pscleanair.org
Puget Sound Clean Air Agency

The Kent, Seattle, and Tacoma, WA

Second 10-year Limited Maintenance Plan for PM_{10}

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In conjunction with
Washington State Department of Ecology

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Acronyms and Abbreviations

ADVMT ..... Average Daily Vehicle Miles Traveled
AERR ..... Air Emissions Reporting Rule
AP42 ..... EPA's Compilation of Air Pollutant Emission Factors
AQI ..... Air Quality Index
AQS ..... Air Quality System
BNSF ..... Burlington Northern Santa Fe Railway
b_{scat} ..... A measure of light scatter, scattering coefficient
CAA ..... Clean Air Act
CAAA ..... Clean Air Act Amendments
CARB ..... California Air Resources Board
CNG ..... Compressed Natural Gas
CRAB ..... County Road Administration Board
DOL ..... Department of Licensing
DQO ..... Data Quality Objectives
DV ..... Design Value
ECA ..... Emission Control Area
Ecology ..... Washington State Department of Ecology
EPA ..... U.S. Environmental Protection Agency
FEM ..... Federal Equivalent Method
FR ..... Federal Register
FRM ..... Federal Reference Method
FTA ..... Federal Transit Administration
GIS ..... Geographic Information Systems
g/hr ..... grams per hour
HPMS ..... U.S. DOT Highway Performance Monitoring System
IPP/QAP ..... Inventory Preparation Plan and Quality Assurance Plan
LMP ..... Limited Maintenance Plan
MA ..... Maintenance Area
MOS ..... Margin of Safety
MOVES ..... Motor Vehicle Emission Simulator
NAA ..... Nonattainment area
NAAQS ..... National Ambient Air Quality Standards
NAMS ..... National Ambient Monitoring Sites

NEI ..... EPA's National Emission Inventory

NESHAP ..... National Emission Standards for Hazardous Air Pollutants

NRLM..... Non-Road, Locomotive, and Marine

NSPS ..... New Source Performance Standards

OLS ..... Ordinary Least Squares

ODEQ..... Oregon Department of Environmental Quality

OSPI ..... Office of the Superintendent of Public Instruction

PSCAA..... Puget Sound Clean Air Agency

PM_{10} ..... Particulate Matter, ten microns or less

$PM_{2.5}$..... Particulate Matter, 2.5 microns or less

RACM ..... Reasonably Available Control Technologies

RWC ..... Residential Wood Combustion

SIP ..... State Implementation Plan

SLAMS ..... State and Local Ambient Monitoring Sites

TCMA..... Thurston County Maintenance Area

TRPC ..... Thurston Regional Planning Council

TEOM ..... Tapered Element Oscillating Microbalance

TSP..... Total Suspended Particulate

ULSD ..... Ultra Low Sulfur Diesel

UP ..... Union Pacific Railroad

$\mu g/m^3$ ..... micrograms per cubic meter

VMT..... Vehicle Miles Traveled

WRAP ..... Western Regional Air Partnership

WSDOT ..... Washington State Department of Transportation

Executive Summary

Portions of Kent and the industrial areas of the Duwamish Valley in Seattle and the Tideflats of Tacoma meet the federal 24-hour standard for particulate matter 10 micrometers and smaller (PM10). This State Implementation Plan (SIP) revision explains how these areas will continue to meet the standard through 2020.

The Environmental Protection Agency (EPA) sets air quality standards for particulate matter to protect public health. Particulate pollution is classified by its size, PM10 is considered coarse particulate matter and PM2.5 is considered fine particulate matter. Particles less than 10 micrometers can penetrate into the lungs and cause short and long-term health problems. There are separate 24-hour standards for PM10 (150 µg/m3) and PM2.5 (35 µg/m3) because particle size is directly linked to their potential for causing health problems.

These three areas were classified as nonattainment areas in 1990 by the Environmental Protection Agency (EPA) for the 24-hour PM10 National Ambient Air Quality Standard (NAAQS). The Kent, Seattle, and Tacoma PM10 nonattainment areas were reclassified to maintenance areas in 1993, 1995, and 1995, respectively. The Clean Air Act (CAA) requires a two 10-year maintenance plans for the three areas, the first 10-year maintenance plan was submitted to the EPA in 1997. This plan is the second and final 10-year maintenance plan and fulfills the CAA requirement.

The Kent, Seattle, and Tacoma PM10 maintenance areas are currently well below the 24-hour NAAQS for PM10. Compliance with this standard is maintained if PM10 values do not exceed 150 µg/m3 more than once a year, on average, over three years.

The areas qualify to submit a streamlined Limited Maintenance Plan (LMP) because the 5-year Design Values for these areas do not exceeded 98 µg/m3 —a screening threshold— and meet other criteria. LMPs are for areas that show little risk of re-violating the PM10 NAAQS.

PM10 concentrations are estimated using the historic relationship between PM10 and PM2.5 described in Section 4. PSCAA will continue to operate ambient PM2.5 monitors in all three maintenance areas. Three-year design values from PM10 concentrations for the three maintenance areas will be estimated annually to verify continued attainment of the NAAQS. Five year design values will be calculated to verify continuing qualification for the LMP option. Direct PM10 monitoring will be reestablished if calculated PM10 design values reach 98 µg/m3, the LMP option screening threshold.

The control and contingency measures from the attainment and maintenance plans are still in place. All existing PM10 control measures will continue in the region and are described in Section 6. Primary control strategies include a residential wood smoke control program, fugitive dust program, and a prohibition on outdoor burning. PSCAA's Regulation I – Article 13.07 (b) provides for prohibition of the use of uncertified woodstoves for the sole purpose of meeting CAA requirements for contingency measures. The contingency measure will be triggered if the estimated PM10 concentrations violate the PM10 NAAQS at the maintenance area monitors.

1. Introduction

This State Implementation Plan (SIP) revision explains how the PM_{10} maintenance areas of Kent, Seattle, and Tacoma currently meet and will continue to meet the 1987 National Ambient Air Quality Standard (NAAQS) for particulate matter ten microns or smaller (PM_{10}) through 2020. Puget Sound Clean Air Agency (PSCAA) prepared this plan with the Washington State Department of Ecology (Ecology). PSCAA is the local clean air agency with jurisdiction over the Kent and Seattle maintenance areas in King County and the Tacoma maintenance area in Pierce County.

Particulate Matter Standards

The Environmental Protection Agency (EPA) sets air quality standards for particulate matter to protect public health. Particulate matter pollution is a public health issue because smaller particles can penetrate deep into the lungs and cause health problems. Particulate matter comes from soot, dust, unburned fuel suspended in the air, and can also be formed in the air from chemical reactions involving gaseous precursors. EPA revised the particulate matter NAAQS from total suspended particulate (TSP) to PM_{10} on July 1, 1987, since smaller particles were determined to be more harmful. The primary health-based 24-hour standard for PM_{10} is 150 $\mu g/m^3$, and cannot be exceeded more than once a year on average over three years. A 24-hour standard for fine particulate matter 2.5 microns or smaller ($PM_{2.5}$) was set to 65 $\mu g/m^3$ on July 18, 1997, and was revised to 35 $\mu g/m^3$ in 2006.

Maintenance Area Compliance History

The Kent, Seattle, and Tacoma PM_{10} maintenance areas were designated Group 1 PM_{10} areas in 1987 by the Environmental Protection Agency (EPA) for having a greater than 95% probability of violating the 24-hour PM_{10} standard. These areas were then classified as nonattainment areas in 1990 as required for Group I areas by the 1990 Amendments to the Clean Air Act (CAA). The PM_{10} attainment plan for Kent was fully approved by EPA on July 27, 1993 (58 FR 40059) and the plans for Tacoma and Seattle were fully approved by EPA on October 25, 1995 and October 26, 1995, respectively (60 FR 54599 and 60 FR 54812). EPA approved the first 10-year maintenance plan on March 13, 2001 (66 FR 14492).

This second 10-year maintenance plan is a Limited Maintenance Plan (LMP) and demonstrates continued attainment of the NAAQS through 2020 at existing $PM_{2.5}$ monitors in the Puget Sound region. PM_{10} concentrations will be estimated using the relationship between PM_{10} and $PM_{2.5}$ described in Section 4. All existing PM_{10} control measures will be continued in the region and are described in Section 6.

Primary control strategies included in the PM_{10} attainment and maintenance plans for the three areas included a residential wood smoke control program, a fugitive dust program, and a prohibition on opening burning, and industrial emission controls. The control and contingency measures from the attainment and maintenance plans are still in place. PSCAA's Regulation I – Article 13.07 (b) provides for prohibition of the use of uncertified woodstoves for the sole purpose of meeting CAA requirements for contingency measures. The contingency measure will be triggered if the estimated PM_{10} concentrations violate the PM_{10} NAAQS at the maintenance area monitor based on nephelometer and/or FEM monitoring of $PM_{2.5}$.

PSCAA will continue to operate ambient $PM_{2.5}$ monitors in all three maintenance areas. PM_{10} concentrations will be estimated based on these measurements and the values will be evaluated annually to verify continued attainment of the NAAQS. PM_{10} monitoring will be reinstituted if calculated design values reach 98 $\mu g/m^3$. If air quality degrades significantly or if there are significant changes in any of the assumptions of this LMP, PSCAA will re-evaluate the plan.

Plan Structure

This SIP revision includes the compliance history for Kent, Seattle, and Tacoma and describes how the areas met and will continue to meet the standard, as well as what will be done if an area violates the NAAQS. This plan also includes other EPA-required elements, such as an emissions and monitoring review and public process requirements.

This document is organized as follows:

Section 2 –Background - describes the area's compliance history and contains background information on the PM_{10} standard

Section 3 – Limited Maintenance Plan (LMP) Option - describes the criteria an area must meet to qualify for this option and how the three maintenance areas meet these criteria

Section 4 – PM_{10} Monitoring History - provides a brief history of monitoring in the three maintenance areas, an evaluation of the relationship of PM_{10} to $PM_{2.5}$ and justification for using an alternative monitoring method

Section 5 – Emission Inventory - includes historical information on the most significant PM_{10} emission categories from the original maintenance plan and an updated inventory on these categories

Section 6 – Control Measures - lists the measures and rules that were in place in the original maintenance plan and the current rules that maintain and enforce these measures

Section 7 – Contingency Measures - describes the provisions that are in place in rules and will be taken, if the PM_{10} standard is violated

Section 8 – Commitment to Continued Monitoring and Verification of Continued Attainment– describes how monitoring will be continued and how compliance will be confirmed

Section 9 – Summary of Maintenance Plan Commitments – outlines commitments of this plan

Section 10 – Completion of Required Plans – states that this document fulfills federal planning requirements

2. Background

Geographic Area

The Kent PM_{10} maintenance area is located on the eastern side of the Green River Valley between the Cities of Tukwila and Auburn. The PM_{10} sources in this region come from residential wood burning, light industry, and mobile sources. The valley floor is roughly two to three miles in width and is bound by hills which rise 300-400 ft. in elevation. These hills act to trap pollutants under stable meteorological conditions (inversions). These conditions exist most frequently during the late fall and winter and are associated with the majority of particulate matter violations. Figure 2.1, below, shows the Kent PM_{10} maintenance area boundary and the location of the monitoring site.

The Seattle PM_{10} maintenance area is comprised of the Duwamish industrial and commercial area immediately south of the downtown district and includes the Port of Seattle. The monitoring site has been in place since 1971 and is located in the center of the Duwamish industrial valley near the Port of Seattle. The site is a neighborhood scale site that is representative of South Seattle neighborhoods and ambient exposure in the industrial valley. The site is influenced by a very complex mixture of mobile sources, port and marine sources, industrial sources, winter home heating wood smoke, and other pollution sources. The site is 80 meters west of E. Marginal Way, which is a main arterial for many large haul trucks, as well as service vehicles and personal automobiles. Figure 2.2 shows the Seattle maintenance area boundary, the areas of the Port of Seattle that lie within the maintenance area, and the air monitoring station.

The Tacoma PM_{10} maintenance area is comprised of the industrial area of Tacoma, including the Port of Tacoma, a Kraft pulp mill and other industrial operations. The monitoring site has been in place since 1987 in the industrial area near the Port of Tacoma. The site is neighborhood scale located near several industrial air pollution sources. The sources that impact the area are a mixture of mobile sources, port and marine sources, industrial sources, and winter home heating from wood burning. The site is also within the Puyallup Indian Reservation, as well as the 2006 $PM_{2.5}$ Tacoma-Pierce County nonattainment area. Figure 2.3 shows the Tacoma maintenance area boundary, the Port of Tacoma, and the location of the monitoring site.

