, acrolein, and formaldehyde.

In addition, the objectives for other possible future monitoring stations within Washington include:

- Determine and characterize ambient concentrations and depositions of volatile, inorganic and carbonyl air toxic compounds in representative monitoring areas;
- Obtain information on spatial and temporal variability of ambient air toxic compounds;
- Determine air toxic concentrations in areas of high population density;
- Collect data to support and evaluate dispersion and deposition models.

The technical approach used followed the conceptual model developed for the PM_{2.5} FRM DQOs. This conceptual model was followed mainly due to its success in use with PM_{2.5} and the flexibility

of the conceptual model. It is a quite general model for simulating the characterization of ambient concentrations in terms of annual or multi-year averages from 1 in 6 day sampling. The model incorporates several sources of variability: seasonal variability, natural day-to-day variability, sampling incompleteness, and measurement error. The measurement error was restricted to a precision component without a bias component because the final mathematical form of the assessment of trends is robust to multiplicative bias. Pollutant specific parameters were used in the modeling. The parameters describing the natural variation of the pollutants were based on data analyses of the EPA's Pilot City data and the Air Toxics Archive. Finally, separate urban and rural DQOs were established for the pollutants that were sufficiently measured in rural locations of the Pilot Study.

A workgroup organized by EPA/OAQPS/EMAD provided representatives of data users, decision makers, state and local parties, and monitoring and laboratory personnel. Battelle provided technical statistical support throughout the process with examples and data analyses. The workgroup guided the DQO development and made the decisions that were not driven by data analyses in the DQO development during a series of conference calls. These decisions included items such as establishing a specific mathematical form for measuring trends and establishing limits on the sampling rate. Battelle and EPA also held a meeting in Research Triangle Park, North Carolina, on June 17, 2002 to discuss the development details.

6.1 The General DQO Process

This section presents an overview of the seven steps in EPA's QA/G-4 DQO process as applied to one of the primary goals of the National Air Toxics Monitoring Network, namely to establish trends and evaluate the effectiveness of HAP reduction strategies (see www.epa.gov/quality/qs-docs/g4-final.pdf). The purpose of this section is to provide general discussion on the specific issues that were used in developing the DQOs as they relate to the general DQO process.

The DQO process is a seven-step process based on the scientific method to ensure that the data collected meet the needs of its data users and decision makers in terms of the information to be collected, in particular the desired quality and quantity of data. It also provides a framework for checking and evaluating the program goals to make sure they are feasible and that the data are collected efficiently. The seven steps are usually labeled as:

- State the Problem
- Identify the Decision
- Identify the Inputs to the Decision
- Define the Study Boundaries
- Develop a Decision Rule
- Specify Tolerable Limits on the Decision Errors
- Optimize the Design.

6.1.1 The Problem

Characterize the ambient concentrations in the region represented by the monitor to establish any significant downward trend measured by a percent change between successive 3-year means of the concentrations.

The ability to characterize the trends was statistically modeled. The statistical model was designed by starting with a model similar to the one used for PM_{2.5} FRM data. The ambient concentrations are modeled as deviations from a sine curve, where the sine curve represents seasonality. This sine curve represents long-term daily averages of the concentrations that one would observe at the site. The form used is as follows:

$$A \left[1 + \left(\frac{r-1}{r+1} \right) \sin \left(\frac{day}{365} 2 \pi \right) \right]$$

Where

A = the long term annual average and
r = the ratio of the highest point on the sine curve to the lowest point. A value of r = 1 indicates no seasonality.

The natural deviations from the sine curve are assumed to follow a lognormal distribution with a mean that is given by the particular point on the sine curve. (For example, the value of the sine curve for Day 100 is the mean for all Day 100s across many years.) The coefficient of variation (CV) of the lognormal distribution is assumed to be a constant. The general model considered also allows for the day-to-day deviations from the sine curve to be correlated, but the current DQOs are based on a correlation of zero. (The correlation effectively measures how quickly the concentrations can change from one deviation from the sine curve to another. A correlation of zero indicates that it can change fast enough that values measured on consecutive days would be completely independent. A value of 0.2 would say that a positive deviation from the curve is somewhat more likely to be followed by another positive deviation than a negative deviation. A value of 0.9 would indicate that positive deviations are almost always followed by another positive deviation.) Finally, the measured values are modeled with a normally distributed random measurement error with a constant coefficient of variation (CV). The specific values for the various parameters are pollutant specific.

The population parameters (the degree of seasonality, the autocorrelation, and the CV of the deviations from the sine curve) were estimated from the Pilot City data (and in the case of benzene compared with estimates from the Air Toxics Data Archive). A near worst-case choice was made for each of the parameters. The power curves and decision errors are established via Monte-Carlo simulation of the model with the particular parameters for various combinations of truth and observed percent changes in three-year mean concentrations. The power curves are plotted as functions of the true percent change in the three-year annual means for compound specific combinations of the sampling frequency, completeness, and precision. Decision errors are stated

for these worst-case scenarios.

Note: It was decided by the workgroup from budgetary considerations that the proposed DQOs should be constrained to no more than one in six day sampling.

6.1.2 The Decision

The decision statement provides a link between the principal study question and possible actions. It was decided that any decision would be based on whether or not a 15 percent decrease was observed. Hence the form of the decision was fixed, and may be specified as follows:

Significant decreases (15 percent or more) between successive three-year mean concentration levels will result in Insignificant decreases, (increases, or decreases of less than 15 percent) will trigger alternate actions of

6.1.3 Identify the Inputs to the Decision

Only six HAPs (benzene, 1,3-butadiene, arsenic, chromium, acrolein, and formaldehyde) were considered in the DQO development. It is assumed that the other pollutants will be represented by at least one of these six. The statements included here apply implicitly to the other HAPs.

The analytical techniques used in the Pilot study will be used throughout the program. Most importantly for the DQOs the Method Detection Limits (MDLs) will not increase. The pollutant specific MDLs assumed are listed in Section 3. Those values were identified as pollutant-site maximums that were achieved by at least two of the pilot sites in each pollutant's case.

Among the key decisions made as a part of the DQO process was that each pollutant will need to be measured on a schedule of at least once every six days with a quarterly completeness of 85 percent for six consecutive years. The completeness criterion was checked against the pilot data, and was generally achieved. All valid measurements count toward the completeness goal, including non-detects. The analysis of the trends at the site level will be based on a percent difference between the mean of the first three annual concentrations and the mean of the last three annual concentrations. Hence for each year the annual average concentration, X_i , needs to be found, $i = 1, 2, \dots 6$. Next find the mean, X , for the first three years and the mean, Y , for years 4 through 6 as follows:

$$X = \frac{X_1 + X_2 + X_3}{3} \text{ and } Y = \frac{X_4 + X_5 + X_6}{3}.$$

Then the downward trend, T , is the percent decrease from the first three-year period to the second three-year period. Namely,

$$T = \frac{X - Y}{X} \cdot 100$$

The Action Level is the cutoff point that separates different decision alternatives. Based on the assumed budgetary constraint of one in six day sampling and the natural variation exhibited by the six compounds considered, an action level of 15 percent was chosen. Hence at least a 15 percent decrease between the two distinct three-year mean concentrations will need to be observed in order to be considered a significant decrease. This assumes that the mean concentrations are above the health standards, and hence it makes sense to consider trends. (Note that characterizing the mean concentrations is a separate goal of the Air Toxics program that has not yet been considered and could result in different DQOs.)

6.1.4 The Study Boundaries

While the much of this document is prepared to address the needs of the existing NATTS site located in Seattle at Beacon Hill, it is also intended to cover activities related to toxic monitoring that may occur throughout the state of Washington. The majority of those types of monitoring activities are short duration monitoring projects, usually scheduled for a sampling duration of one year. The Beacon Hill NATTS site is described in detail below.

Beacon Hill (existing site) – This site is in Seattle, an area of high population density that reflects conditions in a “typical” urban residential neighborhood. It is impacted by a mix of urban source categories. It was originally sited to provide neighborhood/urban scale NO_x concentrations to compare to the annual NO₂ standard. It is also used to evaluate ozone precursors and the metropolitan area’s visibility. The parameters currently measured at this site include VOCs, carbonyls, PM₁₀ metals, PM_{2.5} with manual and automated methods, speciated particulate matter with manual and automated methods, trace carbon monoxide, trace oxides of nitrogen, ozone, trace sulfur dioxide, and meteorological conditions. In addition, an Interagency Monitoring of Protected Visual Environments (IMPROVE) sampler, nephelometer and absorption photometer are also being operated at this site.

6.1.5 The Decision Rule

Significant decreases (15 percent or more) between successive three-year mean concentration levels will provide for the identification of successful reduction strategies.... Insignificant decreases, (increases, or decreases of less than 15 percent) will trigger a review of in place reduction measures’ effectiveness.

6.1.6 Tolerable Limits on the Decision Errors

Since the program will not generate complete, error-free data, there will be some probability of making a decision error. The main goal of the DQO process is to find a workable balance between how complete and error free the data are with acceptable levels of decision errors. To find the balance, the possible errors need to be carefully defined. This usually needs to be done with the recognition that there will be a range, often called the gray zone, where it is impractical to control decision errors.

The QA/G-4 guidance recommends using 0.01 as the starting point for setting decision error rates.

However, such a limit would generally require a sampling rate that is not feasible. The workgroup decided on the following limits:

If there is no true decrease in the three-year average concentrations, then the probability of observing a mean concentration for years four through six that is at least 15 percent below the observed mean concentration from years one through three should be no more than 10 percent.

If there is a true decrease in the three-year average concentrations of at least 30 percent, then the probability of observing a mean concentration for years four through six that is less than 15 percent below the observed mean concentration from years one through three should be no more than 10 percent.

Equivalently, the second statement could read that:

If there is a true decrease in the three-year average concentrations of at least 30 percent, then the probability of observing a mean concentration for years four through six that is at least 15 percent below the observed mean concentration from years one through three should be at least 90 percent.

The power curves shown in Section 6 show the probability of observing at least a 15 percent decrease as a function of the true decrease. In terms of the above goals this means that the power curve graphs should start below 10 percent for a true percent change of 0 and end above 90 percent for a true percent change of 30 percent. Since there is a particular interest in the error rates for no true change and for a true change of a 30 percent decrease, this associated x-axis (horizontal axis) range is shown for each curve. Also, it is sometimes useful to know when the two target error rates are achieved. The range of “truth” between these values is referred to as the gray zone, i.e., the range of true percent decreases that cannot be reliably detected by the sampling scheme. These are also given for each curve (and indicated with vertical dotted lines).

6.1.7 Optimize the Design

In each pollutant’s case, a sampling schedule of once every six days is set forth with a quarterly completeness criteria of 85 percent. Pilot City study participants were surveyed and almost all were collecting and obtaining valid data values at a rate that exceeded 85 percent for each of the six compounds considered (valid non-detects counted toward completeness). Hence, the target rate of 85 percent was selected, instead of the more common 75 percent completeness goal. This should make the power curves more representative of the network’s expected monitoring conditions.

6.1.8 DQO’s For the Six Compounds

This section states the design values, namely it gives the expected maximum error rates, gray zones, and power curves for each of the six compounds considered explicitly. The parameters describing the natural state of the ambient conditions used to construct the power curves, error rates and gray zone are compound specific based on data from the Pilot Study. In each case, the

Pilot City data yielded a range of estimates. The specific values used were the extremes (or nearly so) that would make detecting a downward trend more difficult. Actual performance in almost all cases should be better than that indicated by the power curves, since specific sites would not be characterized by these extremes in each of these parameters. However, since the sensitivity to the different parameters is not the same, the DQOs need to protect against a combined set of extremes. Hence, the use of extremes for network design purposes is conservative.

Since the rural sites can be quite different from urban sites, separate DQOs are shown in those cases where there were sufficient data to support investigating a separate set of DQOs. In the case of formaldehyde, the urban and rural DQOs are essentially the same.