Figure 2.1: The Kent, WA PM_{10} Maintenance Area

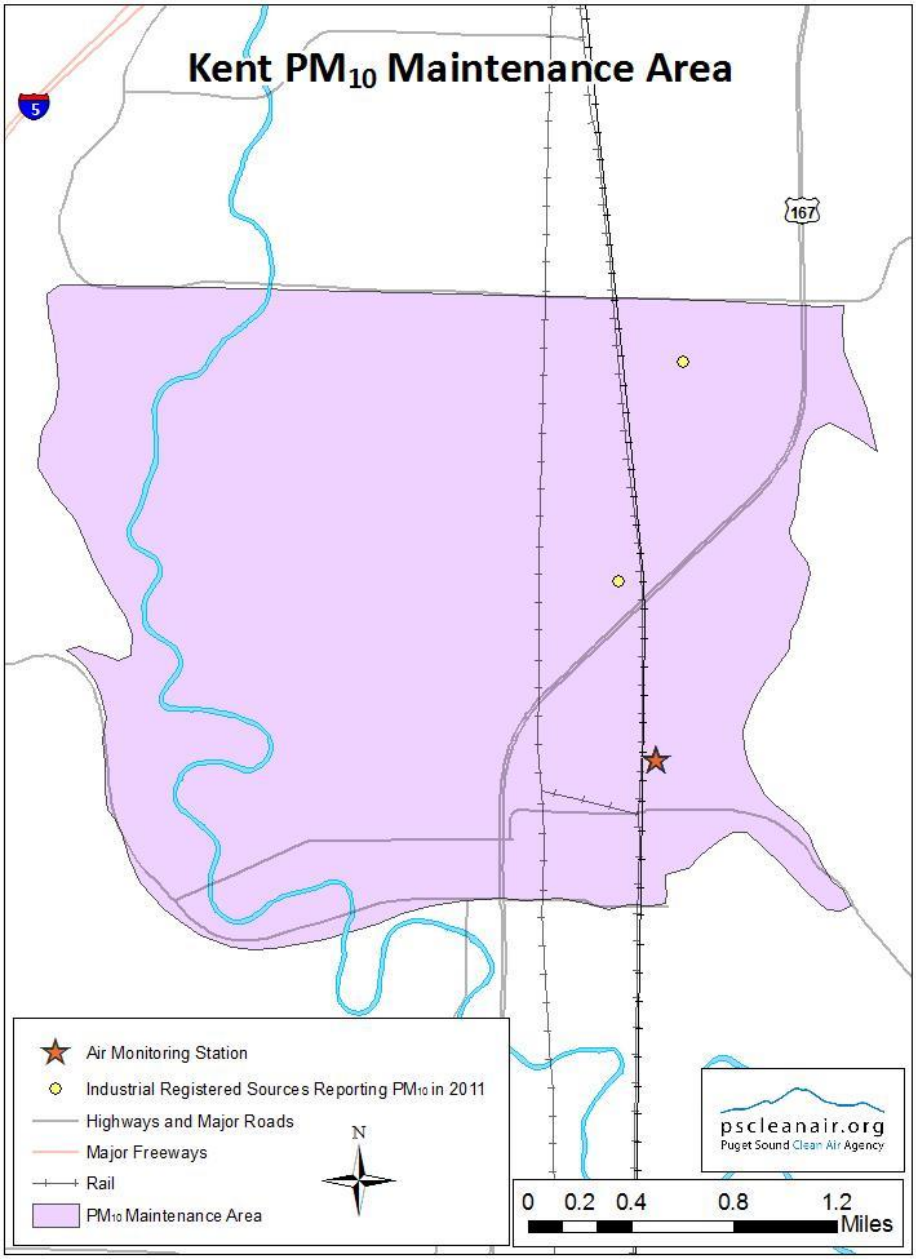


Figure 2.2: The Seattle, WA PM_{10} Maintenance area

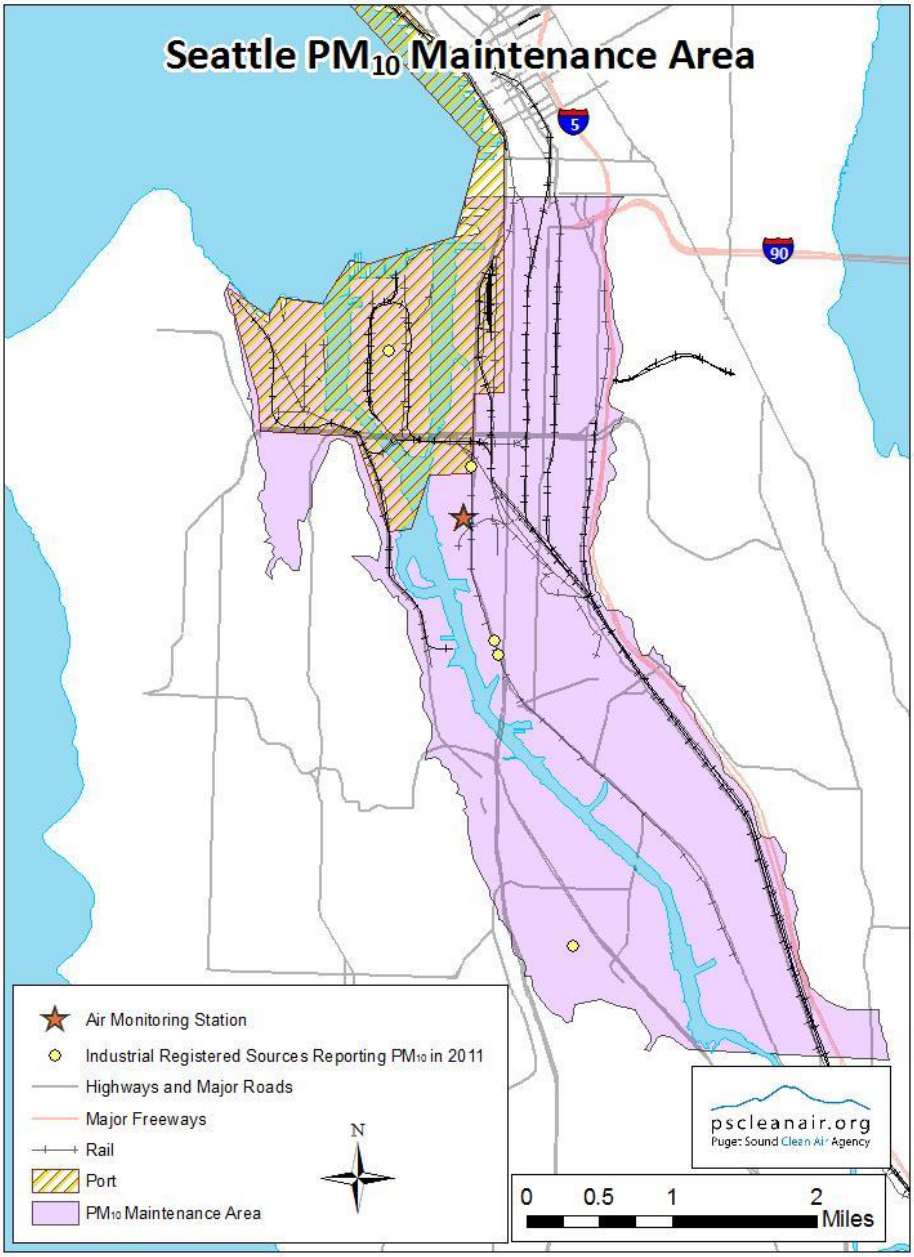
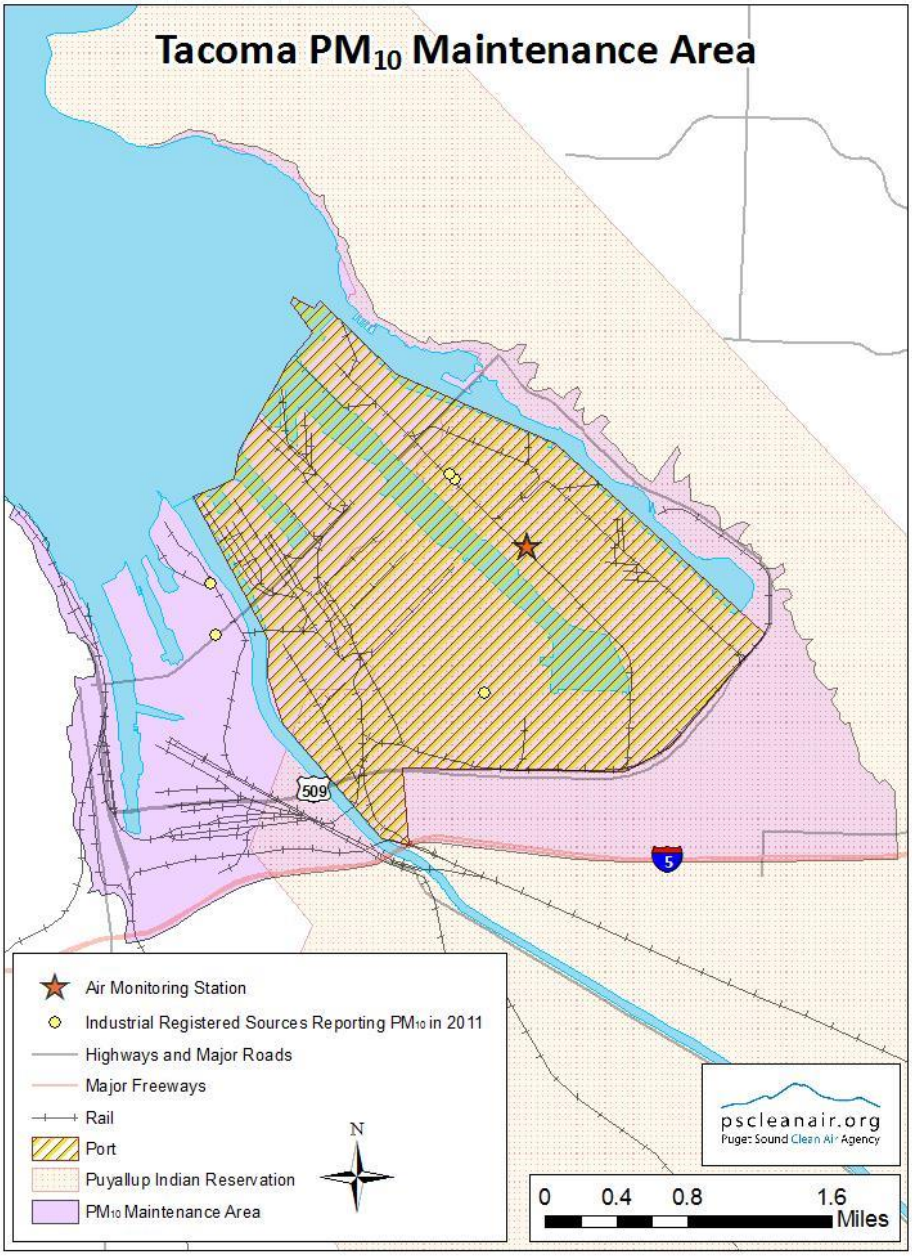


Figure 2.3: The Tacoma, WA PM_{10} maintenance area



Compliance History

On August 7, 1987, EPA identified Kent and the industrial areas of Seattle and Tacoma as having greater than 95% probability of violating the 24-hour PM_{10} average standard. By operation of law, all three areas were designated moderate PM_{10} nonattainment areas upon enactment of the CAA on November 15, 1990.

State Implementation Plan (SIP) submittals addressing PM_{10} nonattainment in Kent and Seattle were submitted by Ecology to EPA in November 1990, followed by the submittal for Tacoma one year later. The principal control strategies included in the PM_{10} attainment plans for the three areas included a residential wood smoke control program, a fugitive dust control program, and a prohibition on outdoor burning.

The PM_{10} attainment plan for Kent was fully approved by EPA on July 27, 1993 (58 FR 40059) and the plans for Tacoma and Seattle were fully approved by EPA on October 25, 1995 and October 26, 1995, respectively (60 FR 54599 and 60 FR 54812). The maintenance plan and request for redesignation from nonattainment to maintenance for Kent, Seattle, and Tacoma were approved on March 13, 2001 (66 FR 14492).

This plan is the Second 10-Year Limited Maintenance Plan for PM_{10} in Kent, Seattle, and Tacoma and is the last maintenance plan for these areas. This maintenance plan revision ensures compliance through 2020 and fulfills the second 10-year planning requirement of CAA Section 175A (b).

3. Limited Maintenance Plan Option

In consultation with Ecology and EPA, PSCAA chose to follow the EPA's Limited Maintenance Plan (LMP) option for the second PM_{10} maintenance plan for the Kent, Seattle, and Tacoma maintenance areas. The EPA developed the Limited Maintenance Plan (LMP) option for areas with little risk of re-violating the PM_{10} standard. EPA allows states to use this policy to prepare the required second 10-year maintenance plans, if the area meets the qualification criteria in the EPA LMP Option Guidance (LMP Guidance)[1]. The LMP option for moderate PM_{10} nonattainment areas requires an area to meet certain applicability criteria in order to qualify for the LPM option. The first criterion is that an area should be attaining the National Ambient Air Quality Standard (NAAQS), the second that the average PM_{10} design value based on the most recent 5 years of air quality data should be at or below 98µg/m^3 for the 24-hour PM_{10} NAAQS[2]. The third criterion is that the area should expect only limited growth in on-road motor vehicle emissions and pass a motor vehicle regional emissions analysis test. The Kent, Seattle, and Tacoma maintenance areas meet these criteria as described below; supporting information can be found in Appendix A.

NAAQS Qualification Criterion

To qualify for the LMP option, the area must be attaining the 24-hour NAAQS, 150 µg/m^3. Monitoring data shows that Kent, Seattle, and Tacoma have been in attainment of the standard since 1987, 1990, and 1989 respectively. The areas were reclassified to attainment for the 24-hour PM_{10} standard in March 2001 when EPA approved the first 10-year maintenance plan for Kent, Seattle, and Tacoma. Table 3.1 below shows the 3-year design values are well below the 24-hour NAAQS of 150 µg/m^3 for all three PM_{10} maintenance areas.

Table 3.1: Three-year design values calculated using the most recent three years of estimated PM_{10} concentrations

Site	YEARS	NO. DATA POINTS	TABLE LOOK-UP, µg/m^3	STATISTICAL FIT, µg/m^3
Kent	2010 - 2012	1017	44	44±3
Seattle	2010 - 2012	1068	48	49±4
Tacoma	2010 - 2012	1030	59	55±5

[1] Limited Maintenance Plan Option for Moderate PM10 Nonattainment Areas
[2] Limited Maintenance Plan Option for Moderate PM10 Nonattainment Areas, pp 3

Design Value Criterion

To qualify for the LMP option, the average 24-hour PM_{10} design value for the area based upon the most recent five years of data should not exceed 98 µg/m^3. A design value is the statistic based on monitoring data that determines an area's compliance status. The LMP Guidance directs the design value be based on the most recent five years of data. The design values for Kent, Seattle, and Tacoma based on Federal Equivalence Method (FEM) 24-hour PM_{10} monitoring data from 2003 through 2007 are 57±3 µg/m^3, 68±4 µg/m^3, and 72±9 µg/m^3. The most recent design values estimated based on an alternative method, using 2008 to 2012 values, are 46±3 µg/m^3, 48±5 µg/m^3, and 58±8 µg/m^3 respectively. All of these values are below the 98 µg/m^3 value stipulated in the LMP Guidance.

The PM_{10} SIP Development Guideline[3] (SIP Guideline) outlines the following four approaches to determine the PM_{10} design value: a table look-up procedure; fitting a statistical distribution to several years of data; a graphical estimation technique; and the use of a conditional probability approach. This analysis uses both the table look-up method and a statistical fit to calculate the PM_{10} design values. The graphical estimation and the conditional analysis were considered for this analysis however the table look-up method and the statistical fit were the most appropriate for the Kent, Seattle, and Tacoma monitoring datasets. The graphical estimation technique was not used in this analysis due to insufficient data in some cases. Where there was insufficient data the concentration that corresponds to a frequency of 1/365 could not be read directly off a graph of the distribution at each of the sites for all of the 5-year time periods. The conditional probability approach is used in cases where individual years of data should be treated separately. Preliminary analysis of the conditional probability approach showed that values for individual years did not vary significantly from year to year. Calculating the design value using the table look-up method and the statistical fit method allows for the most conservative design value to be selected.

The table look-up procedure is outlined in the PM_{10} SIP development guide[4]. The PM_{10} SIP development guide states that the design concentration for PM_{10} is the concentration that corresponds to a frequency of 1/365 on an empirical frequency distribution.[4] Table 3.2 below is used to estimate which point on the empirical frequency distribution corresponds to a frequency of 1/365.

Table 3.2: Tabular Estimation of PM10 Design Values[4]

Number of Values	Data Point to be Used
1 - 347	Highest Value
348 - 695	Second Highest Value
696 - 1042	Third Highest Value
1043 - 1390	Fourth Highest Value

[3] PM-10 SIP Development Guideline, publication EPA 450/2 86-001
[4] PM-10 SIP Development Guideline, publication EPA 450/2 86-001, Table 6-1, pp.6-5

The statistical fit is calculated according to the approach is outlined on pages 18-20 of the Ozone guideline[5]. The design value is calculated by solving for the concentration of PM_{10} that is equal to a probability of 1/365[4]. The 95% confidence interval is reported with the statistical fit design value. The design values calculated using with the table look-up method all fall within the range of the 95% confidence interval of the statistical fit design values.

Design values for the most recent 5 years of monitoring data are shown in bold in Table 3.3 alongside design values calculated using estimated PM_{10} concentrations. Monitoring data is discussed in Section 4.1 and PM_{10} estimates are discussed in Section 4.2.

Table 3.3: Five-Year Design Values for Kent, Seattle, and Tacoma

	5-YEAR PERIOD	**5-YEAR**	**5-YEAR DESIGN VALUE**	**5-YEAR DESIGN VALUE**
Site	**YEARS**	NO. DATA POINTS	TABLE LOOK-UP, µg/m^3	STATISTICAL FIT, µg/m^3
Kent	**2003-2007**	**1149**	**58**	**57±3**
Kent	2008 - 2012	1762	43	46±3
Seattle	**2003-2007**	**1318**	**69**	**68±4**
Seattle	2008 - 2012	1311	50	50±5
Tacoma	**2001-2007***	**900**	***68***	***72*±9**
Tacoma	2008 - 2012	1725	54	58±8

*2004 was excluded because more than 75% of the data was missing

[5] Guideline for the Interpretation of Ozone Air Quality Standards, EPA-450/4-79-003

Motor Vehicle Regional Analysis Criterion

To qualify for the PM_{10} LMP option, an area should expect only limited growth in on-road motor vehicle PM_{10} emissions (including fugitive dust) and pass a motor vehicle regional emissions analysis test, found in Appendix B of the LMP Guidance. The results of the analysis must be less than 98 µg/m³, the Margin of Safety (MOS) value for the 24-hour PM_{10} standard. The Kent, Seattle, and Tacoma maintenance areas meet both these criteria, as described below and in Appendix A.

The following methodology was used to determine whether increased emissions from on-road mobile sources could, in the next 10 years, increase concentrations in the maintenance areas and threaten the assumption of maintenance that underlies the LMP Guidance.

$$DV + (VMT_{pi} \times DV_{mv}) < MOS$$

Where:

DV = the area's design value based on the most recent 5 years of data in µg/m³

VMT_{pi} = the projected percent increase in vehicle miles traveled (VMT) over the next 10 years

DV_{mv} = motor vehicle design value based on on-road mobile portion of the attainment year inventory in µg/m³

MOS = margin of safety for the relevant PM_{10} standard for a given area: 40 µg/m³ for the annual standard or 98 µg/m³ for the 24-hour standard

Qualification for the LMP approach is demonstrated when the motor vehicle regional analysis results in a value less than the MOS of 98 µg/m³ for the 24-hour PM_{10} standard. The variables and results for the equation for each of the three maintenance areas are shown in Table 3.4. The results of the calculation is less than the MOS of 98 µg/m³ and therefore demonstrates that the Kent, Seattle, and Tacoma PM_{10} maintenance areas pass the motor vehicle regional analysis and qualify for the LMP approach.

Table 3.4: Margin of Safety Comparison

	Kent	Seattle	Tacoma
DV (µg/m³)	60	72	81
VMT_{pi}	9%	11%	12%
DV_{mv} (µg/m³)	16.8	24.5	24.3
DV + (VMT_{pi} x DV_{mv})	61.5	74.7	83.9
MOS (µg/m³)	98	98	98

LMP Qualification

The Kent, Seattle, and Tacoma PM_{10} maintenance areas meet the LMP qualification criteria and qualify for the LMP option. As described above and in Appendix A, these areas are in compliance with the 24-hour NAAQS for PM_{10}, the five year design values are well below 98µg/m^3 and the growth in PM_{10} emissions from motor vehicles will not threaten compliance with the standard.

PSCAA provided its analysis to Ecology and EPA Region 10 office. EPA Region 10 and Ecology mutually agreed to the LMP approach. We have discussed the alternative approach for PM_{10} estimation, outlined in Section 4.2, with Ecology and EPA. With this submittal, we request approval for the alternative approach for PM_{10} estimation. PSCAA will calculate the 3-year and 5-year PM_{10} design value estimates and provide them to Ecology annually. Ecology will include a statement that the area continues to qualify for the LMP option in the annual monitoring network report. The report can be found at https://fortress.wa.gov/ecy/publications/UIPages/Home.aspx

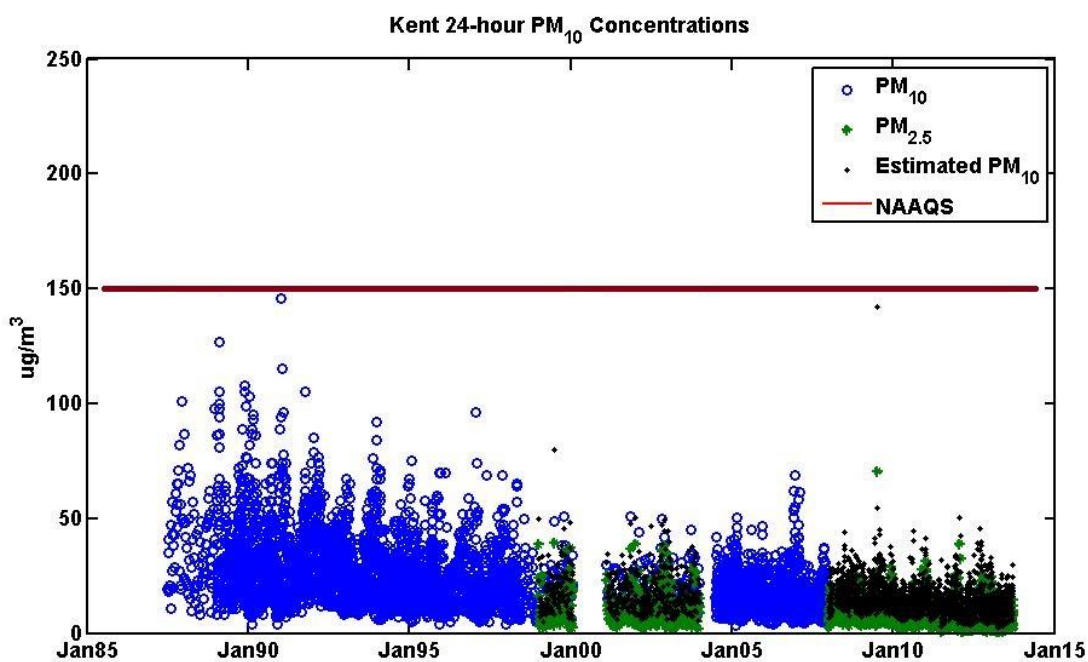
4. Particulate Matter Monitoring

4.1. PM_{10} Concentrations

Kent Maintenance Area

The daily (midnight to midnight) concentrations of PM_{10} and $PM_{2.5}$ are shown in Figure 4.1.1. PM_{10} monitored values are shown from 1987 through 2007 (blue circles), $PM_{2.5}$ monitored values are shown from 1999 through 2012 (green plus), and estimated PM_{10} values based on $PM_{2.5}$ monitored values are shown from 1999 through 2012 (black dots). Monitored concentrations have never exceeded the NAAQS since monitoring began in 1987. The maximum 24-hour concentration recorded during the last five years of PM_{10} FEM monitoring was 69 µg/m^3 in 2006. Estimated PM_{10} concentrations are shown in black, the highest estimated PM_{10} concentration is 144 µg/m^3, this value occurred on July 4, 2009. Estimated concentrations of PM_{10} are shown in the figure below (black dots). Model development is described in Section 4.3.

Figure 4.1.1: Kent Historical PM_{10} Concentrations



Kent Monitoring

The Kent PM_{10} maintenance area is shown in Figure 4.1.1. PSCAA monitored PM_{10} at James Street and Central Avenue using a Federal Reference Method (FRM) between 1988 and 2003 and a Federal Equivalent Method (FEM) from July 2004 through December 2007. The area has been in compliance with the standard since 1987. Federal Equivalent Method (FEM) PM_{10} values were low enough that the FEM monitor was removed with EPA approval at the end of 2007. Excerpts from this report are included as Appendix B. Since then, continuous monitoring of $PM_{2.5}$ has been conducted in Kent with a TEOM, which has been correlated with a co-located PM_{10} monitor to provide estimated PM_{10} values.

Figure 4.1.2 shows the dates and monitors located at the Central and James Street monitoring site from 1988 – 2007. All of the data used to develop the relationship between PM_{10} and $PM_{2.5}$ relied exclusively on data downloaded from EPA's Air Quality System (AQS). The data downloaded from AQS was collected using the monitors show in Figure SS. The model described in section 4.2 was developed using data from the time period where PM_{10} and $PM_{2.5}$ measurements are co-located (1999-2003). For the period 2008 – present the PM_{10} concentrations are estimated using $PM_{2.5}$ concentrations measured with the instruments in Figure 4.1.3. Details on the PM_{10} and $PM_{2.5}$ relationship are described in section 4.2.