There are twelve input parameters shown in each section. They are:

1. T1. This is the target error rate for when there is no change. It is always 10 percent.
2. T2. This is the target error rate for when there is a 30 percent decrease. It is always 10 percent.
3. The action limit. This is the minimum observed percent change from the mean concentration of the first three years to the mean concentration from the last three years that would be used to indicate that the concentrations have decreased. Decreases less than this amount would not be considered significant decreases in the mean concentration.
4. The sampling rate. It is set to one in six day sampling in each case.
5. The quarterly completeness criterion. This was set to 85 percent based on the recommendation of ERG and a review of the Pilot Study data completeness.
6. Measurement error Coefficient of Variation (CV). This was assumed to be 15 percent for each compound. (A sensitivity analysis showed that the DQOs are robust to moderate changes in this value.)
7. Seasonality ratio. This is a measure of the degree of seasonality. Specifically, it is the ratio of the highest point on the seasonal curve to the lowest point. A value of 1 indicates no seasonality. Larger values make it more difficult to estimate an annual or three-year mean concentration, and hence larger values make it more difficult to measure the percent change.
8. Autocorrelation. This is a measurement of how quickly day-to-day deviation from the seasonal curve can occur. A value of 0 indicates that changes occur quickly enough that each day is independent of the preceding day. Values greater than 0 indicate that the changes are generally slower, so that days with concentrations above the seasonal curve are more likely to be followed by another day above the seasonal

curve. Values greater than 0 increase the precision of the three-year means and the percent change between the three-year means. Hence, a value of 0 is the most conservative choice for the DQOs. Zero was used in all cases, because many daily measurements are required to obtain a reliable estimate of this parameter.

9. Population CV. This is a measurement of the natural variation about the seasonal curve. Larger values decrease the precision of the three-year mean concentration estimates and the percent change between them. The power curves are strongly dependent on this parameter, but the estimates can be strongly influenced by a few outlier values. Generally the 90th percentile of the estimates from the Pilot study was used as a balance between these competing forces. This value was then rounded up to be a multiple of 5 percent for the urban DQOs. For the rural DQOs an additional 5 percent was added, since there were fewer rural sites on which to base the estimates.
10. MDL. This is the MDL used in the simulations. The value was chosen to be a reasonably attainable maximum for a site and compound.
11. Initial mean concentration. This is the mean concentration of the first three years in the simulations. Values closer to the MDL decrease the precision of the percent change estimate. The value chosen was approximately equal to the 25th percentile of the site-compound means from the Pilot study.
12. Health Risk Standard. This value is shown for reference only. It was not used in the simulations.

In addition to the power curves, there are three sets of output values.

1. Error₀ is the percent of the simulations with no change in the true three-year means that in fact generated at least a 15 percent decrease in the observed three-year means.
2. Error₃₀ is the percent of the simulations with a 30 percent decrease in the true three-year means that generated less than a 15 percent decrease in the observed three-year means.
3. The gray zone is the interval of the true decreases that cannot be detected with confidence by the study design. In this range, the probability of observing at least a 15 percent decrease is greater than 10 percent, but less than 90 percent.

In summary, based on variability and uncertainty estimates from the ten-city Pilot Study, the following Sections 3.1 through 3.10 suggest that the specified air toxics trends DQOs will be met for monitoring sites that satisfy the goals of 1 in 6 day sampling, 85 percent completeness, and 15 percent measurement CV. These results were explicitly developed for benzene (urban and rural); 1,3-butadiene (urban and rural); arsenic (urban and rural); chromium (urban only); acrolein (urban only); and formaldehyde (urban and rural).

6.1.9 DQO's for Measuring the Percent Decrease

6.1.9.1 Benzene at Urban Locations

Table 6.1 shows the input parameters used in the simulation model in developing the DQOs for measuring the percent decrease between three-year mean concentrations of benzene at urban locations. Table 6.2 shows the output values from the simulations. Figure 6.1 shows the associated power curve, which is the probability of observing a 15 percent difference between successive three-year means as a function of the true percent difference in the distinct three-year means. In summary, based on variability and uncertainty estimates from the ten-city Pilot Study data, Table 6.2 suggests that the specified air toxics trends DQOs will be met for benzene at urban monitoring sites that satisfy the goals of one in six-day sampling, 85 percent completeness, and 15 percent measurement CV.

Table 6.1 DQO input parameters for benzene at urban locations

T1	Action Limit	Sampling Rate	Seasonality	Population CV	Initial Concentration ($\mu\text{g}/\text{m}^3$)
10%	15%	1 in 6 day	4.5	85%	1.0
T2	Measurement CV	Completeness	Autocorrelation	MDL ($\mu\text{g}/\text{m}^3$)	Risk Standard ($\mu\text{g}/\text{m}^3$)
10%	15%	85%	0	0.044	0.128

Table 6.2 DQO output parameters for benzene at urban locations

Error rate for no true change	Error rate for 30% decrease	Gray zone
6%	97%	3% - 26%

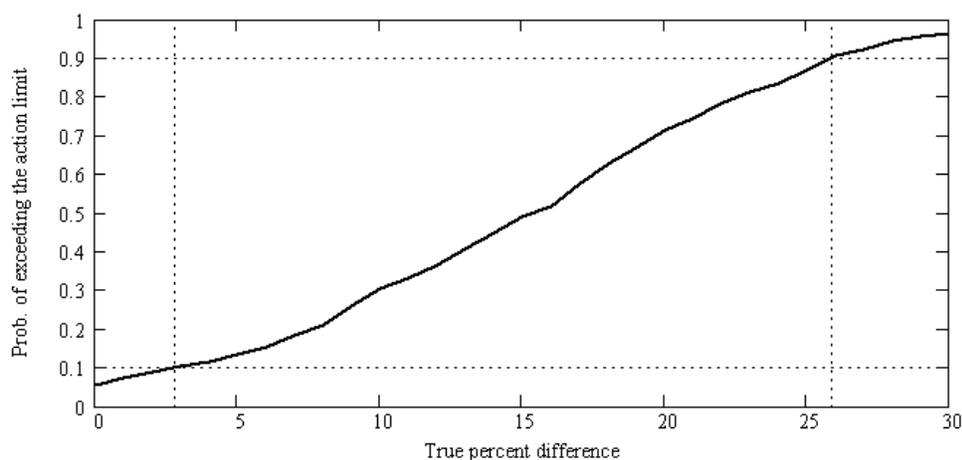


Figure 6.1 Power curve for detecting a 15 percent decrease between successive three-year means of benzene concentrations based on the data variation found in urban locations of the Pilot Study

6.1.9.2 DQOs for Measuring the Percent Decrease of Benzene at Rural Locations

Table 6.3 shows the input parameters used in the simulation model in developing the DQOs for measuring the percent decrease between three-year mean concentrations of benzene at rural locations. Table 6.4 shows the output values from the simulations. Figure 6.2 shows the associated power curve, which is the probability of observing a 15 percent difference between successive three-year means as a function of the true percent difference in the distinct three-year means. In summary, based on variability and uncertainty estimates from the ten-city Pilot Study data, Table 6.4 suggests that the specified air toxics trends DQOs will be met for benzene at rural monitoring sites that satisfy the goals of one in six-day sampling, 85 percent completeness, and 15 percent measurement CV.

Table 6.3 DQO input parameters for benzene at rural locations

T1	Action Limit	Sampling Rate	Seasonality	Population CV	Initial Concentration ($\mu\text{g}/\text{m}^3$)
10%	15%	1 in 6 day	4.0	60%	1.0
T2	Measurement CV	Completeness	Autocorrelation	MDL ($\mu\text{g}/\text{m}^3$)	Risk Standard ($\mu\text{g}/\text{m}^3$)
10%	15%	85%	0	0.044	0.128

Table 6.4 DQO output parameters for benzene at rural locations

Error rate for no true change	Error rate for 30% decrease	Gray zone
2%	99%	7% - 23%

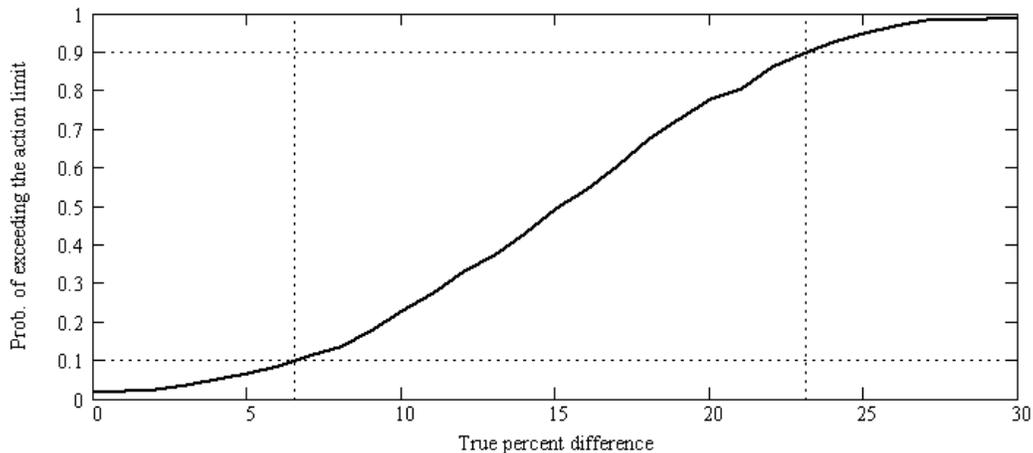


Figure 6.2 Power curve for detecting a 15 percent decrease between successive three-year means of benzene concentrations based on the data variation found in rural locations of the Pilot Study

6.1.9.3 DQOs for Measuring the Percent Decrease of 1,3-Butadiene at Urban Locations

Table 6.5 shows the input parameters used in the simulation model in developing the DQOs for measuring the percent decrease between three-year mean concentrations of 1,3-butadiene at urban locations. Table 6.6 shows the output values from the simulations. Figure 6.3 shows the associated power curve, which is the probability of observing a 15 percent difference between successive three-year means as a function of the true percent difference in the distinct three-year means. In summary, based on variability and uncertainty estimates from the ten-city Pilot Study data, Table 6.6 suggests that the specified air toxics trends DQOs will be met for 1,3-butadiene at urban monitoring sites that satisfy the goals of one in six-day sampling, 85 percent completeness, and 15 percent measurement CV.