Figure 4.1.2: PM10 and $PM_{2.5}$ data used to develop the PM_{10} to $PM_{2.5}$ relationship

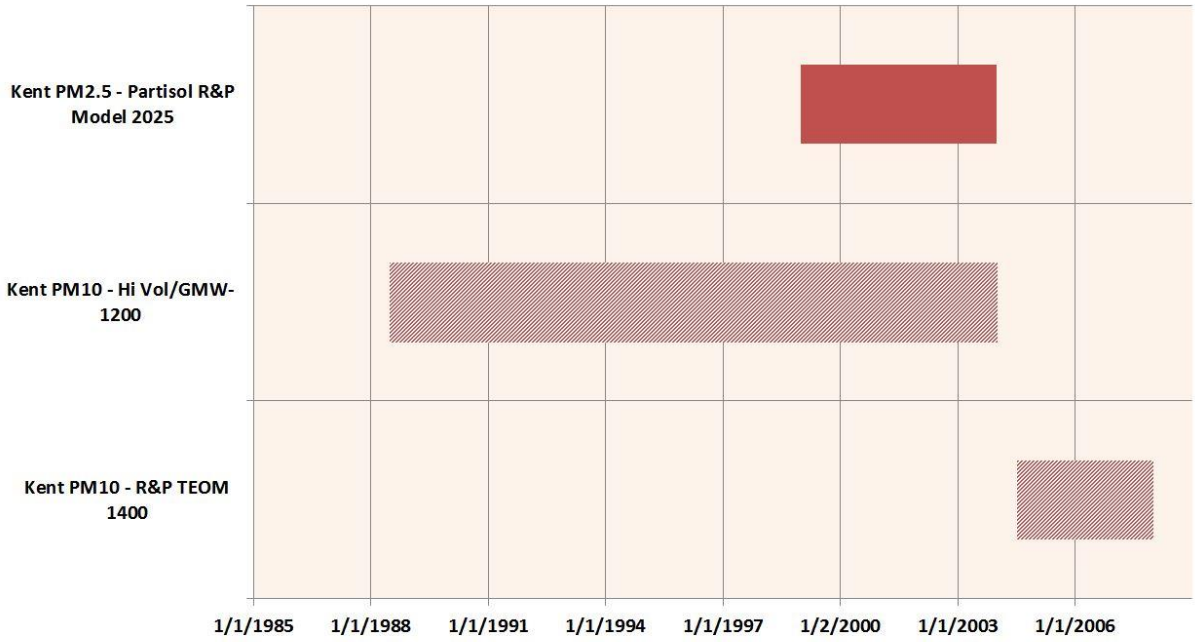
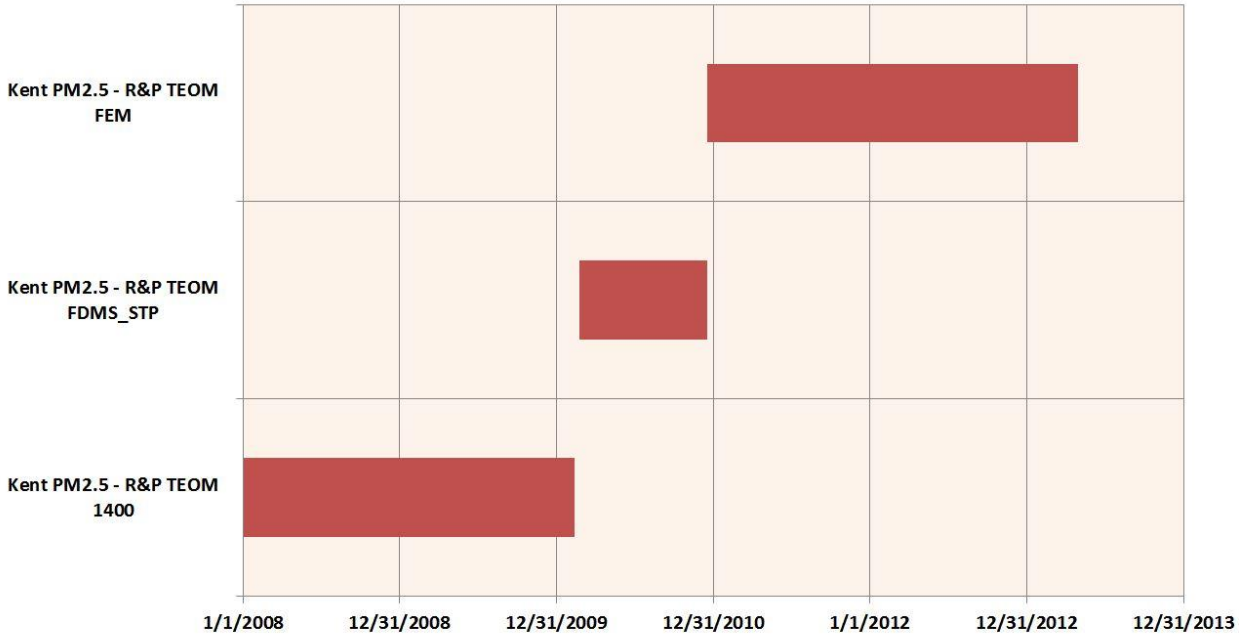


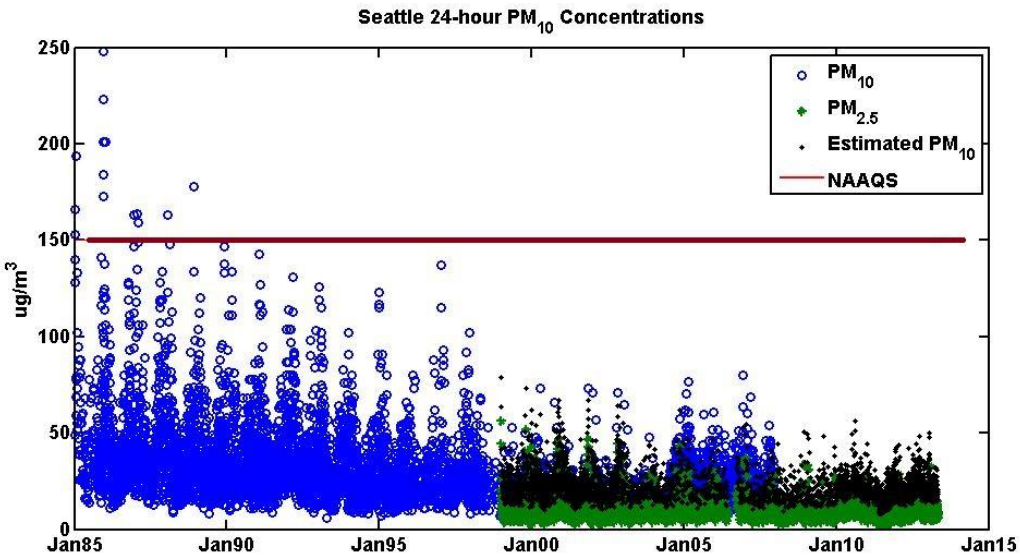
Figure 4.1.3: $PM_{2.5}$ monitoring data used to estimate PM_{10} concentrations from 2008-present



Seattle Maintenance Area

The 24-hour concentrations of PM_{10} and $PM_{2.5}$ are shown in Figure 4.1.4 below. PM_{10} monitored values are shown from 1985 through 2007 (blue circles), $PM_{2.5}$ monitored values are shown from 1999 through 2012 (green plus), and estimated PM_{10} values based on $PM_{2.5}$ monitored values are shown from 1999 through 2012 (black dots). Monitored concentrations have not exceeded the NAAQS since 1990. The maximum 24-hour concentration recorded during the last five years of FEM monitoring was 80 µg/m^3 in 2006.

Figure 4.1.4: Seattle Historical PM_{10} Concentrations



Seattle Monitoring

The Seattle PM_{10} maintenance area is shown in Figure 2.2. PSCAA monitored PM_{10} at both 4401 and 4752 East Marginal Way South using an FRM between June 1988 and December 2003 and an FEM from October 2004 through 2007. The area has been in compliance with the standard since 1990. Federal Equivalent Method (FEM) PM_{10} values were low enough that the monitor was removed with EPA approval at the end of 2007. Excerpts from this report are included as Appendix B. Since then, continuous, reference and non-reference method monitoring of $PM_{2.5}$ has been conducted at the Seattle monitoring site and correlated with a co-located PM_{10} monitor to provide estimated PM_{10} values. .

Figure 4.1.5 shows the dates and monitors located at the 4401 and 4752 East Marginal Way South monitoring site from 1985 – 2007. All of the data used to develop the relationship between PM_{10} and $PM_{2.5}$ relied exclusively on data downloaded from EPA's Air Quality System (AQS). The data downloaded from AQS was collected using the monitors show in Figure 4.1.5. The model described in section 4.2 was developed using data from the time period where PM_{10} and $PM_{2.5}$ measurements are co-located (1999-2007). For the period 2008 – present the PM_{10} concentrations are estimated using $PM_{2.5}$ concentrations measured with the instruments in Figure 4.1.6. Details on the PM_{10} and $PM_{2.5}$ relationship are described in section 4.2.

Figure 4.1.5: PM_{10} and $PM_{2.5}$ data used to develop the PM_{10} to $PM_{2.5}$ relationship

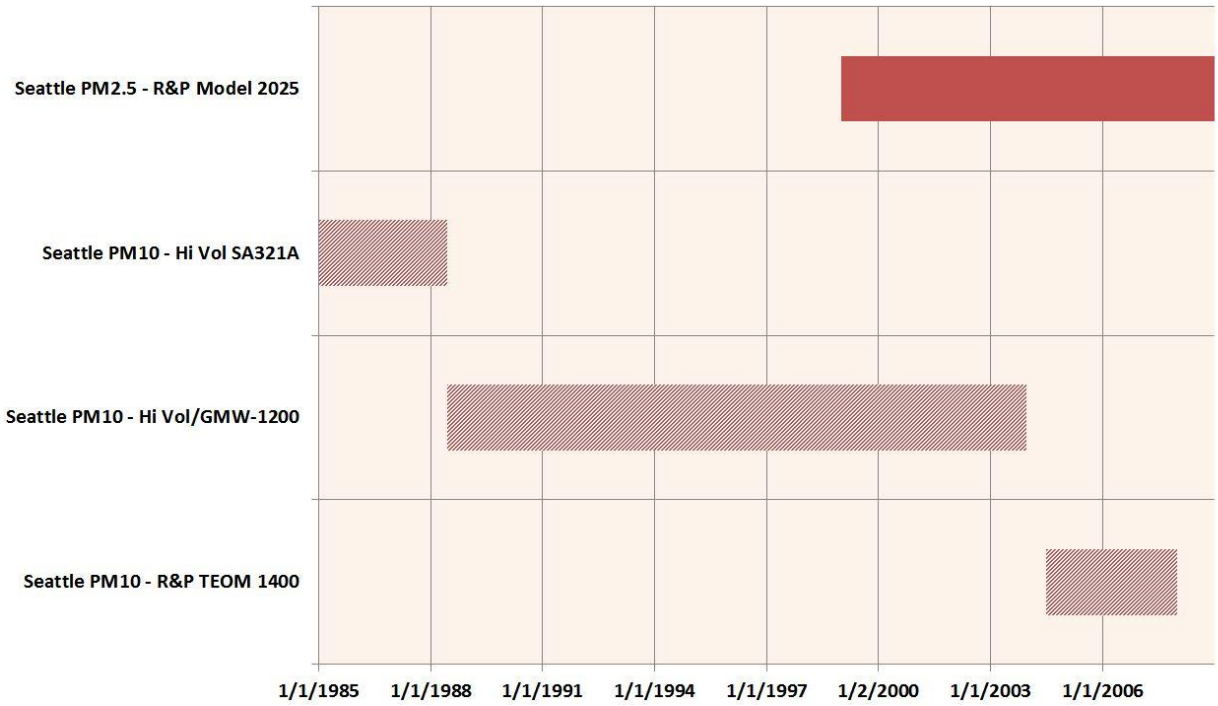
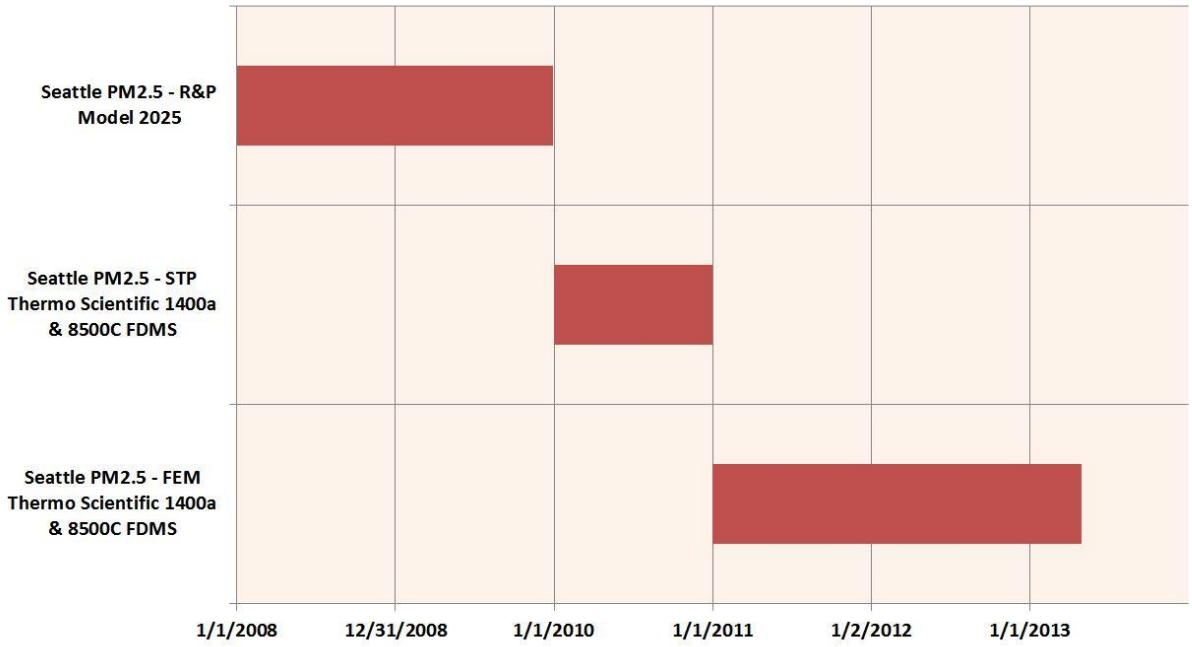


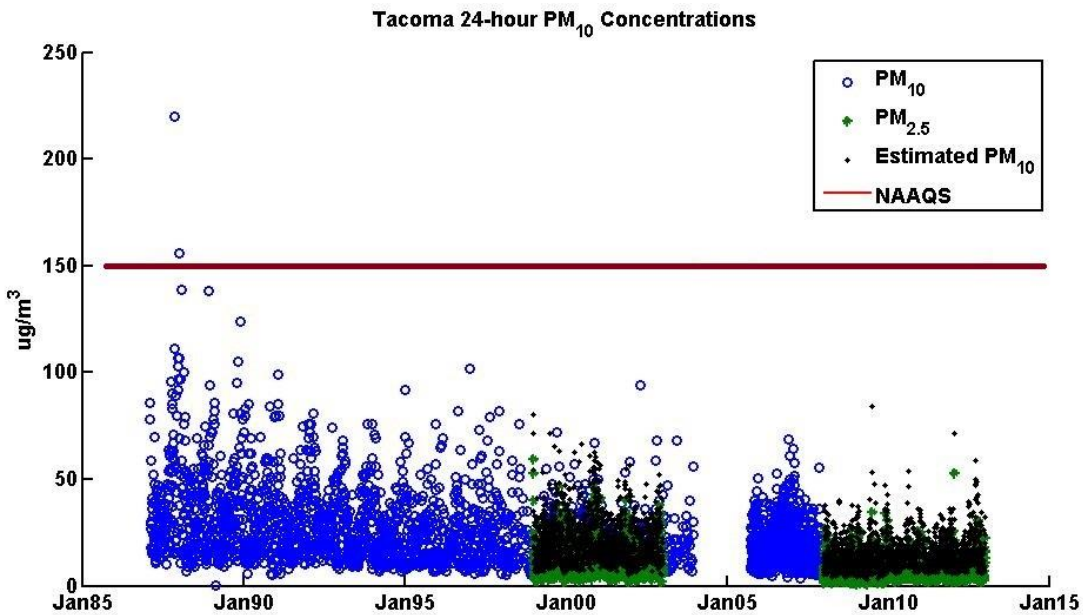
Figure 4.1.6: $PM_{2.5}$ monitoring data used to estimate PM_{10} concentrations from 2008-present



Tacoma Maintenance Area

The 24-hour concentrations of PM_{10} and $PM_{2.5}$ are shown in Figure 4.1.7 below. PM_{10} monitored values are shown from 1987 through 2007 (blue circles), $PM_{2.5}$ monitored values are shown from 1999 through 2012 (green plus), and estimated PM_{10} values based on $PM_{2.5}$ monitored values are shown from 1999 through 2012 (black dots). Monitored concentrations have not exceeded the NAAQS since 1988. The maximum 24-hour concentration recorded during the last five years of FEM monitoring was 69 µg/m^3 in 2006.

Figure 4.1.7: Tacoma Historical PM_{10} Concentrations



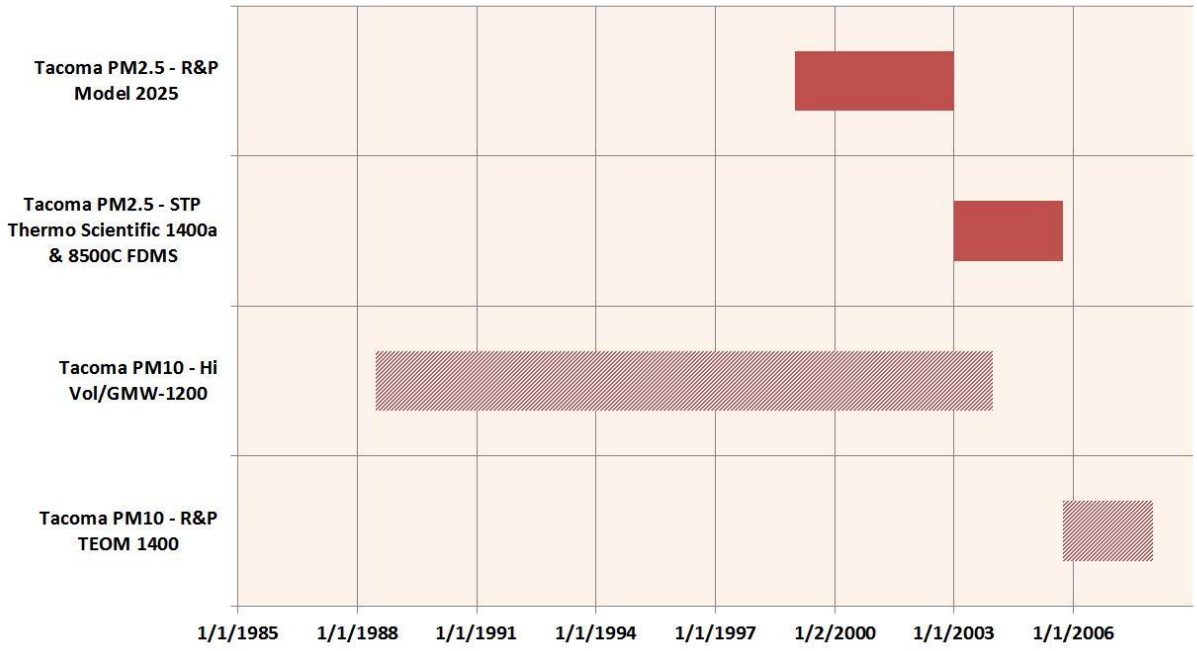
Tacoma Monitoring

The Tacoma PM_{10} maintenance area is shown in **Error! Reference source not found.**. PSCAA monitored M_{10} at 2301 Alexander Avenue site in Tacoma, Washington. The area has been in compliance with the standard since 1990. Federal Equivalent Method (FEM) PM_{10} values were low enough that the monitor was removed with EPA approval at the end of 2007. Excerpts from this report are included as Appendix B. Since then continuous monitoring of $PM_{2.5}$ has been conducted at the Tacoma monitoring site and correlated with a co-located PM_{10} monitor to provide estimated PM_{10} values. Figure 4.1.8 shows the dates and monitors located at the 2301 Alexander Avenue monitoring site from 1988 – 2007. All of the data used to develop the relationship between PM_{10} and $PM_{2.5}$ relied exclusively on data downloaded from EPA's Air Quality System (AQS). The data downloaded from AQS was collected using the monitors show in Figure 4.1.8. The model described in section 4.2 was developed using data from the time period where PM_{10} and $PM_{2.5}$ measurements are co-located (1999-2003). For the period 2008 – present the PM_{10} concentrations are estimated directly from a correlated nephelometer. The nephelometer is the only instrument presently reporting $PM_{2.5}$ concentrations at the Alexander Avenue monitoring site.

Nephelometers have been used to monitor particulate matter light scatter in the maintenance areas for decades. A nephelometer measures light scatter (bscat) and, when correlated with a Federal Reference Method (FRM) instrument, accurately represents particulate matter levels. Because of the high correlation between nephelometer readings and FRM and Federal Equivalent Method (FEM) monitors, Ecology and PSCAA conclude that $PM_{2.5}$ values calculated directly from a nephelometer are sufficiently reliable and reproducible. Nephelometer measurements began in the maintenance areas in 1999 and measurements continue in those areas today. Each of the monitoring stations in the three maintenance areas measure $PM_{2.5}$ with a nephelometer. The Seattle and Kent monitoring stations currently both use a FEM method and a nephelometer. $PM_{2.5}$ measurements reported using the FEM monitoring and the nephelometer the Seattle and Kent maintenance areas are well correlated.

Details on the PM_{10} and $PM_{2.5}$ relationship are described in Section 4.2.

Figure 4.1.8: Tacoma monitoring data used to calculate the PM_{10} $PM_{2.5}$ relationship



4.2. Model Development

Monitoring for PM_{10} concentrations was discontinued with EPA approval at all three monitoring stations in late 2007 because PM_{10} levels were so low and continued attainment of the NAAQS could be ensured through correlation with $PM_{2.5}$ monitoring. PM_{10} concentrations from 2008 to the present are calculated using a relationship between PM_{10} and $PM_{2.5}$. $PM_{2.5}$ measurements collected from 1999 – 2007 were correlated to PM_{10} measurements collected in the same period. Many of the sources of PM_{10} are independent of season; however, residential wood burning in all three maintenance areas occurs primarily in the winter months, October-March. Due to the difference in emission sources in the winter months compared to the summer months, the relationship was calculated separately for summer months, April – September, and winter months, October – March.

The relationship between $PM_{2.5}$ and PM_{10} was calculated using a robust regression technique. The standard ordinary least squares (OLS) regression technique, which uses a Pearson correlation, is not suitable for data with outliers or uncertainty in the independent variable. For weaker correlations, an OLS regression will result in a slope with a significant low bias. A robust regression technique reduces the low bias on the slope[6.1] and is less sensitive to outliers[6.2]. For our analysis, the OLS approach resulted in a slope with a low bias for some of the maintenance areas, which underestimated the PM_{10} concentrations. Instead, we used an iteratively re-weighted least squares algorithm (with a bi-square weighting function) to calculate the slope and intercept of the PM_{10} to $PM_{2.5}$ relationship. This relationship was then used to estimate PM_{10} concentrations using measurements of $PM_{2.5}$.

Kent

The correlation between PM_{10} and $PM_{2.5}$ is strongest in the winter months, October – March. This is expected because residential wood burning accounts for most of the winter time PM_{10} and $PM_{2.5}$ emissions in Kent. For the winter time period, the PM_{10} to $PM_{2.5}$ relationship can be described similarly using and OLS regression or a robust regression. The summer months, April – September, have lower concentrations and a weaker relationship. Since the summer relationship has a lower correlation than the winter relationship, the robust regression technique produces a steeper slope for the PM_{10} to $PM_{2.5}$ relationship than the OLS technique. For consistency we use the robust regression technique to calculate the slope and intercept to describe the relationship for both the winter and summer months. The relationships for PM_{10} to $PM_{2.5}$ in the summer and winter months are shown in Figure 4.2.1.

The estimated PM_{10} values are calculated using measured $PM_{2.5}$ and the equation of the line for summer or winter depending on the date of the $PM_{2.5}$ measurement. In other words, all PM_{10} concentrations estimated for dates from April through September use the summer slope and intercept as the PM_{10} model. As a check for the model, PM_{10} concentrations were estimated over the period 1999-2007 and plotted against PM_{10} measurements from the same period. The results are shown in Figure 4.2.2.

[6.1] Ayers, G. P. (2001), Comment on regression analysis of air quality data, Atmos. Environ., 35(13), 2423 – 2425, doi:10.1016/S1352-2310(00)00527-6

[6.2] Huber, P. J. Robust Statistics. Hoboken, NJ: John Wiley & Sons, Inc., 1981.