Table 6.5 DQO input parameters for 1,3-butadiene at urban locations

T1	Action Limit	Sampling Rate	Seasonality	Population CV	Initial Concentration ($\mu\text{g}/\text{m}^3$)
10%	15%	1 in 6 day	7.0	100%	0.1
T2	Measurement CV	Completeness	Autocorrelation	MDL ($\mu\text{g}/\text{m}^3$)	Risk Standard ($\mu\text{g}/\text{m}^3$)
10%	15%	85%	0	0.02	10^{-5}

Table 6.6 DQO output parameters for 1,3-butadiene at urban locations

Error rate for no true change	Error rate for 30% decrease	Gray zone
10%	94%	0% - 28%

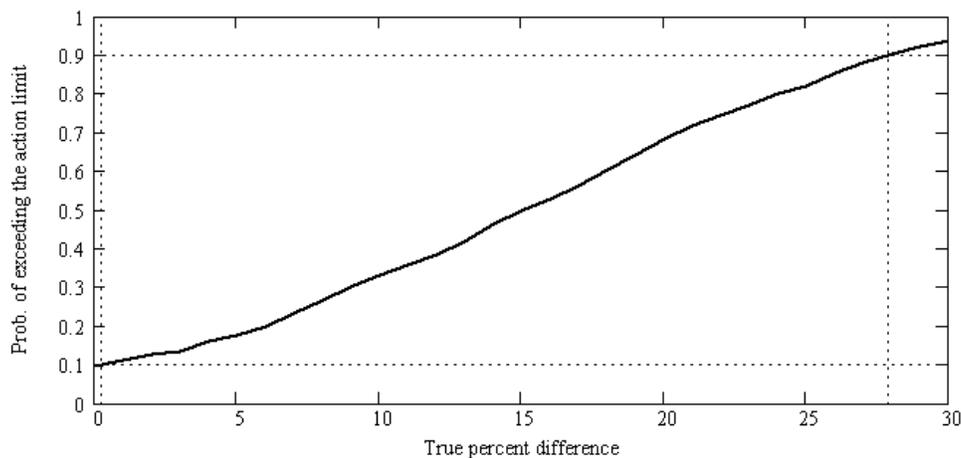


Figure 6.3 Power curve for detecting a 15 percent decrease between successive three-year means of 1,3-butadiene concentrations based on the data variation found in urban locations of the Pilot Study

6.1.9.4 DQOs for Measuring the Percent Decrease of 1,3-butadiene at Rural Locations

Table 6.7 shows the input parameters used in the simulation model in developing the DQOs for measuring the percent decrease between three-year mean concentrations of 1,3-butadiene at rural locations. Table 6.8 shows the output values from the simulations. Figure 6.4 shows the associated power curve, which is the probability of observing a 15 percent difference between successive three-year means as a function of the true percent difference in the distinct three-year means. In summary, based on variability and uncertainty estimates from the ten-city Pilot Study data, Table 6.8 suggests that the specified air toxics trends DQOs will be met for 1,3-butadiene at rural monitoring sites that satisfy the goals of one in six-day sampling, 85 percent completeness, and 15 percent measurement CV.

Table 6.7 DQO input parameters for 1,3-butadiene at rural locations

T1	Action Limit	Sampling Rate	Seasonality	Population CV	Initial Concentration ($\mu\text{g}/\text{m}^3$)
10%	15%	1 in 6 day	6.0	75%	0.1
T2	Measurement CV	Completeness	Autocorrelation	MDL ($\mu\text{g}/\text{m}^3$)	Risk Standard ($\mu\text{g}/\text{m}^3$)
10%	15%	85%	0	0.02	10^{-5}

Table 6.8 DQO output parameters for 1,3-butadiene at rural locations

Error rate for no true change	Error rate for 30% decrease	Gray zone
4%	98%	4% - 25%

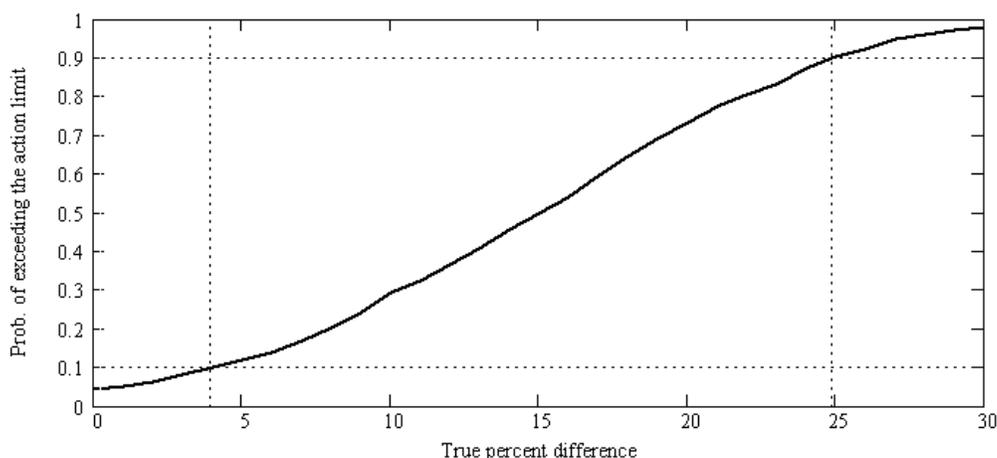


Figure 6.4 Power curve for detecting a 15 percent decrease between successive three-year means of 1,3-butadiene concentrations based on the data variation found in rural locations of the Pilot Study

6.1.9.5 DQOs for Measuring the Percent Decrease of Arsenic at Urban Locations

Table 6.9 shows the input parameters used in the simulation model in developing the DQOs for measuring the percent decrease between three-year mean concentrations of arsenic at urban locations. Table 6.10 shows the output values from the simulations. Figure 6.5. shows the associated power curve, which is the probability of observing a 15 percent difference between successive three-year means as a function of the true percent difference in the distinct three-year means. In summary, based on variability and uncertainty estimates from the ten-city Pilot Study data, Table 6.10 suggests that the specified air toxics trends DQOs will be met for arsenic at urban monitoring sites that satisfy the goals of one in six-day sampling, 85 percent completeness, and 15 percent measurement CV.

Table 6.9 DQO input parameters for arsenic at urban locations

T1	Action Limit	Sampling Rate	Seasonality	Population CV	Initial Concentration ($\mu\text{g}/\text{m}^3$)
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10%	15%	1 in 6 day	5.0	85%	0.002
T2	Measurement CV	Completeness	Autocorrelation	MDL ($\mu\text{g}/\text{m}^3$)	Risk Standard ($\mu\text{g}/\text{m}^3$)
10%	15%	85%	0	0.000046	0.0043

Table 6.10 DQO output parameters for arsenic at urban locations

Error rate for no true change	Error rate for 30% decrease	Gray zone
8%	95%	2% - 27%

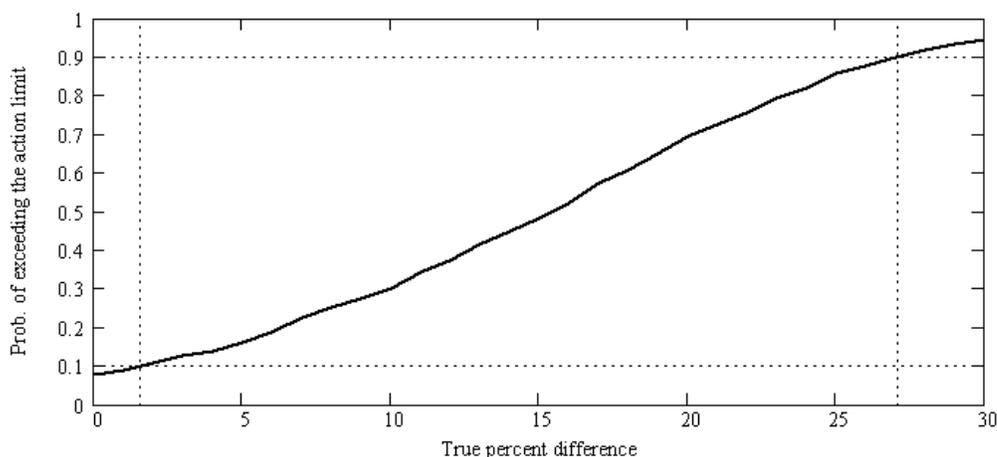


Figure 6.5 Power curve for detecting a 15 percent decrease between successive three-year means of arsenic concentrations based on the data variation found in urban locations of the Pilot Study

6.1.9.6 DQOs for Measuring the Percent Decrease of Arsenic at Rural Locations

Table 6.11 shows the input parameters used in the simulation model in developing the DQOs for measuring the percent decrease between three-year mean concentrations of arsenic at rural locations. Table 6.12 shows the output values from the simulations. Figure 3.6.1 shows the associated power curve, which is the probability of observing a 15 percent difference between successive three-year means as a function of the true percent difference in the distinct three-year means. In summary, based on variability and uncertainty estimates from the ten-city Pilot Study data, Table 6.12 suggests that the specified air toxics trends DQOs will be met for arsenic at rural monitoring sites that satisfy the goals of one in six-day sampling, 85 percent completeness, and 15 percent measurement CV.

Table 6.11 DQO input parameters for arsenic at rural locations

T1	Action Limit	Sampling Rate	Seasonality	Population CV	Initial Concentration ($\mu\text{g}/\text{m}^3$)
10%	15%	1 in 6 day	4.0	65%	0.001
T2	Measurement CV	Completeness	Autocorrelation	MDL ($\mu\text{g}/\text{m}^3$)	Risk Standard ($\mu\text{g}/\text{m}^3$)

10%	15%	85%	0	0.000046	0.0043
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Table 6.12 DQO output parameters for arsenic at rural locations

Error rate for no true change	Error rate for 30% decrease	Gray zone
3%	99%	5% - 24%

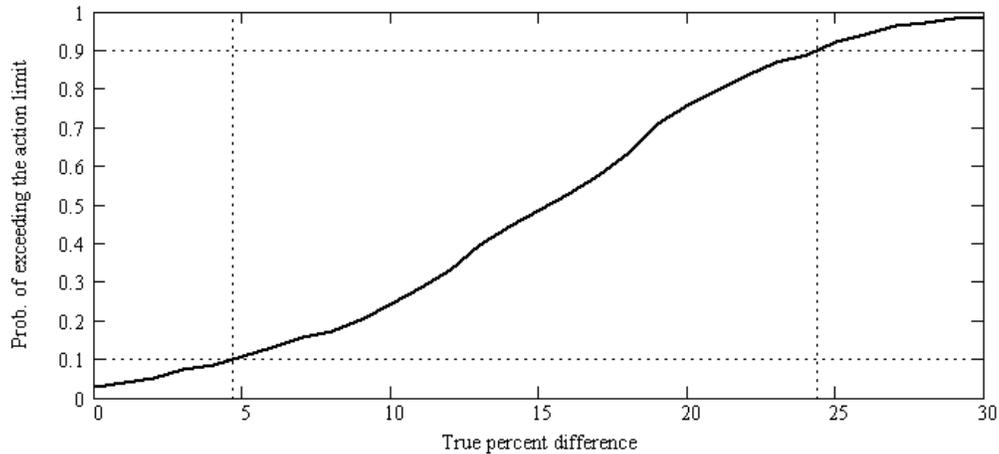


Figure 6.6 Power curve for detecting a 15 percent decrease between successive three-year means of arsenic concentrations based on the data variation found in rural locations of the Pilot Study

6.1.9.7 DQOs for Measuring the Percent Decrease of Chromium

Table 6.13 shows the input parameters used in the simulation model in developing the DQOs for measuring the percent decrease between three-year mean concentrations of chromium. Table 6.14 shows the output values from the simulations. Figure 6.7 shows the associated power curve, which is the probability of observing a 15 percent difference between successive three-year means as a function of the true percent difference in the distinct three-year means. In summary, based on variability and uncertainty estimates from the ten-city Pilot Study data, Table 6.14 suggests that the specified air toxics trends DQOs will be met for chromium at monitoring sites that satisfy the goals of one in six-day sampling, 85 percent completeness, and 15 percent measurement CV. (See section 3.0 for definitions of the input parameters and output values.)

Table 6.13 DQO input parameters for chromium

T1	Action Limit	Sampling Rate	Seasonality	Population CV	Initial Concentration ($\mu\text{g}/\text{m}^3$)
10%	15%	1 in 6 day	5.0	90%	0.0015
T2	Measurement CV	Completeness	Autocorrelation	MDL ($\mu\text{g}/\text{m}^3$)	Risk Standard ($\mu\text{g}/\text{m}^3$)
10%	15%	85%	0	0.00018	0.012

Table 6.14 DQO output parameters for chromium

Error rate for no true change	Error rate for 30% decrease	Gray zone
7%	96%	2% - 27%

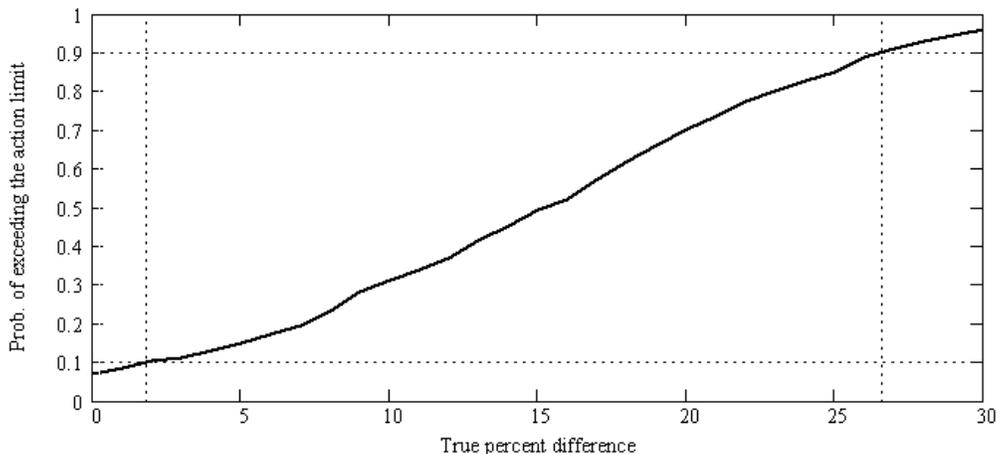


Figure 6.7 Power curve for detecting a 15 percent decrease between successive three-year means of chromium concentrations based on the data variation found in of the Pilot Study

6.1.9.8 DQOs for Measuring the Percent Decrease of Acrolein

Table 6.15 shows the input parameters used in the simulation model in developing the DQOs for measuring the percent decrease between three-year mean concentrations of acrolein. Table 6.16 shows the output values from the simulations. Figure 6.8 shows the associated power curve, which is the probability of observing a 15 percent difference between successive three-year means as a function of the true percent difference in the distinct three-year means. In summary, based on variability and uncertainty estimates from the ten-city Pilot Study data, Table 6.16 suggests that the specified air toxics trends DQOs will be met for acrolein at monitoring sites that satisfy the goals of one in six-day sampling, 85 percent completeness, and 15 percent measurement CV.

Table 6.15 DQO input parameters for acrolein

T1	Action Limit	Sampling Rate	Seasonality	Population CV	Initial Concentration ($\mu\text{g}/\text{m}^3$)
10%	15%	1 in 6 day	4.0	105%	0.4
T2	Measurement CV	Completeness	Autocorrelation	MDL ($\mu\text{g}/\text{m}^3$)	Risk Standard ($\mu\text{g}/\text{m}^3$)
10%	15%	85%	0	0.14	-

Table 6.16 DQO output parameters for acrolein

Error rate for no true change	Error rate for 30% decrease	Gray zone
10%	91%	0% - 29%

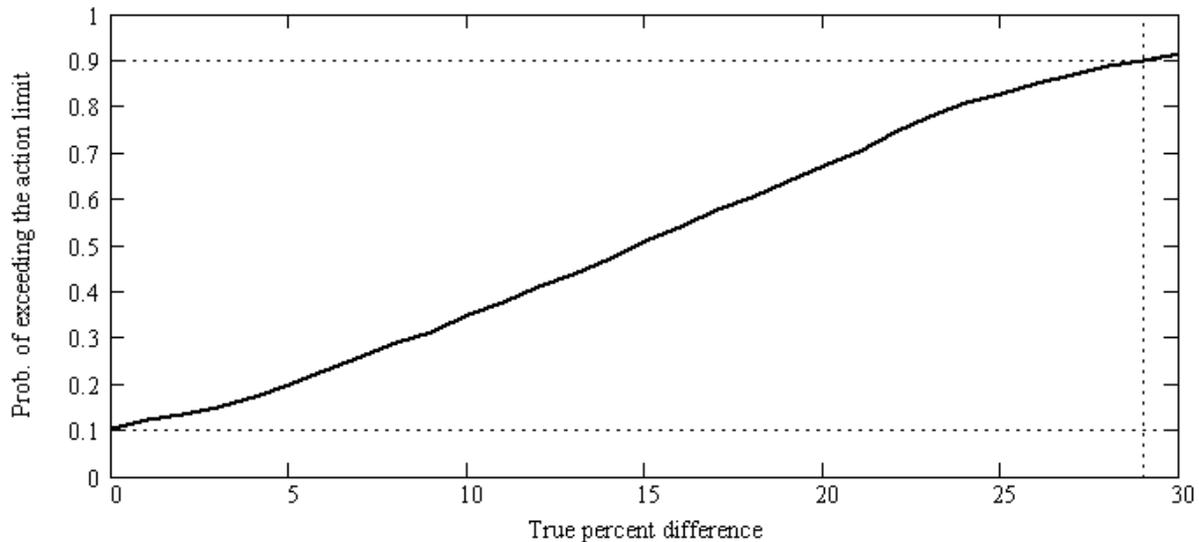


Figure 6.8 Power curve for detecting a 15 percent decrease between successive three-year means of acrolein concentrations based on the data variation found in the Pilot Study

6.1.9.9 DQOs for Measuring the Percent Decrease of Formaldehyde at Urban Locations

Table 6.17 shows the input parameters used in the simulation model in developing the DQOs for measuring the percent decrease between three-year mean concentrations of formaldehyde at urban locations. Table 6.18 shows the output values from the simulations. Figure 6.9 shows the associated power curve, which is the probability of observing a 15 percent difference between successive three-year means as a function of the true percent difference in the distinct three-year means. In summary, based on variability and uncertainty estimates from the ten-city Pilot Study data, Table 6.18 suggests that the specified air toxics trends DQOs will be met for formaldehyde at urban monitoring sites that satisfy the goals of one in six-day sampling, 85 percent completeness, and 15 percent measurement CV.

Table 6.17 DQO input parameters for formaldehyde at urban locations

T1	Action Limit	Sampling Rate	Seasonality	Population CV	Initial Concentration ($\mu\text{g}/\text{m}^3$)
10%	15%	1 in 6 day	7.0	90%	2.5
T2	Measurement CV	Completeness	Autocorrelation	MDL ($\mu\text{g}/\text{m}^3$)	Risk Standard ($\mu\text{g}/\text{m}^3$)
10%	15%	85%	0	0.014	$1.3 \cdot 10^{-5}$

Table 6.18 DQO output parameters for formaldehyde at urban locations

Error rate for no true change	Error rate for 30% decrease	Gray zone
8%	95%	2% - 27%

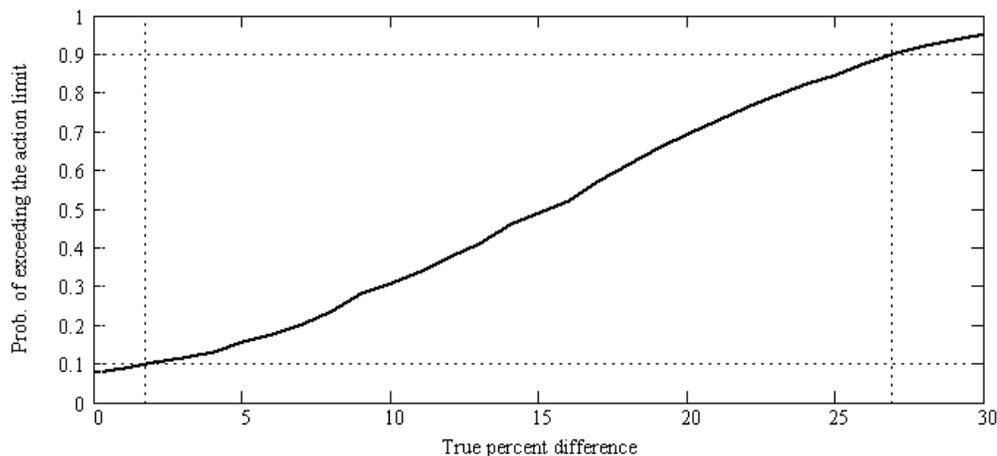


Figure 6.9 Power curve for detecting a 15 percent decrease between successive three-year means of formaldehyde concentrations based on the data variation found in urban locations of the Pilot Study

6.1.9.10 DQOs for Measuring the Percent Decrease of Formaldehyde at Rural Locations

Table 6.19 shows the input parameters used in the simulation model in developing the DQOs for measuring the percent decrease between three-year mean concentrations of formaldehyde at rural locations. Table 6.20 shows the output values from the simulations. Figure 6.10 shows the associated power curve, which is the probability of observing a 15percent difference between successive three-year means as a function of the true percent difference in the distinct three-year means. In summary, based on variability and uncertainty estimates from the ten-city Pilot Study data, Table 6.20 suggests that the specified air toxics trends DQOs will be met for formaldehyde at rural monitoring sites that satisfy the goals of one in six-day sampling, 85 percent completeness, and 15percent measurement CV.

Table 6.19 DQO input parameters for formaldehyde at rural locations

T1	Action Limit	Sampling Rate	Seasonality	Population CV	Initial Concentration ($\mu\text{g}/\text{m}^3$)
10%	15%	1 in 6 day	7.0	90%	2.1
T2	Measurement CV	Completeness	Autocorrelation	MDL ($\mu\text{g}/\text{m}^3$)	Risk Standard ($\mu\text{g}/\text{m}^3$)
10%	15%	85%	0	0.014	$1.3 \cdot 10^{-5}$

Table 6.20 DQO output parameters for formaldehyde at rural locations

Error rate for no true change	Error rate for 30% decrease	Gray zone
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8%	95%	1% - 27%
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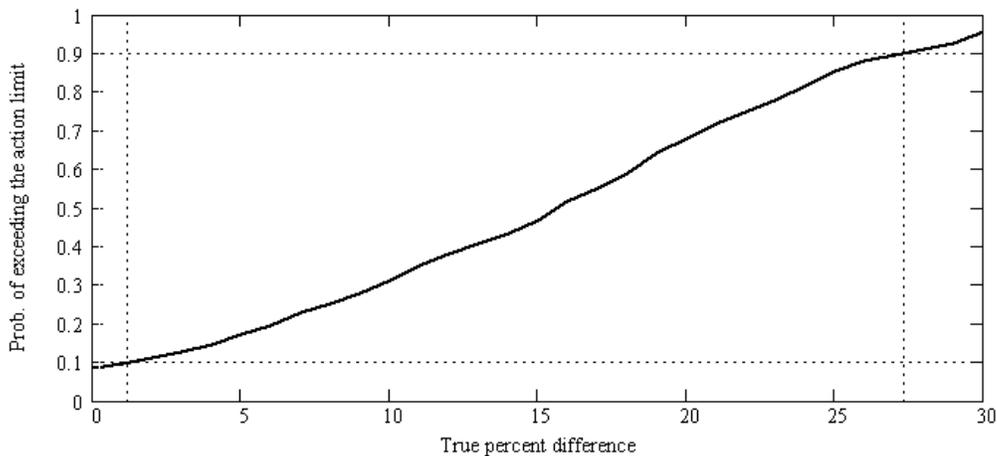


Figure 6.10 Power curve for detecting a 15 percent decrease between successive three-year means of formaldehyde concentrations based on the data variation found in rural locations of the Pilot Study

7 Training

Air monitoring personnel will be recruited and screened to ensure they are experienced and qualified.

Air monitoring personnel will receive sufficient training in their appointed jobs to contribute to the reporting of complete and high quality data. Workshops and courses will be provided by EPA. Primary responsibility for training will rest with the individual's supervisor.

Prior to installation of new equipment, station operators will attend training sessions where either experienced air monitoring field staff will familiarize them with the operation, calibration and maintenance of the new equipment.

8 Documentation and Records

The Air Quality Program's Quality Assurance Policy and Procedure Manual describes document and records procedures. ERG's Quality Assurance Project Plan (QAPP) describes their data management, recording, validation, transformation, transmittal, reduction, summary, tracking, storage and retrieval protocols. ERG will submit air toxics results to EPA's AQS database no later than 120 days following the end of each calendar quarter.