Figure 4.2.1: Summer and Winter PM_{10} to $PM_{2.5}$ from 1999-2007 at the Kent Monitoring Site

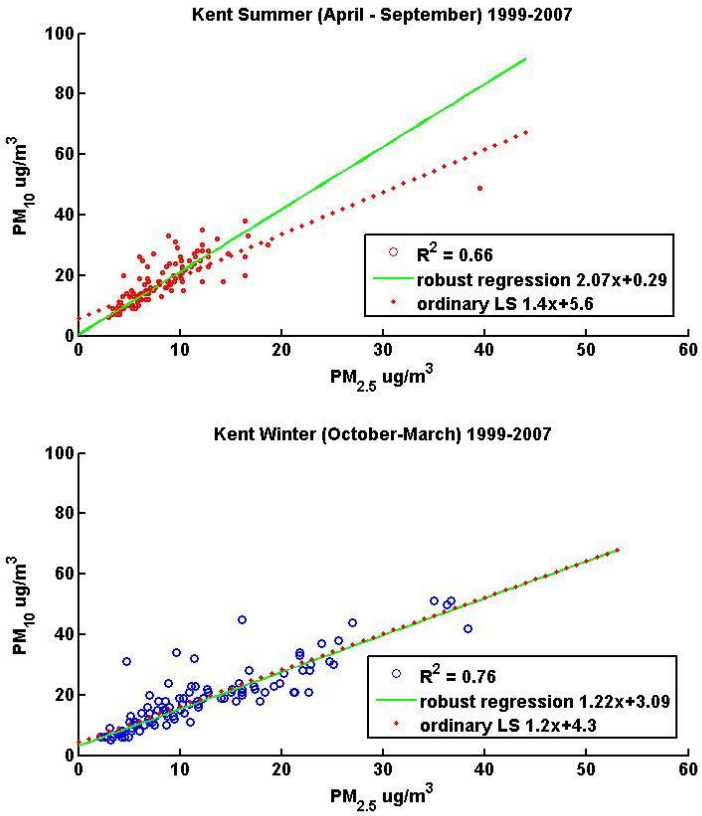
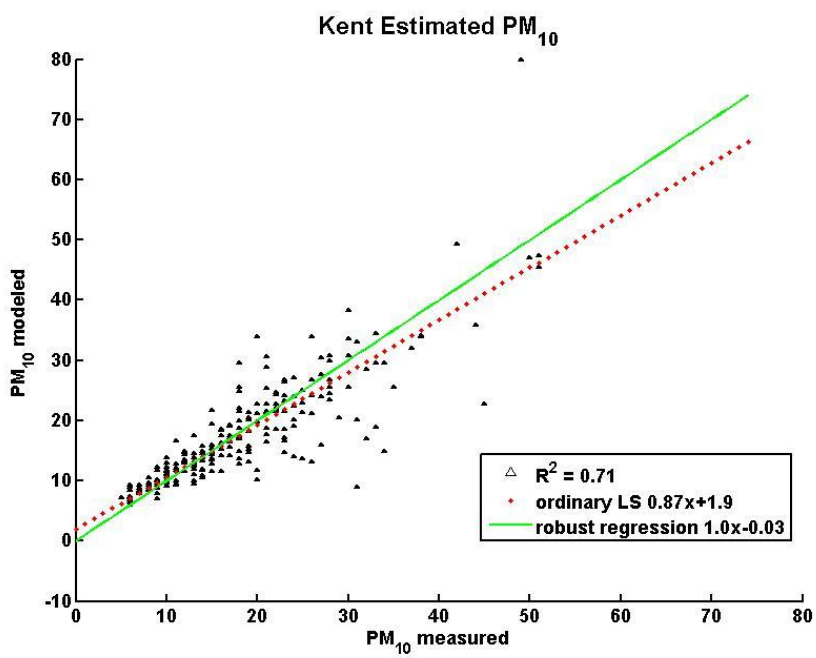


Figure 4.2.2: Estimated PM_{10} to Measured PM_{10} for the years 1999-2007



Seattle

The relationship between PM_{10} and $PM_{2.5}$ in Seattle is similar in both seasons. Because this area is characterized by emissions from industry and the Port of Seattle, PM_{10} and $PM_{2.5}$ emissions are likely more uniform throughout the year. Higher wintertime concentrations are likely a result of winter inversion and stagnation events which trap pollutants near the surface. Although the OLS technique produces a slightly steeper slope than the robust regression technique, the PM_{10} model for the Seattle maintenance area will use the relationship described by the robust regression technique for consistency with the Kent and Tacoma maintenance areas. The relationships for PM_{10} to $PM_{2.5}$ in the summer and winter months are shown in Figure 4.2.3

The estimated PM_{10} values are calculated using measured $PM_{2.5}$ concentrations and the equation of the line for summer or winter depending on the date of the $PM_{2.5}$ measurement. In other words, all PM_{10} concentrations estimated for dates from April through September were estimated using the summertime slope and intercept from the PM_{10} model. As a check for the model, PM_{10} concentrations were estimated over the period 1999-2007 and plotted against PM_{10} measurements from the same period. The results are shown in Figure 4.2.4.

Figure 4.2.3: Summer and Winter PM_{10} to $PM_{2.5}$ from 1999-2007 at the Seattle Monitoring Site

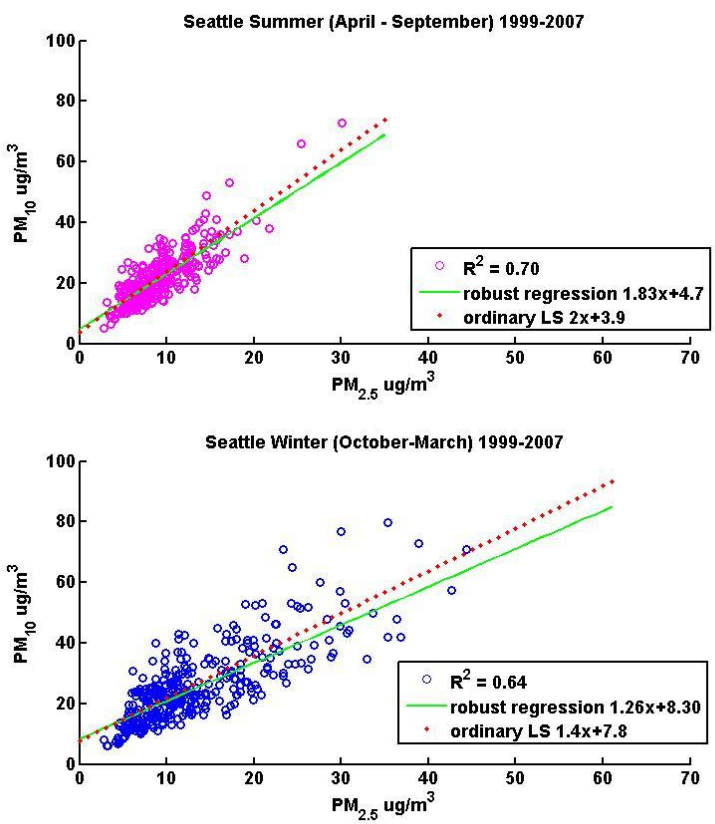
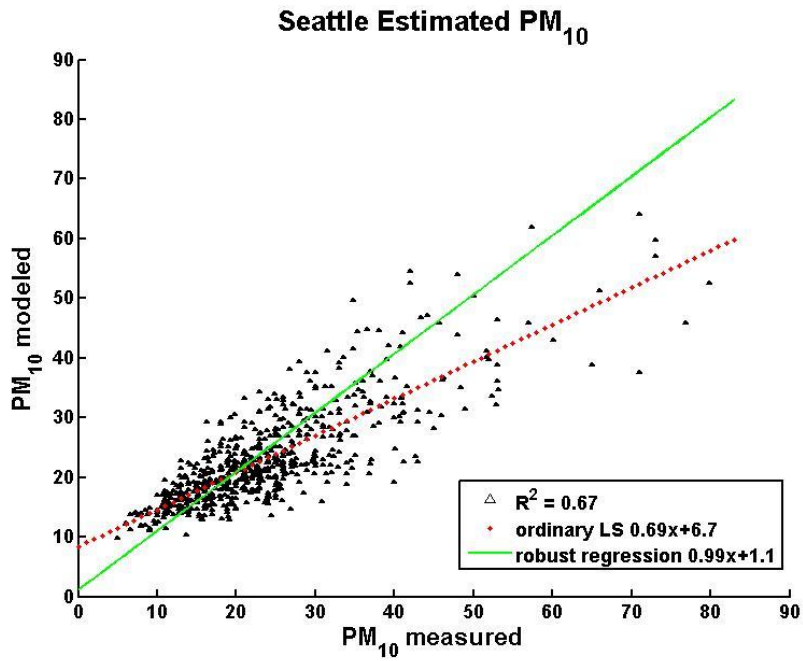


Figure 4.2.4: Estimated PM_{10} to Measured PM_{10} for the years 1999-2007



Tacoma

In the Tacoma maintenance area the winter correlation between PM_{10} and $PM_{2.5}$ is stronger than the summer months. This may be explained by the residential wood smoke emissions in the Tacoma region as well as decreased road dust emissions in the wintertime. For the winter time period, the PM_{10} to $PM_{2.5}$ relationship can be described similarly using and OLS regression or a robust regression. The summer months, April – September, have higher PM_{10} concentrations and a weaker relationship. It is likely this is a reflection of the difference in PM_{10} and $PM_{2.5}$ emission sources in the summer months. The PM_{10} model for the Tacoma maintenance area uses the relationship described by the robust regression technique. The relationships for PM_{10} to $PM_{2.5}$ in the summer and winter months are shown in Figure 4.2.5

The estimated PM_{10} values are calculated using measured $PM_{2.5}$ and the equation of the line for summer or winter depending on the date of the $PM_{2.5}$ measurement. In other words, all PM_{10} concentrations estimated for dates from April through September the summer slope and intercept are used as the PM_{10} model. As a check for the model, PM_{10} concentrations were estimated over the period 1999-2007 and plotted against PM_{10} measurements from the same period. The results are shown in Figure 4.2.6.

Figure 4.2.5: Summer and Winter PM_{10} to $PM_{2.5}$ from 1999-2007 at the Tacoma Monitoring Site

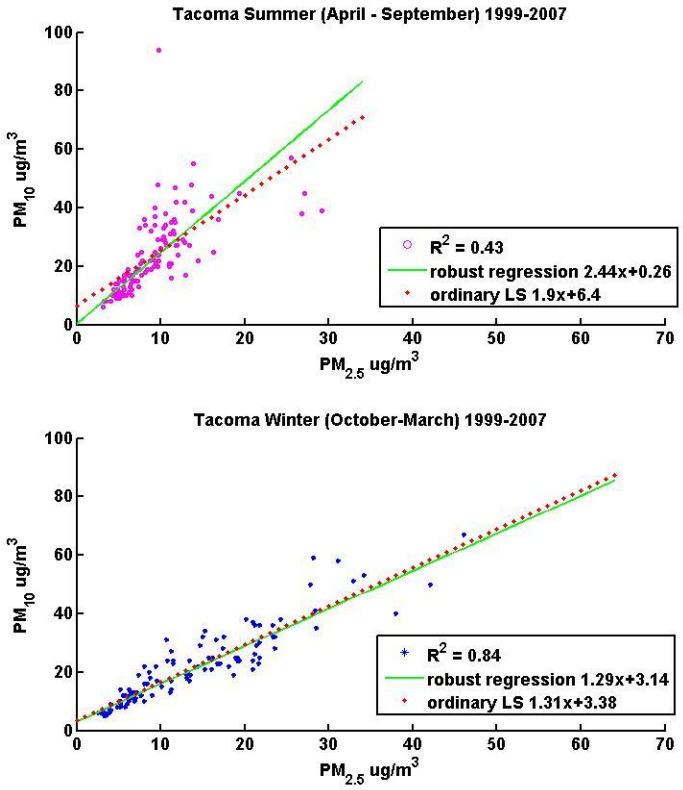
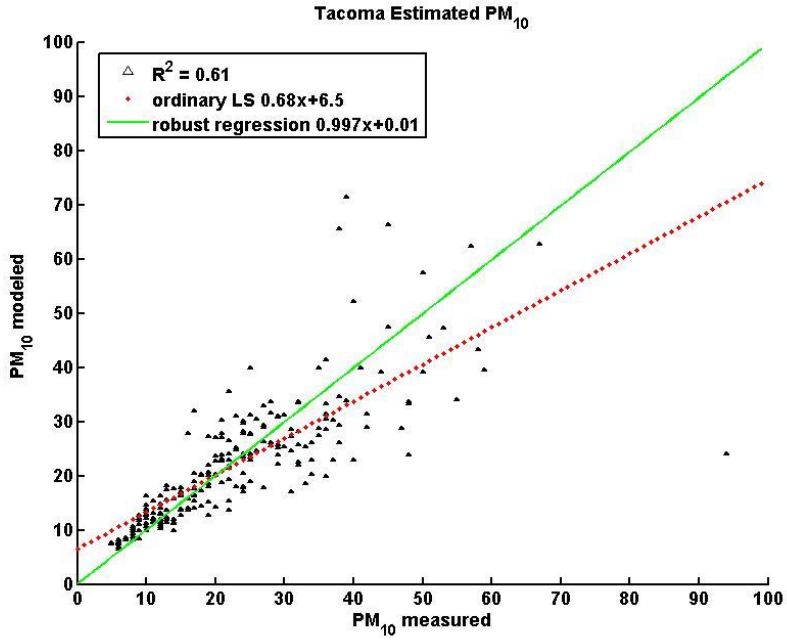


Figure 4.2.6: Estimated PM_{10} to Measured PM_{10} for the years 1999-2007



PM_{10} Violation Unlikely

Compliance with the 2006 24-hour $PM_{2.5}$ standard of 35 µg/m^3 will help assure continued compliance with the 1987 PM_{10} standard. PSCAA ran collocated FRM/ FEM PM_{10} and FRM/FEM $PM_{2.5}$ monitors from 1999 through 2007. Using the relationships described in the model development section above, we can estimate the measured $PM_{2.5}$ concentrations that would suggest an exceedance of the 24-hour PM_{10} standard of 150µg/m^3 in the summer and winter seasons. $PM_{2.5}$ concentrations that would be required to exceed the 24-hour PM_{10} standard are summarized in Table 4.2.1.

Table 4.2.1 $PM_{2.5}$ concentrations corresponding to a PM_{10} concentration of 150 µg/m^3

	Summer $PM_{2.5}$ Concentration (µg/m^3)	Max Summer $PM_{2.5}$ (µg/m^3)* since 2008	Winter $PM_{2.5}$ Concentration (µg/m^3)	Max Winter $PM_{2.5}$ (µg/m^3) since 2008
Kent	75	71*	122	33
Seattle	79	28	113	34
Tacoma	62	35	114	53

*Maximum value was observed on July 4th , 2009. The second highest value at Kent from 2008-2012 is 28µg/m^3

The maximum summer and winter $PM_{2.5}$ concentrations observed at each of the monitoring sites from 2008-2012 are listed in Table 4.4.1. Using the relationship between PM_{10} and $PM_{2.}5$, 24-hour $PM_{2.5}$ levels would have to exceed, at a minimum, 62 µg/m^3, in summer or at least 113 µg/m^3 in the winter to exceed the PM_{10} standard at any of the three maintenance area monitoring sites. Because of the form of the PM_{10} standard, the $PM_{2.5}$ level would have to be exceeded more than once a year, over a three year average, to violate the PM_{10} standard. For example the 71 µg/m^3, recorded at Kent on July 4, 2009, corresponds to a PM_{10} concentration of 142 µg/m^3. While 142 µg/m^3 is near the NAAQS of 150 µg/m^3, it is not an exceedance. However, the $PM_{2.5}$ concentration of 71 µg/m^3 is well above the NAAQS of 35 µg/m^3. This demonstrates that $PM_{2.5}$ is the controlling standard. The maximum observed $PM_{2.5}$ concentrations in table 4.4.1 demonstrate that an exceedance of the PM_{10} NAAQS is highly unlikely.

4.3. Current PM_{10} and $PM_{2.5}$ Data Availability

PM_{10} concentrations calculated from the PM_{10} model described above are available from PSCAA and can be provided to EPA and the public on request. Both the 3-year and 5-year design values will be included in Ecology's annual monitoring network report to EPA, this report is available to the public at https://fortress.wa.gov/ecy/publications/UIPages/Home.aspx The $PM_{2.5}$ monitored concentrations used to calculate the PM_{10} concentrations are available from the PSCAA website, www.pscleanair.org.

5. Emission Inventory

This section presents the emissions inventory for this second 10-year maintenance plan and briefly describes its development. The LMP Guidance requires the maintenance plan include an attainment inventory—that is, an inventory with emission levels consistent with attainment of the PM_{10} standard.

EPA develops a triennial national emission inventory based on EPA and state inputs. EPA issued the Air Emissions Reporting Rule (AERR) to clarify state reporting requirements. EPA and Ecology agreed on developing the attainment inventory from available triennial inventory information and annual reported industrial emissions. Appendix C provides details on the emission inventory development.

Emission years and categories

EPA approved the Inventory Preparation Plan (IPP) prepared by Ecology that proposed use of readily available information. This plan is provided as Appendix D. Emission estimates in this maintenance plan inventory are from Ecology's draft 2011 triennial emissions inventory[7] (2011 EI) and the annual 2011 industrial emissions reported to PSCAA and Ecology.

The original seven significant emission categories are reorganized in seven new categories in this attainment inventory as listed in Table 5.1. County values from the seven most significant categories have been temporally and spatially allocated to their respective maintenance areas. These seven emissions categories were chosen based on a review of the emission sources in the original maintenance plan.

Table 5.1: Emission Categories used in this LMP

1994 Emissions Categories	2011 Emission Categories
Gasoline Exhaust	On-road Mobile
Diesel Exhaust	Port and Marine, On-road Mobile
Ships	Port and Marine
Locomotives	Locomotives (including fugitive dust)
Wood Burning	Residential Wood Combustion
Road Dust	Paved Road Dust, Unpaved Road Dust
Allowable Industrial	Industrial

[7] Draft Excerpts of the Washington State Base Year 2011 County Inventories, Washington State Department of Ecology Air Quality Program, Sally Otterson, 2013.

Emission inventory geography

The emission inventory is an estimate of the total PM_{10} tons boundaries shown in the Figure 2.1, Figure 2.2, and Figure 2.3.

Significant source categories

The most significant sources of PM_{10} listed in the original maintenance plan for the Seattle and Tacoma Maintenance Areas was industrial emissions. For the Kent Maintenance Area, the major source of emission was from Residential Wood Combustion, and to a lesser extent diesel and gas vehicle exhaust.

Fugitive dust emissions from coal trains were estimated and are included in the total locomotive emissions, see Appendix C.

Other sources are deemed insignificant, including outdoor burning, construction dust, aircraft emissions, wildfires, cigarette smoke, commercial charbroiling, and secondary particulate matter. Outdoor burning is prohibited in the three maintenance areas, so emissions would be minimal. Neither Ecology nor PSCAA have local information on emissions for construction dust, cigarette smoke, or commercial charbroiling, but is assumed to be minimal in these areas. Smoke from wildfires in Puget Sound is rare and was considered negligible. Some of these values are included in the 2011 NEI, however the emission estimates have large uncertainties because the data was collected nationally and was not developed specifically for local areas, or for sub-county regions like the Seattle, Tacoma, and Kent Maintenance Areas.

Maintenance Plan Inventory

Emissions for these seven emission categories are shown in Table 5.2 below. Washington State's 2011 EI is the most recent, complete, readily available emission inventory for King and Pierce County.

Table 5.2: Seattle, Tacoma, and Kent Maintenance Area Annual and Winter Day PM_{10} Emissions

			Seattle Duwamish			Tacoma Tideflats			Kent		
Emission Categories	**Emission Inventory Source**	**Emission Report Year**	**Annual, tons/yr**	**Tons/winter day**	**% of total tons/winter day**	**Annual, tons/yr**	**Tons/winter day**	**% of total tons/winter day**	**Annual, tons/yr**	**Tons/winter day**	**% of total tons/winter day**
On-road Mobile	2011 EI	2011	100.8	0.29	12%	59.9	0.17	11%	21.7	0.06	10%
Port and Marine	2011 EI	2011	122.2	0.33	14%	77.0	0.21	14%	0.0	0.00	0%
Locomotives (including fugitive dust)	2011 EI	2011	43.5	0.12	5%	13.4	0.04	2%	13.8	0.04	6%
Residential Wood Combustion	2011 EI	2011	17.0	0.13	5%	6.6	0.05	3%	34.8	0.26	42%
Paved Road Dust	2011 EI	2011	190.1	0.53	22%	104.6	0.29	19%	40.9	0.11	18%
Unpaved Road Dust	2011 EI	2011	133.6	0.65	27%	23.3	0.11	7%	28.7	0.14	23%
Industrial	PSCAA, Ecology	2011	127.3	0.35	15%	243.4	0.67	43%	0.5	0.00	0%
Total	--	2011	734.5	2.40	--	528.2	1.53	--	140.4	0.61	--

6. Control Measures

PSCAA and Ecology relied upon Reasonably Available Control Measures (RACM) for residential wood combustion and fugitive dust to return the three maintenance areas to compliance with the 1987 PM_{10} standard. In addition to the RACM for wood smoke and fugitive dust, PSCAA and Ecology have enforceable and permanent control measures for industrial sources and outdoor burning. Improved federal standards for diesel emissions have also helped to control emissions.

PSCAA and Ecology continue to implement the control measures included in the attainment plan and the first maintenance plan.

Federal, PSCAA, and Ecology rules provide the legal authority to implement, maintain, and enforce the control measures in this plan. Control measures are listed below, with further explanation and references following:

Wood Smoke Curtailment

- Mandatory curtailment and enforcement program during impaired air quality (PSCAA Regulation 1, Article 13.05)
- Opacity limits (PSCAA Regulation 1, Article 13.03)
- Fuel restrictions (PSCAA Regulation 1, Article 13.04)
- Prohibition and sale of uncertified wood stoves (PSCAA Regulation 1, Article 13.07)
- Allow woodstoves to be prohibited entirely as a SIP contingency measure (PSCAA Regulation 1, Article 13.07 (b))
- Certification of new woodstoves (PSCAA Regulation 1, Article 13.02)
- Rules that govern the sale and transfer of uncertified stoves (PSCAA Regulation 1, Article 13.06)

Fugitive Dust Control Measures

- Prevent spillage and track out of dirt and mud on to public roadways (PSCAA Regulation 1, Article 9.15(a)(4))
- Improved industrial hygiene (PSCAA Regulation 1, Article 9.15(a))

Industrial Source Program

- Modifications of existing major sources
- Boiler replacement
- Facility Shutdown
- Monitoring opacity of emissions (PSCAA Regulation 1, Article 9.04)
- Emissions standards in PSCAA Regulation I - Article 9 and Chapter 173-400 WAC
- PSCAA Orders of Approval and Ecology Regulatory Orders for Simpson Tacoma Kraft

Diesel Programs

- Emissions have been reduced as a result of federal regulations on the sulfur content of diesel fuel and the particulate emissions of new vehicles.
- Chapter 173-422A WAC requires heavy duty vehicles registered in Kent, Seattle, and Tacoma to pass a vehicle inspection and pass specific emissions standards.

Outdoor Burning Restrictions

- Land clearing is prohibited in King and Pierce Counties (PSCAA Regulation 1, Article 8.13)
- Residential yard waste burning is prohibited in urban growth areas in King and Pierce Counties (PSCAA Regulation 1, Article 8.9 and 8.10)

Emission Reduction Programs

The following programs are believed to be responsible for the region maintaining compliance with the ambient air quality standard. Where applicable, we have also included voluntary measures that reduce emissions under the appropriate category (explicitly noted voluntary). Unless noted voluntary, the emission reductions listed below are considered permanent and enforceable.

Wood Smoke Curtailment

PSCAA successfully implements the curtailment program in the Kent, Seattle, and Tacoma PM_{10} maintenance areas. Mandatory curtailment and enforcement of solid fuel burning devices is outlined in PSCAA Regulation I, Article 13.05. When wood smoke pollution is forecasted to impair air quality, PSCAA restricts wood burning. When PSCAA calls burn bans for the area, woodstove use and outdoor burning are restricted or prohibited. Burn bans do not apply to homes without another source of adequate heat.

PSCAA calls burn bans in two stages. A Stage 1 ban prohibits all uncertified wood heating devices when pollution approaches unhealthful levels. A Stage 2 ban prohibits all wood heating when pollution reaches a specified higher level. Unhealthful levels are defined as follows: a Stage 1 burn ban (First Stage of Impaired Air Quality) is declared when meteorological conditions are forecast to cause fine particulate levels to exceed 35 $\mu g/m^3$ within 48 hours, when measured on a 24 hour average basis (or 30ug/m^3 within 72 hours in counties with a PM2.5 nonattainment area – this includes Pierce County). A Stage 2 burn ban (Second Stage of Impaired Air Quality) is declared when a first stage of impaired air quality has been in force and has not been sufficient to reduce the increasing fine particulate pollution trend. Under certain circumstances a Stage 2 ban may be declared without calling a Stage 1 ban first.

Since Stage 1 and Stage 2 burn bans are designed to maintain the more stringent 2006 $PM_{2.5}$ standard, PSCAA's burn ban rules are more protective of the PM_{10} standard than the state burn ban rules supporting the attainment and first 10-year maintenance plan for Kent, Seattle, and Tacoma PM_{10} maintenance areas.

Fugitive Dust

Spillage and track out of dirt and mud onto public roadways is regulated in section 9.15(a) of Regulation I in the PSCAA rules. The PSCAA fugitive dust program has been determined by EPA to meet the RACM requirements in CAA Section 189(a)(1)(C). The emission reductions from this program are considered both permanent and enforceable.

Industrial Sources

Reductions in actual and allowable emissions from industrial sources have occurred as a result of facilities permanently shutting down as well as new federal regulations for specific stationary sources. The National Emission Standards for Hazardous Air Pollutants (NESHAPS) are stationary source standards for hazardous air pollutants (40 CFR Part 61 and 40 CFR Part 63). Particulate matter is regulated in NESHAPs found in 40 CFR Part 63. Section 111 of the Clean Air Act authorized the EPA to develop technology based standards which apply to specific categories of stationary sources. These standards are referred to as New Source Performance Standards (NSPS) and are found in 40 CFR Part 60. The NSPS apply to new, modified and reconstructed affected facilities in specific source categories such as manufacturers of glass, cement, rubber tires and wool fiberglass.[8] The NSPS apply to industrial sources in the Tacoma and Seattle PM_{10} maintenance areas. Emission standards contained in Article 9 of PSCAA Regulation I and Chapter 173-400 WAC as well as PSCAA Orders of Approval and the Ecology Regulatory Orders for Simpson Tacoma Kraft have been determined by EPA to be permanent and enforceable.