The Air Quality Program Manager will certify that the annual summary is accurate to the best of their knowledge. This certification will be based on the various assessments and reports performed by the organization.

9 Sampling Design

9.1 Scheduled Project Activities, Including Measurement Activities

Ecology is currently monitoring concentrations at one location, the Seattle Beacon Hill NATTS site; however this section will apply to future sites designed and operated for short duration studies. Therefore, this section will discuss the operation and installation of samplers at the NATTS. Since Ecology participated in the National Air Toxics Pilot Program, many of the samplers were already in place.

9.2 Rationale for the Design

9.2.1 Primary Samplers

The purpose of the NATTS site is to determine the long term trends. By employing samplers that are described in the appropriate compendia, the data collected will be comparable to standard EPA methods. By complying with the sampling frequency requirements of *Network Design and Site Exposure Criteria for Selected Noncriteria Air Pollutants*, Ecology assumes that the sampling frequency is sufficient to attain the desired confidence in the annual 95th percentile and annual mean of concentrations. By selecting locations using the rules in *Network Design and Site Exposure Criteria for Selected Noncriteria Air Pollutants*, Ecology can be confident that the concentrations within its jurisdiction are adequately characterized. Sampler type, frequency, and siting are further described in section 9.4.

9.2.2 QA Samplers

The purpose of collocated samplers and the performance evaluation is to estimate the precision of the various systems samplers. The goal of is to have concentrations measured by a sampler be within $\pm 10\%$ of the true concentration and that the precision have a coefficient of variation less than 10%. To estimate the level of precision being achieved in the field, the NATTS site will operate collocated samplers for VOCs. The Aldehyde samplers have a dual channel configuration, which allows DNPH cartridges to be loaded and allowed to collect samples on the same instrument as the primary sample. The QA samples will be set, run and collected on a 1 in 12 day schedule. There will be 2 analytes from each instrument that will be used to determine the precision.

Field accuracy will be estimated using flow, temperature sensor and barometric checks. Laboratory accuracy will be determined by the analysis of known reference analytes prepared by independent laboratories submitted to the ERG laboratory when available through EPA. If a sampler and laboratory equipment are operating within the required precision and accuracy levels, then the decision maker can proceed knowing that the decisions will be supported by unambiguous

data. Thus the key characteristics being measured with the QA samplers are precision.

9.3 Design Assumptions

The sampling design is based on the assumption that following the rules and guidance provided in CFR and *Network Design and Site Exposure Criteria for Selected Noncriteria Air Pollutants* will result in data that can be used to measure compliance with the national standards. The only issue at Ecology's discretion is the sampler siting, and to a degree, sampling frequency. The siting assumes homogeneity of concentrations within the MSA. Boundaries will be regularly reviewed, as part of the network reviews. The basis for creating and revising the boundaries is described in the following section.

9.4 Procedure for Locating and Selecting Environmental Samples

9.4.1 Sampling Design

The design of the air toxics network must achieve the monitoring objective. For the Seattle Beacon Hill NATTS site, the objectives are stated in Statement 1 and for any future short term monitoring sites, the objective is stated in Statement 2.

Detect a percent difference change between successive three-year average concentration levels that are greater than or equal to 15 percent

Determine the highest concentrations expected to occur in the area covered by the network, i.e., to verify the spatial and temporal characteristics of HAPs within the city.

The procedure for siting the samplers to achieve the objective is based on judgmental sampling, as is the case for most ambient air monitoring networks. Judgmental sampling uses data from existing monitoring networks, knowledge of source emissions and population distribution, and inference from analyses of meteorology to select optimal sampler locations. The exact location is discussed in Section 9.4.2.

9.4.2 Sampling Locations

Jefferson Park on Beacon Hill (NATTS site) – The Jefferson Park site on Beacon Hill represents urban scale air quality in the Puget Sound metropolitan area. The site is in an area of high population density that reflects conditions in a “typical” urban residential neighborhood. The site is situated in an area that is not directly impacted by any one source or source category. The site is centrally located within the Seattle urban area. The nearest roads are at least 1 km away. It is surrounded by Jefferson Park, a community center, residential neighborhoods and a middle school. It is about 100 meters above sea level. The hill is part of a larger ridge defining the eastern edge of an area of light industry including a major seaport, an airport and warehousing and trucking activity about 4 to 10 km west of the site. Interstate freeways and arterial roads carrying large amounts of traffic are closely situated 2 to 4 km northwest of the site. The site is considered to be representative of 24 hour average PM_{2.5} levels within a 20 km

radius (Goswami 2002). The prevailing winds at the monitoring site are from the south (19%), southwest (17%), and northeast (17%). The highest wind speeds (upper 25%) are typically from the southwest.

The Beacon Hill monitoring station was originally sited to provide maximum neighborhood/urban scale NO_x concentrations to compare to the annual NO₂ standard. It is also used to evaluate ozone precursors. The parameters currently measured at this site include VOCs, carbonyls, PM₁₀ metals, hexavalent chromium, PM_{2.5}, speciated particulate matter, trace level carbon monoxide, trace level oxides of nitrogen, ozone, trace level sulfur dioxide, EC/OC, and meteorological conditions. In addition, an Interagency Monitoring of Protected Visual Environments (IMPROVE) sampler is also being operated at this site.



Figure 9-1 Seattle Beacon Hill NATTS Location

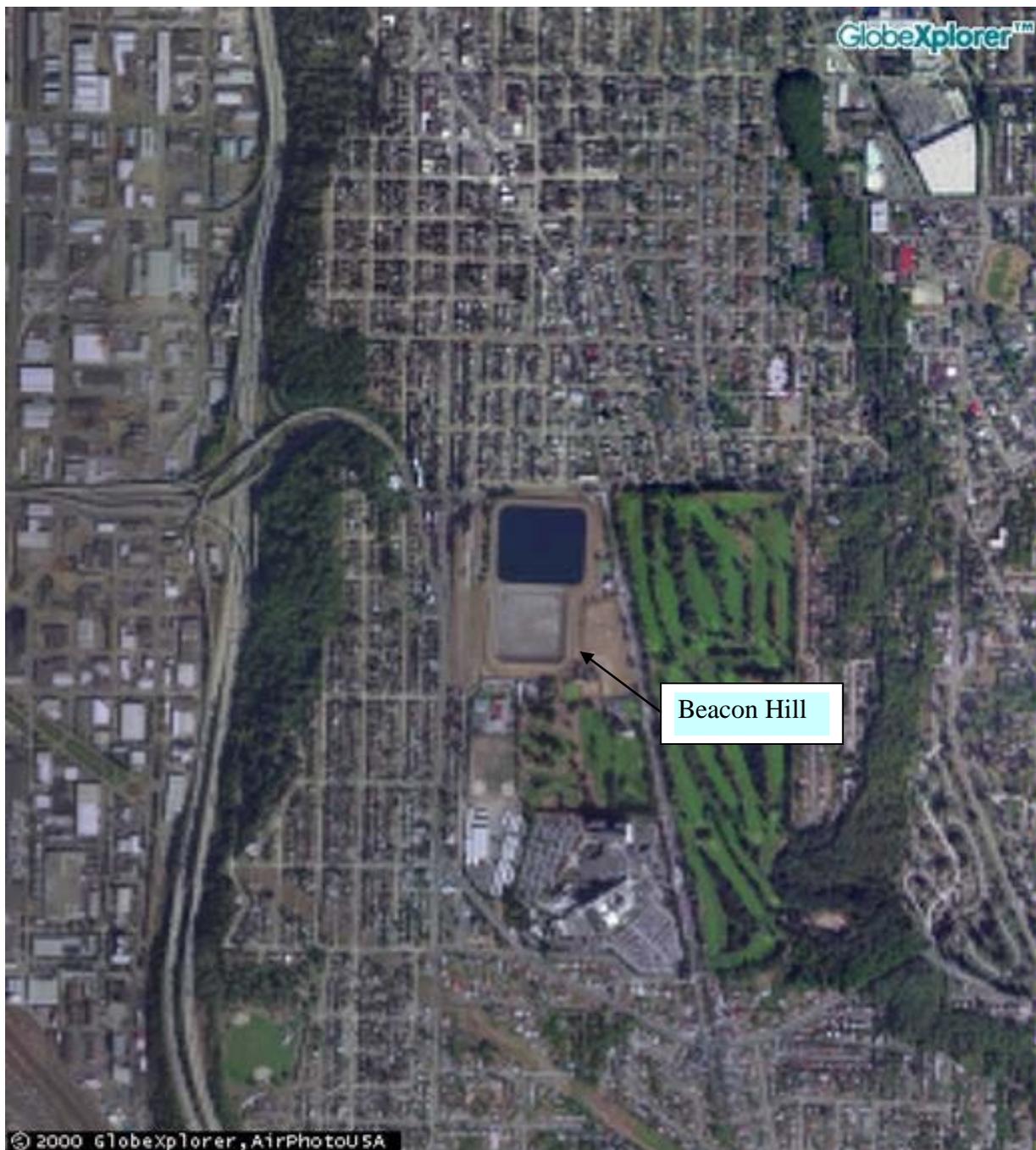


Figure 9-2 Seattle Beacon Hill NATTS Location Aerial Photo

9.5 Classification of Measurements as Critical/Noncritical

The ambient concentration and site location data is identified in AQS. The information collected at collocated samplers is the same as that presented in Tables 5-1, 5-2, 5-3, 5-4, 5-5, and 5-6 for primary samplers. All of the measurements in these tables are considered critical because it forms the basis for estimating precision, which are critical for evaluating the ability of the decision makers to make decisions at desired levels of confidence.

9.6 Validation of Any Non-Standard Measurements

At this time there are no NAAQS for the air toxics compounds, with the exception of lead. Ecology deploys and operates instruments according to descriptions in the applicable EPA guidance documents.

References

1. Compendium Method for the Determination of Inorganic Compounds in Air, United States Environmental Protection Agency, June 1999, Section IO-2.1.
2. Compendium Method for the Determination of Toxic Organic Compounds in Air, United States Environmental Protection Agency, Section TO-11A, January 1999
3. Compendium Method for the Determination of Toxic Organic Compounds in Air, United States Environmental Protection Agency, Section TO-15, January 1999
4. Network Design and Site Exposure Criteria for Selected Non-criteria Air Pollutants, EPA Document Number, EPA 450/4-84-022, September 1984.

10 Sampling Methods

The following sampling methods will be utilized in determining the pollutants listed in Section 4.2: EPA methods IO-3.5 (ICP-MS) for metals, ERG-MOR-063 method for hexavalent chrome, TO-15 for VOCs, TO-11A for Carbonyls and TO-13A for PAHs.

10.1 Sample Collection and Preparation

The sampling frequency for metals, VOCs, Carbonyls, and PAHs are once every six days. The sampling schedule is consistent with the one-in-six timing relative to the EPA's published Monitoring Schedule. All samples will be 24-hr integrated samples. This will yield about 60 sampling days per year for determination of the air toxic compounds. All samples will be shipped from the NWRO to ERG within three days following the sample collection.

Sample medium preparation involves preparing sample filters and cleaning canisters. ERG's Quality Assurance Project Plan (QAPP) describes these activities.

10.2 Sample Set-up

Air monitoring station operators are responsible for sample collection set-up and collection. The frequency of sample collection is described in Section 5.1 and will follow the published Monitoring Schedule. Air monitoring station operators will use the following Standard Operating Procedures prepared by Ecology:

- High Volume PM₁₀ Volumetric Flow Controlled Procedure
- Hexavalent Chromium Sampling Procedure
- Volatile Organic Compound Sampling Procedure
- Carbonyl Compounds Air Sampling Procedures
- PAH Sampling Procedure

Representativeness will be achieved by adhering to the specifications in 40 CFR 58, Appendix D, "Network Design for State and Local Air Monitoring Stations (SLAMS) and National Air Monitoring Stations (NAMS)", Appendix E, "Probe Siting Criteria for Ambient Air Quality Monitoring", and EPA's Quality Assurance Guidance Document "Model Quality Assurance Project Plan for the National Air Toxics Trends Stations" December 2007.

10.3 Sampling Measurement System Corrective Actions

Corrective action measures will be taken to ensure data quality objectives are attained and are described in the Table 10.3 below.

Table 10.3

Item	Problem	Action	Responsible Party
Pre/Post Filter Inspection	Pinholes/Tears Visual detection of a leak	Void Sample Document in log book; notify field operator	Laboratory
Erratic Flow Rates	Motor near failure	Document in log book; notify lab; flag data	Field operator; Laboratory
PM ₁₀ Sample Flow Rate >± 10%	Leak in sampling train/out of calibration	Document in log book; notify lab; recalibrate; flag data	Field operator; Laboratory
Leak Test	Canister won't hold pressure	Document in log book; inspect connections; flag data	Field operator; Laboratory
Carbonyl Sample Flow Rate >± 10%	Leak in sampling train/out of calibration	Document in log book; notify lab; recalibrate; flag data	Field operator; Laboratory
Elapsed Time >± 10 min/day	Check programming; verify if power outage	Document in log book; notify lab; reprogram; flag data	Field operator; Laboratory
Elapsed Time;	Check programming	Document in log	Field operator

sample didn't run		book; notify lab; reprogram	
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10.4 Sampling Equipment, Preservation, and Holding Time Requirements

For data comparability, the National Air Toxics program specifies that EPA Compendium Methods IO-3.5 (ICP-MS) for metals, ERG-MOR-063 for hexavalent chromium, TO-15 for VOCs, TO-11A for Carbonyls, and TO-13A for PAHs will be used for sampling each suite of the air toxic parameters. The sample medium, storage temperature, temperature and chemical preservation, holding time and air sample volume requirements are specified in each of these methods.

10.5 Sample Contamination Prevention

The Air Monitoring network has rigid requirements for preventing sample contamination. These requirements are discussed in the Air Quality Program's Quality Assurance Policy and Procedure Manual.

11 Sample Custody

Sample custody is established utilizing the forms and field data sheets described in ERG's Quality Assurance Project Plan (QAPP).

12 Analytical Methods

Analytical methods that are used for the analysis of each suite of air toxics parameters are as follows. Metals on PM₁₀ filter samples will be analyzed EPA's Compendium Method IO-3.5 (ICP/MS). 47 mm filter samples will be analyzed for hexavalent chromium using ERG-MOR-063. Air samples collected in certified clean canisters will be analyzed for the core HAP Volatile Organic Compounds (VOCs) using Compendium Method TO-15. Air samples collected in DNPH-coated cartridges will be analyzed for carbonyl compounds using the Compendium Method TO-11A (HPLC). PUF filters will be analyzed for PAHs using Compendium Method TO-13A. Collocated samples will be analyzed for metals, hexavalent chromium, VOCs, carbonyls and PAHs following the same methods stated above. All of the QA/QC requirements of the methods specified above shall be followed throughout the sample collection and analysis process of this program. All laboratory analyses will be performed by ERG.

13 Quality Control Requirements

The quality control procedures specified in 40 CFR 58, Appendix A and EPA's Quality Assurance Handbook for Air Pollution Measurement Systems, Volumes II and IV will be utilized to check the quality of the data. Quality control activities, including precision checks, will be documented on the chart and station logbook. The quality control checks for the analytical instrumentation will be performed in accordance with EPA's "Technical Assistance Document for the National Ambient Air Toxics Trends and Assessment Program". The frequencies, control limits, and corrective actions associated with the field equipment are presented in Table 13.

Table 13 - Quality Control Checks

Parameter	Check	Control Limit	Corrective Action
Manual Method	Monthly		
PM₁₀	Flow Check	> ±10%	Re-calibrate Rectify Problem, Flag Data
VOC (Xontech)	Monthly		
	Leak Check	Leak indicated	Rectify Problem, Flag Data
Carbonyl (Xontech)	Quarterly		
	Flow/Leak Check	> ±10%	Rectify Problem, Flag Data
Carbonyl (Xontech)	Monthly		
	Leak Check	Leak indicated	Rectify Problem, Flag Data
Meteorological	Quarterly		
	Wind Speed	> ±5%	Invalidate Data
	Wind Direction	> ±3°	Rectify Problem
		> ±5°	Invalidate Data
	Temperature	> ±0.5°	Invalidate Data

14 Procurement, Acceptance Testing, and Maintenance Requirements for Instruments, Supplies and Consumables

This section details the procedures used for procuring, inspecting, testing, and accepting instruments, supplies and consumables that directly or indirectly affect data quality. The sampling and analytical methods, TO-15, TO-11A, IO-3.5, ERG-MOR-063, & TO-13A specify the instruments, supplies, and consumables that will be employed in this program. The ERG laboratory has developed Standard Operating Procedures (SOPs) for each parameter to maximize data quality.

14.1 Procurement and Acceptance Testing of Equipment

The Air Toxics Monitoring Project Manager is responsible for identifying air monitoring equipment needs and approving equipment purchases. The following protocol is used in procurement of air monitoring equipment:

- Equipment evaluation and selection. Prior to purchase, the equipment's performance will be evaluated and other users queried in regard to the performance, dependability and ease of operation.
- Purchase specifications. The purchase contract will state the performance specifications that insure only equipment of the desired quality is obtained, require a one year warranty, and indicate payment will not be made until the equipment has passed an acceptance test.
- Acceptance Testing. Prior to payment, the equipment will be tested to ensure that it meets the requirements listed in the purchase specifications. For analyzers, the minimum test consists of checking zero drift, span drift, voltage stability, temperature stability, and linearity.

14.2 Maintenance of Equipment

Utilizing the specifications in EPA's Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II and IV and specific instrument manufacturer's manuals, preventive and remedial maintenance tasks, schedules, parts and supplies will be maintained.

The Station Operators are responsible for performing routine preventive and corrective maintenance. They will prepare maintenance reports that will be reviewed and archived.

Major maintenance and repair will be performed by the by the air toxics station operator.

15 Instrument Calibration and Frequency

Instrumentation specific to the laboratory are calibrated as often as specified in methods TO-15, TO-11A, IO-3.5, ERG-MOR-063, & TO-13A and in accordance with the requirements set forth by the analytical methods. Instruments and equipment used in the field will be calibrated at the required frequency stated in the SOPs or in accordance with the manufacturer's specifications.

16 Data Acquisition Requirements

This section addresses data not obtained by direct measurement from the Air Quality Program. This includes both outside data and historical monitoring data. Non-monitoring data and historical monitoring data are used by the Program in a variety of ways. Data obtained in this manner must comply with the requirements for data acceptance as outlined in the Air Quality Program's Quality Assurance Policy and Procedure Manual.

17 Data Management

This section addresses data management procedures used in support of the Air Quality Program. Specific details of data recording, processing, validation, assessment, transmittal, reporting, archiving and retrieval are discussed in the Air Quality Program's Quality Assurance Policy and Procedure Manual and in the following sections.

Air monitoring station reports (Site Masters) will be prepared by the Station Operators and revised when changes in the instrumentation or surrounding area occur. These reports will identify the station name, station number, date, time, operator, instrument identification, parameter, scale and units. Additionally, the report will document the station location, address, UTM coordinates, elevation, and probe location. These reports will be sent to the Air Monitoring Unit for review, processing and archiving.

Air monitoring equipment calibration reports will be prepared and archived by the Air Monitoring Unit.

The Station Operators will maintain station logbooks documenting operational and maintenance activities at the monitoring site. The logbook will be identified with the station name, station number, date, time, operator, instrument identification, parameter, scale and units. The log book

will be used to document quality control checks (time, zero, span, precision, calibration, temperature, pressure, flow, etc.), maintenance, audits, equipment changes (span gas, permeation tubes, analyzer, recorder, pen, paper, probe, etc), and missing or invalid data. The logbooks will be reviewed by the Quality Assurance Unit and archived.

Laboratory Data Management – ERG will provide the post analysis data management and validation. Data management (recording, transformation, transmittal, reduction, summary, tracking, storage and retrieval) and validation (review, verification, and analysis) will be performed using the protocols specified in ERG’s April 2007 QAPP.

ERG’s QAPP describes the data management operations used for NATTS data, with an overview of the mathematical operations and analyses performed on raw data. These operations include data recording, validation, transformation, transmittal, reduction, analysis, management, storage, and retrieval.

Date Recording – Data entry, validation, and verification functions are all integrated in the ERG LIMS. The Procedures for providing all laboratory notebook information and subsequent data entry are provided in ERG-MOR-039 “Procedures for Maintaining Laboratory Notebooks”.

Data Validation – Data validation is a combination of checking that data processing operations have been carried out correctly and of monitoring the quality of the field operations. Data validation will identify problems in either of these areas. Once problems are identified, the data will be corrected or invalidated, and corrective actions will be taken for field or laboratory operations. The following validation functions are incorporated to ensure quality of data entry and data processing operations:

- **Completeness Checks** – When the data are processed certain completeness criteria must be met. For example, each sample must have a start time, an end time, an average flow rate, dates analyzed, and operator and technician names.
- **Data Retention** – Raw data sheets are retained on file at ERG for a minimum of five years after the close of the contract, and are readily available for audits and data verification activities. After five years, hardcopy records and computer backup media are disposed.
- **Statistical Data Checks** – Errors found during statistical screening will be traced back to original data entry files and to the raw data sheets, if necessary. These checks shall be run on an annual schedule and prior to any data submission to AQS. Data validation is the process by which raw data are screened and assessed before they can be included in the main data base.

Data Transformation - Calculations for transforming raw data from measured units to final concentrations use standardized procedures listed in ERG’s individual SOPs. All data are double checked to ensure there are no incorrect transformations. All new spreadsheets go through peer review as well, to ensure that all data submitted are accurate. The peer reviewer uses hand calculations and visual verification to review all data reported to the EPA and Ecology are valid. Specific procedures as outlined in ERG-MOR-057, and separate SOPs for Developing,

Documenting, and Evaluating the Accuracy of Spreadsheet Data are presented in ERG-MOR-017.

Data Transmittal - Data transmittal occurs when data are transferred from one person or location to another or when data are copied from one form to another. Some examples of data transmittal are copying raw data from a notebook onto a data entry form for keying into a computer file and electronic transfer of data over a computer network. Each individual SOP listed in ERG's QAPP Appendix C discusses the procedures for determining the calculations of concentrations as well as data entry.

ERG will report all ambient air quality data and information coded in the AQS format. Such air quality data and information will be fully screened and validated and will be submitted directly to the AQS via electronic transmission, in the format of the AQS, and in accordance with the annual schedule.

ERG will submit the resulting data and associated quality assurance information to EPA's Air Quality System (AQS) no later than 120 days following the end of each calendar quarter. ERG will submit data as is, including values below the calculated MDL.

Data Reduction - Data reduction processes involve aggregating and summarizing results so that they can be understood and interpreted in different ways. Examples of data summaries include:

- Average concentration for a station or set of stations for a specific time period;
- Accuracy, bias, and precision statistics; and
- Data completeness reports based on numbers of valid samples collected during a specified period.

Data Summary - ERG has a through data summary and analysis program. As the Air Toxics Monitoring Program develops, additional data analysis procedures will be developed. The following specific summary statistics will be tracked and reported for the network:

- Single sampler bias or accuracy (based on laboratory audits if available);
- Sampler precision (based on collocated data);
- Network-wide bias and precision; and
- Data completeness.

Data Tracking - The ERG LIMS database contains the necessary input functions and reports appropriate to track and account for the whereabouts of specific samples during processing operations. The following input locations are used to track sample location and status:

- Laboratory (initial receipt)
 - Sample receipt (by Work Order);

- Canister number (VOC only);
- Filter package for the laboratory (filter numbers in each package are recorded);
- Laboratory (receipt from field)
 - Package receipt (package is opened and contents are logged in);
 - Samples are stored in correct locations (i.e., carbonyl tubes, XAD resin, and PUF are stored in separate refrigerators, metals filters are stored in the ICP-MS laboratory, and canisters are stored in the Air Toxics laboratory);
- Refrigerator, by refrigerator number.

Data Storage and Retrieval - Data archival policies are shown in Table 15-2 of ERG's QAPP.

All data will be stored on the ERG LIMS server. This system has the following specifications:

- C Storage: 438G (RAID 5 array);
- Backup: DLT (80GB per tape in compressed mode) - incremental backups daily; full backups weekly;
- Network: Novell Netware 5.0, Windows NT, Linux RedHat, 10/100 Mbps Ethernet network (Windows 95/98 on workstations); and
- Security: Network login password protection on all workstations and dial-in-lines; Additional password protection applied by application software.

Security of the data in the database is ensured by the following controls:

- Password protection on the data base that defines three levels of access to the data;
- Regular password changes (quarterly for continuing personnel);
- Logging of all incoming communication sessions, including the originating telephone number, the user's ID, and connect times; and
- Storage of media including backup tapes in locked, restricted access areas.

18 Assessments and Response Actions

An assessment, for this Plan, is defined as an evaluation process used to measure the performance or effectiveness of the quality system, the establishment of the monitoring network and sites and various measurement phases of the data operation.

18.1 Assessment Activities and Project Planning

18.1.1 Management Systems Review (MSR)

An MSR is a qualitative assessment of a data collection operation or organization to establish whether the prevailing quality management structure, policies, practices, and procedures are adequate. MSRs should be conducted every three years by EPA. The MSR will use appropriate regulations, and the QAPP to determine the adequate operation of the program and its related quality system. The quality assurance activities of all criteria pollutants including air toxics will be part of the MSR. EPA staff will report its findings within 30 days of completion of the MSR. The report will be appropriately filed. Follow-up and progress on corrective action(s) will be determined during regularly scheduled division directors meetings.

ERG will conduct MSRs every year when their internal audit is conducted. Their MSR will use the appropriate regulations and their QAPP to determine the adequate operation of their systems. A Laboratory Quality Manual for the ERG laboratory is also available for reference. The quality assurance activities for air toxics monitoring will be part of the MSR. The Project QA Officer will report the findings to the Program Manager, and the Program QA Officer within 30 days of completion of the MSR. The report will be appropriately filed. Follow-up and progress on corrective actions will be determined during regularly scheduled meetings.

18.1.2 Network Reviews

Conformance with network requirements of the monitoring network is accomplished through annual reviews. The network review is used to determine how well a particular air monitoring network is achieving its required air monitoring objective, and how it should be modified to continue to meet its objective. Since the NATTS site will be collecting long term trends data and is not anticipated to move, the network review will not be performed. Other short term monitoring sites will be expected to collect data for only one year and therefore a network review will not be needed in that case either.

18.1.3 Technical Systems Audits (TSA)

A TSA is a thorough and systematic on-site qualitative audit, where facilities, equipment, personnel, training, procedures, and record keeping are examined for conformance to the QAPP. TSAs of the network will be accomplished every three years and will be conducted by the EPA Regional Office. EPA will implement the TSA either as a team or as an individual auditor. EPA will perform TSA activities that that will focus on:

- Field - handling, sampling, shipping.;
- Laboratory - Pre-sampling, shipping, receiving, post-sampling weighing, analysis, archiving, and associated QA/QC;
- Data management - Information collection, flagging, data editing, security, upload.

Key personnel to be interviewed during the audit are those individuals with responsibilities for: planning, field operations, laboratory operations, QA/QC, data management, and reporting. To increase uniformity of the TSA, an audit checklist will be developed and used. This checklist is based on the *EPA R-5* guidance.

The audit team will prepare a brief written summary of findings, organized into the following areas: planning, field operations, laboratory operations, quality assurance/quality control, data management, and reporting. Problems with specific areas will be discussed and an attempt made to rank them in order of their potential impact on data quality.

The audit finding form has been designed such that one is filled out for each major deficiency that requires formal corrective action. The finding should include items like: systems impacted, estimated time period of deficiency, site(s) affected, and reason of action. The finding form will inform Ecology about serious problems that may compromise the quality of the data and therefore require specific corrective actions. They are initiated by the Audit Team, and discussed at the debriefing

Post-Audit Activities- The major post-audit activity is the preparation of the systems audit report. The report will include:

- Audit title and number and any other identifying information;
- Audit team leaders, audit team participants and audited participants;
- Background information about the project, purpose of the audit, dates of the audit; particular measurement phase or parameters that were audited, and a brief description of the audit process;
- Summary and conclusions of the audit and corrective action requires;
- Attachments or appendices that include all audit evaluations and audit finding forms.

To prepare the report, the audit team will meet and compare observations with collected documents and results of interviews and discussions with key personnel. Expected QA Project Plan implementation is compared with observed accomplishments and deficiencies and the audit findings are reviewed in detail. Within thirty (30) calendar days of the completion of the audit, the audit report will be prepared and submitted. The systems audit report will be submitted to the appropriate managers and appropriately filed.

If Ecology has written comments or questions concerning the audit report, the Audit Team will review and incorporate them as appropriate, and subsequently prepare and resubmit a report in final form within thirty (30) days of receipt of the written comments. The report will include an agreed-upon schedule for corrective action implementation.

EPA will also conduct TSAs at the ERG laboratory. These activities include the following:

- Laboratory - Presampling, shipping, receiving, post-sampling weighing, analysis, archiving, and associated QA/QC; and

- Data management – Information collection, flagging, data editing, security, upload.

Follow-up and Corrective Action Requirements- EPA, Ecology, and ERG will work together to solve required corrective actions. As part of corrective action and follow-up, an audit finding response letter will be generated by Ecology. The audit finding response letter will address what actions are being implemented to correct the finding of the TSA. The audit response letter will be completed within 30 days of acceptance of the audit report.

18.1.4 Performance Audit

A Performance Audit is a field operations audit that ascertains whether the samplers are operating within the specified limits as stated in the SOPs and QAPP. The Performance Audit will be performed by Ecology at least once every year. The audit consists of challenging the samplers to operate using independent NIST-traceable orifices or other flow devices. Once the audit has been performed, the flow rate is calculated and compared against the flow rates as specified in the QAPP or SOPs. If the flow rates are not within these ranges, then the field operations technician is notified in writing and corrective action ensues. Once the field technicians have remedied the situation, a post audit confirms the adjustment or maintenance.

EPA provides quality assurance performance audit samples to ERG for analysis. Based on the results from these samples, percent accuracy (or bias) is calculated using the EPA-reported audit sample concentration as the true value. For the NMOC program, audit samples of propane or multi-components in air are analyzed as received. Multi-component audit samples will be analyzed for the 12-month UATMP by the GC/FID/MS. For the SNMOC and PAMS programs, multi-component audit samples are also analyzed as received by the GC/FID/MS analytical system.

Currently, the only audit program supported by this contract is the PAMS carbonyl audit, providing three separate audits throughout the summer months. The acceptable limits are provided on the annual reports presented to the participating States and EPA.

18.1.5 Data Quality Assessments

A data quality assessment (DQA) is the statistical analysis of environmental data to determine whether the quality of data is adequate to support the decision which are based on the DQOs. Data are appropriate if the level of uncertainty in a decision based on the data is acceptable. The DQA process is described in detail in *Guidance for the Data Quality Assessment Process*, EPA QA/G-9 and is summarized below.

- *Review the data quality objectives (DQOs) and sampling design of the program:* review the DQO. Define statistical hypothesis, tolerance limits, and/or confidence intervals.

- *Conduct preliminary data review.* Review Precision & Accuracy (P&A) and other available QA reports, calculate summary statistics, plots and graphs. Look for patterns, relationships, or anomalies.
- *Select the statistical test:* select the best test for analysis based on the preliminary review, and identify underlying assumptions about the data for that test.
- *Verify test assumptions:* decide whether the underlying assumptions made by the selected test hold true for the data and the consequences.
- *Perform the statistical test:* perform test and document inferences. Evaluate the performance for future use.

Measurement uncertainty will be estimated for both automated and manual methods. Terminologies associated with measurement uncertainty are found within 40 CFR Part 58 Appendix A and includes:

- Precision - a measurement of mutual agreement among individual measurements of the same property usually under prescribed similar conditions, expressed generally in terms of the standard deviation;
- Accuracy- the degree of agreement between an observed value and an accepted reference value, accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations;
- Bias- the systematic or persistent distortion of a measurement process which causes errors in one direction. Estimates of the data quality will be calculated on the basis of single monitors and aggregated to all monitors.

18.1.6 Performance Evaluations (PE)

The PE is an assessment tool for the laboratory operations. The EPA's Contract laboratory for the UATMP creates "blind" samples and sends them periodically to ERG. Upon receipt, the laboratory logs in the samples and performs the normal handling routines as any other sample. The PE is analyzed in accordance with ERG's QAPP and SOPs. Then the results are reported to the EPA's Contract Laboratory Director. The Contract laboratory writes up a PE report and sends a copy of the results to Ecology, ERG, and the EPA QA Office. Any results outside of the EPA's acceptance criteria are then noted in the PE report. Ecology has 120 days to address any deficiencies noted in the PE Report.

18.2 External Assessment Schedule

Table 18.1 Assessment Summary

Agency	Type of Assessment	Agency Assessed	Frequency
EPA - NAREL	TSA and PEs, round robin inter-laboratory samples	ERG	Annually
ERG	PEs	S/L/T agencies	Annually
OAQPS-EMAD	MSRs, TSAs	ERG, NAREL, EPA Regional and S/L/T agencies	As needed by EMAD determination
Regional Offices	Network Reviews	S/L/T agencies	Once every 5 years
Regional Offices	TSAs and IPAs	S/L/T agencies	Once every 3 years

19 Reports to Management

Important benefits of regular QA reports to management include the opportunity to alert the management of data quality problems, to propose viable solutions to problems, and to procure necessary additional resources. Management should not rely entirely upon the MSRs for their assessment of the data. The MSR only occurs once every three years. Quality assessment, including the evaluation of the technical systems, the measurement of performance, and the assessment of data, is conducted to help insure that measurement results meet program objectives and to insure that necessary corrective actions are taken early, when they will be most effective.

Effective communication among all personnel is an integral part of a quality system. Regular, planned quality reporting provides a means for tracking the following:

- Adherence to scheduled delivery of data and reports;
- Documentation of deviations from approved QA and test plans, and the impact of these deviations on data quality;
- Analysis of the potential uncertainties in decisions based on the data.

19.1 Frequency, Content, and Distribution of Reports

Required reports to management for monitoring in general are discussed in various sections of 40 CFR Parts 53 and 58. Guidance for management report format and content are provided in guidance developed by EPA's Quality Assurance Division (QAD) and the Office of Air Quality Planning and Standards. These reports are described in the following subsections.

19.1.1 Toxics QA Annual Report

Periodic assessments of air toxics data are required to be reported to EPA (40 CFR 58 Appendix A, Section 1.4, revised July 18, 1997). The Toxics QA Annual Report prepared the ERG laboratory

will include quality information for each air toxic monitored in the network. The annual report documents the statistical analysis and quality for the measurement data and how the objectives for the program were met.

The report includes the following topics:

- Program overview and update;
- Quality objectives for measurement data;
- Data quality assessment.
- Collocated and duplicate sampling estimates for precision and bias; and
- Audits that were performed during the study period.

19.1.2 Technical System Audit Reports

External systems audits are conducted at least annually by the EPA Regional Office as required by 40 CFR Part 58. Further instructions are available from the EPA Regional QA Coordinator or the Systems Audit QA Coordinator, Office of Air Quality Planning and Standards, Emissions Monitoring and Analysis Division (MD-14), U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

ERG will perform a technical system audit once a year for the monitoring the NATTS network. These reports will be filed and available to the EPA personnel during their technical system audit.

19.1.3 Response/Corrective Action Reports

The Data Disposition procedure will be followed whenever a problem is found such as a safety defect, an operational problem, or a failure to comply with procedures. A Data Disposition Report is one of the most important ongoing reports to management because it documents primary QA activities and provides valuable records of QA activities.

20 Data Verification and Validation

20.1 Data Verification Design

The primary purpose of this section is to describe the data verification procedures which are used by Ecology and ERG to process ambient air toxics data. ERG's LIMS will be used to facilitate data storage, retrieval, analysis, and reporting. Data summaries, QC charts, and other graphs, aid in maintaining consistent data quality. All data reported by ERG will use a flagging system to notify the observer of compounds detected at a level less than the detection limit.

Data Review Design - Each sample received at the ERG Laboratory will be logged into the ERG LIMS. The accompanying field data forms are reviewed to verify that all data entry is complete and correct. The personnel performing the data review are:

- familiar with typical diurnal concentration variations (for example, benzene, toluene, and xylene concentrations usually increase and decrease together, since the occurrence of these compounds is attributed to mobile sources);
- familiar with the type of instrument malfunctions which cause characteristic trace irregularities;
- recognize that cyclical or repetitive variations (at the same time each day or at periodic intervals during the day) may be caused by excessive line voltage or temperature variations. Nearby source activity can also cause erroneous or non-representative measurements; and
- recognize that flow rates showing little or no activity often indicate flow problems, or sample line leaks.

Information used to validate air toxics data, includes:

- Multi-point calibrations - the multipoint calibrations are used to establish proper initial calibration and can be used to show changes in calibration.
- Instrument logs - all activities and samples analyzed are entered into the log books to track the samples throughout the measurement procedures.
- Blanks, replicate and spike results - these QC indicators can be used to ascertain whether sample handling or analysis is causing bias in the data set.

Summary Reports - Quarterly summary reports will present the preliminary data to the EPA and Ecology. Final data reports will be completed at the end of the year including all data collected throughout the year's measurements. These data will include:

- summaries for the monitoring locations in the respective cities;
- analysis and interpretation of data trends for that year's group of prevalent compounds;
- illustration of changes in ambient air concentrations of the most prevalent components of urban air pollution from year to year;
- completeness report;
- collocated and duplicate results from the field and replicate results from the laboratory.

The reliability and acceptability of environmental analytical information depends on the rigorous completion of all the requirements outlined in the QA/QC protocol. During data analysis and validation, data are filtered and accepted or rejected based on the set of QC criteria listed in the individual SOPs included in Appendix C of ERG's QAPP. The data are critically reviewed to locate and isolate spurious values. A spurious value, when located, is not immediately rejected. All questionable data, whether rejected or not, are maintained along with rejection criteria and any possible explanation. Such a detailed approach can be time-consuming but can also be helpful in identifying sources of error and, in the long run, save time by reducing the number of outliers.

ERG's QAPP describes the data management operations used for NATTS data, the mathematical operations and analyses performed on raw data.

20.2 Data Review

Prior to performing any statistical calculations, the reported data from the chain of custody forms will be checked to ensure accurate transcription. The value is double-checked and a comparison to previously recorded data is made. Using conveniently formatted and bound prepared data recording forms will be used; hardcopies of data will also be obtained directly from measuring devices equipped with the necessary digital recording peripherals. This method of recording data is sufficient if the hardcopies are properly labeled and filed, although a periodic check will be performed to ensure the proper operation of such a device.

The collected data will be reviewed by the Analyst and the Task Leader. The data will be scrutinized daily to eliminate the collection of invalid data. The analyst will record any unusual circumstances (no matter how minor) during analysis (e.g., power loss or fluctuations, temporary leaks or adjustments, operator error) on the chain of custody form and notifies the analytical Task Leader. A copy of the chain of custody form can be found in ERG's QAPP Section 9.

Data Verification - Data verification consists of confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. The specific requirements are QC checks, acceptable data entry limits, etc. Data validation is confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. Intended use deals with data of acceptable quality to permit making decisions at the correct level of confidence. The following sections outline ERG's data validation and usability requirements.

At least 10 percent of the database is checked to verify its validity. Items checked include original data sheets, checks of all calculations (from calibration to sample analysis), and data transfers. As the data are checked, corrections are made to the database as errors or omissions are encountered. If errors are located, all of the data is checked to verify data quality. The analytical reviewer examines all data for overall data quality and completeness. ERG's Program Manager reviews all data before data are reported to the EPA or Ecology.

NATTS Data Reduction, Preliminary Data Validation, and Reporting - A sample analysis logbook will be maintained to detail pertinent sample information at the time of analysis. Entries

include site code, sample date, analysis date, and electronic file names. A chromatograph and area count report from each detector will be printed for each analysis and the analytical database for each analysis acquires, integrates, and stores the analytical data.

Monthly site-specific data update summaries will be developed for the purpose of distribution to the participating EPA technical staff, administrators, and Ecology Project Manager. Quarterly data summaries will be developed for the distribution of the air toxics data to the EPA technical staff, administrators, and Ecology Project Manager. Air Toxic data consists of any toxics VOC, SNMOC, carbonyl, semi-volatile (or other HAPs) requested by the program participants. Each summary updates prior data listings. Cumulative listings will be periodically generated upon request. Even though these data summaries have not passed through the final data validation steps, this timely turnaround of data assists in planning, preliminary modeling, and program development. Any changes made in the preliminary data as a result of subsequent data validation processes will be noted in the cumulative project data summaries for each specific sampling site. The data summaries include:

- Site code;
- Sample identifications;
- Sample dates;
- Target compound list;
- Concentrations (parts per billion by volume (ppbv), ppbC, and $\mu\text{g}/\text{m}^3$); and
- Method detection limits.

Preliminary data summaries are mailed to Ecology. These data summaries are considered preliminary until the final report is prepared, at which time the data are validated.

The Analytical Peer Reviewer examines all data for overall data quality and completeness. The ERG Program Manager reviews all data before they are reported to the EPA and Ecology. ERG will prepare a final report containing all aspects of the individual programs including data summaries, QA, QC, and data analysis results for EPA, and will distribute site-specific summaries of the final data to Ecology. ERG will submit the final UATMP data to the AQS, as detailed in Section 18.7 of their QAPP.

20.3 Data Validation

The following quality assurance and data validation processes will provide for data that meets the Program's quality assurance criteria.

Station Operator's will be responsible for the first phase of data validation. They will screen, organize, and process the data and associated quality control information.

The laboratory will perform a full data validation of the analytical data to determine the bias and usability of the reported values. Data validations will be performed in accordance with the QA/QC requirements outlined in the QA Project Plan for Air Toxics, the specific Compendium Methods used, the Standard Operating Procedures of the laboratory, the Measurement Guidelines and the Validation Guidelines established by OAQPS for this program.

Many of the processes ERG uses for verifying and validating the measurement phases of the data collection operation have been discussed in Section 15 of their QAPP. If these processes as written in the QAPP are followed, and the sites are representative of the boundary conditions for which they were selected, one would expect to achieve the DQOs. However, exceptional field events may occur, and field and laboratory activities may negatively affect the integrity of samples. In addition, it is expected that some of the QC checks will fail to meet the acceptance criteria. This section will outline how ERG will take the data to a higher level of quality analysis by performing software tests, plotting, and other methods of analysis.

20.3.1 Process for Validating and Verifying Data

Verification of Data

After a reporting batch is completed, a thorough review of the data will be conducted for completeness and manual and electronic data entry accuracy. For the chromatographic data, the entries are reviewed to reduce the possibility of entry and transcription errors. Once the data are transferred to the ERG LIMS database, the data will be reviewed for routine data outliers and data outside acceptance criteria. These data will be flagged appropriately. All flagged data will be verified to ensure that the values are entered correctly. Appropriate data qualifiers or flags can be found in the SOPs.

Validation

Records of all invalid samples will be retained on file for five years. Information will include a brief summary of why the sample was invalidated along with the associated flags. This record will be available on stored electronic media.

Validation of Measurement Values

Certain criteria based upon the laboratory analyst judgment have been developed that will be used to invalidate a sample or measurement (i.e., water in cartridges, vacuum on canister too low, etc.). In all cases the sample will be returned to the laboratory for further examination. When the laboratory analyst reviews the chain of custody forms they will look for possible problems. Filters that have flags related to obvious contamination, filter damage, or field accidents will be examined immediately. Upon concurrence of the associated laboratory analyst, the Analytical Coordinator, and the Field Task Leader, these samples will be invalidated.

Data Analysis

Data analysis refers to the process of interpreting the data that are collected. Although there are a large number of parameters to analyze, many of these parameters present similar characteristics, (i.e., VOC, SVOC, and particulate metals, grouped according to their physical and chemical properties). This section will describe how ERG will begin to analyze the data to ascertain what the data illustrate and how the data should be applied.

Analytical Tests

ERG will employ software programs, described below, to help analyze the data.

ERG will perform a rudimentary analysis on the data sets using Excel spreadsheets. Spreadsheets allow the user to input data and statistically analyze, plot and graph linear data. This type of analysis will allow the user to see if there are any variations in the data sets. In addition, various statistical tests such as tests for linearity, slope, intercept or correlation coefficient can be generated between two strings of data. Time series plots can help identify the following trends:

- Large jumps or dips in concentrations;
- Periodicity of peaks within a month or quarter; and
- Expected or unexpected relationships among species.

Recently, the EPA has made software available that can analyze data. One such program is VOCDat, developed by Sonoma Technology, Inc., under contract to EPA. ERG has a subcontract with Sonoma Technology, Inc., who provides VOCDat to State/local/tribal agencies. This software program was originally written for input of PAMS data. VOCDat is a Windows based program that provides a graphical platform from which to display collected VOC data; to evaluate data according to specified quality control procedures; and for exploratory data analysis. This program will enable the States to rapidly validate and release their air toxics VOC data to AQS. VOCDat displays the observed VOC concentrations using scatter, fingerprint, and time series plots. Customizable screening criteria may be applied to the data and the quality control codes may be changed for individual data points as well as for the entire sample on all plots. VOCDat allows a user to find out the percentage a particular compound is of the total. This test allows the user the ability to see if the data exceed the 3 sigma rule for outliers.

21 Reconciliation with Data Quality Objectives

21.1 Reconciling Results with DQOs

The DQOs for the air toxics monitoring network were developed in Section 6 and are stated below:

For the NATTS site, detect a percent difference change between successive three-year average concentration levels that are greater than or equal to 15 percent.

In addition, for the rest of the air toxics systems in the network:

Determine the highest concentrations expected to occur in the area covered by the network, i.e., to verify the spatial and temporal characteristics of HAPs.

The assessment procedure is used to determine whether the monitors and laboratory analyses are producing data that comply with the stated goals. Such an assessment is termed a Data Quality Assessment (DQA) and is thoroughly described in *EPA QA/G-9: Guidance for Data Quality Assessment*¹.

For the stated DQO, the assessment process will follow statistical routines. The following five steps identify how this will be achieved. Note that OAQPS will perform DQAs of the data from a national perspective. Therefore, Ecology will allow OAQPS to perform these assessments on their behalf. The DQAs that will be performed by the Ecology will pertain to the data collected at any other sites and the DQAs will pertain to answering the second statement.

21.2 Five Steps of DQA Process

The following will be performed as part of the DQA process:

- A review of the DQOs and sampling design;
- A preliminary data review;
- Summary statistics performed;
- Conclusions drawn from the data;
- An action plan based on conclusions from the DQA.