Diesel Emissions

National diesel fuel standards have significantly reduced sulfur content in diesel fuel since 1997. The diesel program regulations are located in 40 CFR Part 80 subpart I. A 15 parts per million (ppm) sulfur specification, known as Ultra Low Sulfur Diesel (ULSD), was phased in for highway diesel fuel from 2006-2010. Diesel engines equipped with advanced emission control devices (generally, 2007 and later model year engines and vehicles) must use highway ULSD fuel. Exhaust emissions from these engines will decrease by more than 90%.[9] Low sulfur (500 ppm) and Ultra Low Sulfur Diesel (ULSD) fuel will be phased in for non-road, locomotive, and marine (NRLM) engines from 2007-2014. These fuel requirements, coupled with advanced emission control technologies, will decrease emissions from these engines by more than 90%.[9] EPA adopted changes to the diesel fuel program to allow for the production and sale of diesel fuel with up to 1,000 ppm sulfur for use in Category 3 marine vessels. The regulations generally forbid production and sale of fuels with more than 1,000 ppm sulfur for use in most U.S. waters, unless operators achieve equivalent emission reductions in other ways[9].

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[8] New Source Performance Standards and State implementation Plans http://www.epa.gov/compliance/monitoring/programs/caa/newsource.html

[9] EPA Diesel Fuel Page http://epa.gov/otaq/fuels/dieselfuels/index.htm

In 2010, the International Maritime Organization designated specific portions of U.S. waters as an Emission Control Area (ECA). In our region, the ECA extends out to approximately 200 nautical miles west of the West Coast. The ECA became enforceable in August 2012, but the most stringent fuel sulfur reductions will come into effect in January 2015.

The ECA will reduce the sulfur content in fuels from an average of about 2.7% sulfur to 0.1% sulfur by January 2015. This cleaner fuel will result in decreases in both sulfur oxides and PM_{10} pollution in the Tacoma and Seattle Maintenance Areas. It should reduce emissions from ocean-going ships of sulfur oxides by approximately 95% and PM_{10} pollution by approximately 60 to 80%.

Voluntary diesel emissions reductions:

Strategies for reducing diesel emissions in the Kent, Seattle, and Tacoma PM_{10} maintenance areas have been achieved through the PSCAA Diesel Solutions Program as well as the Northwest Ports Clean Air Strategy. These programs target emissions in four transportation sectors: off-road equipment, on-road vehicles, maritime vessels and equipment, and rail.

Off-road: Off-road diesel emissions include construction equipment, aircraft-support equipment, and cargo handling equipment used at seaports and rail yards. Voluntary strategies to reduce diesel emissions in the off-road sector include cleaner fuels, retrofit technologies and vehicle replacement. Through the voluntary programs, cargo handling equipment has been retrofitted and replaced in the Seattle and the Tacoma PM_{10} maintenance areas.

On-road and School Buses: Voluntary strategies to reduce diesel emissions from the on-road sector include cleaner fuels, retrofit technologies and vehicle replacements. Between 2003 and 2008 PSCAA retrofitted school busses through the Puget Sound region with diesel oxidation catalysts and crankcase filters. As part of the Puget Sound Clean Cities Petroleum Reduction Project, waste hauling fleets are reimbursed for the cost difference between a conventional diesel truck and a natural gas or hydraulic-hybrid natural gas truck

Ports: Since both The Port of Tacoma and The Port of Seattle fall within two of the maintenance areas, diesel reduction projects at the ports have contributed to reducing emissions. Public and private fleets in The Port of Seattle were replaced with new trucks and diesel oxidation catalysts as part of the Diesel Solutions Program between November 2009 and January 2011. Through the voluntary programs, cargo handling equipment has been retrofitted and replaced in both the Seattle and the Tacoma PM_{10} maintenance areas. As part of the Puget Sound Clean Cities Petroleum Reduction Project, waste hauling fleets are reimbursed for the cost difference between a conventional diesel truck and a natural gas or hydraulic-hybrid natural gas truck.

Outdoor burning

While not considered a significant contributor to high PM_{10} concentrations on stagnant winter days, outdoor burning of land clearing debris and yard waste has potential for causing violations of the PM_{10} standard. In 2000 and 2008 Article 8 of Regulation I was amended to prohibit residential yard burning in the King and Pierce County urban growth areas as well as the former carbon monoxide non-attainment area (Seattle/Tacoma/Everett urban areas, as defined by the Washington State Department of Transportation, 1983 version, urban area maps). Article 13 of Regulation 1 prohibits land clearing burning completely in King and Pierce counties. PSCAA continues to encourage development of alternatives to outdoor burning such as chipping, composting and yard waste collection programs.

Control Measures in PSCAA Rules

Washington State's Clean Air Act grants the authority for and outlines the conditions under which PSCAA may adopt its own rules. PSCAA has jurisdiction over the Kent, Seattle, and Tacoma PM_{10} maintenance areas and relies upon its rules to maintain and enforce the PM_{10} standard.

The PSCAA rules as listed in Table 6.1, Table 6.2, and Table 6.3 are included in the federally approved SIP.

Table 6.1: PSCAA Regulation I – Article 8: Outdoor Burning

Regulation I - Article 8: Outdoor Burning	State Adoption	EPA Effective Date
8.04 General Conditions for Outdoor Burning	11/9/2000	9/30/2004
8.05 Agricultural Burning Permits	11/9/2000	9/30/2004
8.06 Outdoor Burning Ozone Contingency Measure	12/19/2002	9/7/2004
8.09 Description of the King County No-Burn Area	11/9/2000	9/30/2004
8.10 Description of the Pierce County No-Burn Area	11/9/2000	9/30/2004
8.11 Description of the Snohomish County No-Burn Area	11/9/2000	9/30/2004
8.12 Description of the Kitsap County No-Burn Area	10/24/2002	9/30/2004

Table 6.2: PSCAA Regulation I – Article 9: Emission Standards

Regulation I - Article 9: Emission Standards	State Adoption	EPA Effective Date
9.03 Emission of Air Contaminant: Visual Standard	3/11/1999	9/30/2004
9.04 Opacity Standard for Equipment with Continuous Opacity Monitoring Systems	4/9/1998	9/30/2004
9.05 Refuse Burning	12/9/1993	6/29/1995
9.08 Fuel Oil Standards	4/14/1994	6/29/1995
9.09 Particulate Matter Emission Standards	4/9/1998	9/30/2004
9.15 Fugitive Dust Control Measures	3/11/1999	9/30/2004
9.16 Spray-Coating Operations	7/12/2001	9/30/2004
9.20 Maintenance of Equipment	6/9/1988	10/28/1994

Table 6.3: PSCAA Regulation I – Article 13: Solid Fuel Burning Device Standards

Regulation I – Article 13: Solid Fuel Burning Device Standards	State Adoption	EPA Effective Date
13.03 Opacity Standards	10/25/2012	6/28/2013
13.04 Allowed and Prohibited Fuel Types	10/25/2012	6/28/2013
13.05 Restrictions on Operation of Solid Fuel Burning Devices	10/25/2012	6/28/2013
13.06 Emission Performance Standards	10/25/2012	6/28/2013
13.07 Prohibitions on Wood Stoves that are not Certified Wood Stoves	10/25/2012	6/28/2013

7. Contingency Measures

CAA Section 175(A) requires a maintenance plan include contingency measures necessary to ensure prompt correction of any violation of the standard that may occur after redesignation. PSCAA's Regulation I – Article 13.07 (b) provides for prohibition of the use of uncertified woodstoves for the sole purpose of meeting CAA requirements for contingency measures. To implement this provision, the rule requires that the EPA, in consultation with Ecology and PSCAA, must make written findings that:

(1) The area has failed to maintain a national ambient air quality standard

(2) Emissions from solid fuel burning devices from a particular geographic area are a contributing factor to such failure to make reasonable further progress or attain or maintain a national ambient air quality standard

Contingency Measure Trigger

The contingency measure will be triggered if a violation of the PM_{10} standard occurs at the maintenance area monitor based on nephelometer and/or FRM monitoring. A violation of the PM_{10} standard will be determined by the procedures outlined in 40 CFR Part 50.

8. Commitment to Continued Monitoring and Verification of Continued Attainment

Emissions in the Kent, Seattle, and Tacoma PM_{10} maintenance areas are not expected to grow to threaten compliance with the standard as discussed in Section 3 of this plan.

PSCAA makes a commitment to continue operation of $PM_{2.5}$ monitors in the Kent, Seattle, and Tacoma PM_{10} maintenance areas through 2020, the end of the maintenance period. The $PM_{2.5}$ measurements will be used to calculate PM_{10} levels in the maintenance areas. In the unlikely event that after exceptional events are taken into account (using EPA guidance), the calculated design value for PM_{10} exceeds the LMP threshold of 98µg/m^3, PSCAA will reestablish PM_{10} monitoring as part of the annual network monitoring report process. PM_{10} concentrations calculated from the PM_{10} model described in section 4.3 are available from PSCAA and can be provided to EPA and the public on request. The $PM_{2.5}$ monitored concentrations used to calculate the PM_{10} concentrations are available from the PSCAA website, www.pscleanair.org. Both 3-year and 5-year design values will be provided annually to Ecology for the annual monitoring network report. The network review is available at https://fortress.wa.gov/ecy/publications/UIPages/Home.aspx

PSCAA will calculate 3-year and 5-year PM_{10} design value estimates annually for the Kent, Seattle, and Tacoma maintenance areas through 2020 to confirm the areas continue to meet the PM_{10} NAAQS. A 3-year PM_{10} design value estimate of or below 150 µg/m^3 demonstrates continued compliance with the PM_{10} NAAQS. Ecology will include a statement in the annual network report to inform EPA of continued attainment for the Kent, Seattle, and Tacoma PM_{10} maintenance areas based on calculated PM_{10} values.

9. Summary of Maintenance Plan Commitments

Commitments made in this maintenance plan are summarized in Table 9.1.

Table 9.1: Second 10-Year LMP Commitments

Section	Commitment	Responsible Agency
3	Annual calculation of the Kent, Seattle, and Tacoma PM_{10} 5-year design values through 2020 to show continued qualification for the LMP option.	PSCAA
3	Reporting to EPA on continued qualification for the LMP option in the annual monitoring network report	Ecology
7	Implementation of the contingency measure if the Kent, Seattle, or Tacoma maintenance area violates the PM_{10} standard based on $PM_{2.5}$ monitoring	PSCAA
8	Continued monitoring of $PM_{2.5}$ in the Kent, Seattle, and Tacoma maintenance areas through 2020	PSCAA
9	Annual calculation of the 3-year PM_{10} design values for the Kent, Seattle, and Tacoma maintenance areas through 2020 to assess compliance with the PM_{10} standard	PSCAA
9	Reporting to EPA on continued PM_{10} attainment in the annual monitoring network report	Ecology

The PM_{10} attainment plan for Kent was fully approved by EPA on July 27, 1993 (58 FR 40059) and the plans for Tacoma and Seattle were fully approved by EPA on October 25, 1995 and October 26, 1995, respectively (60 FR 54599 and 60 FR 54812). EPA approved the first 10-year maintenance plan on March 13, 2001 (66 FR 14492). This plan ensures compliance through 2020 and fulfills the final requirement for maintenance plans specified by the CAA.

Appendix A

Limited Maintenance Plan Qualification

A. Design Values

The Limited Maintenance Plan (LMP) option for moderate PM_{10} nonattainment areas requires an area to meet certain applicability criteria in order to qualify for the LPM option. The first criteria is that an area should be attaining the National Ambient Air Quality Standard (NAAQS) and the average PM_{10} design value based on the most recent 5 years of air quality data should be at or below 98µg/m^3 for the 24-hour PM_{10} NAAQS[1]. Using the most recent 5 years of data, downloaded from the Air Quality System (AQS), for the Kent, Seattle, and Tacoma PM_{10} maintenance areas design values are, 57±3µg/m^3, 68±4µg/m^3, and 72±9µg/m^3 respectively.

The PM_{10} SIP Development Guideline[2] (SIP Guideline) outlines the following four approaches to determine the PM_{10} design value: a table look-up procedure; fitting a statistical distribution to several years of data; a graphical estimation technique; and the use of a conditional probability approach. This analysis uses both the table look-up method and a statistical fit to calculate the PM_{10} design values. The graphical estimation and the conditional analysis were considered for this analysis however the table look-up method and the statistical fit were the most appropriate for the Kent, Seattle, and Tacoma monitoring datasets. The graphical estimation technique was not used in this analysis due to insufficient data in some cases. Where there was insufficient data the concentration that corresponds to a frequency of 1/365 could not be read directly off a graph of the distribution at each of the sites for all of the 5-year time periods. The conditional probability approach is used in cases where individual years of data should be treated separately. Preliminary analysis of the conditional probability approach showed that values for individual years did not vary significantly from year to year. Calculating the design value using the table look-up method and the statistical fit method allows for the most conservative design value to be selected.

The table look-up procedure is outlined in the PM_{10} SIP development guide[3]. The PM_{10} SIP development guide states that the design concentration for PM_{10} is the concentration that corresponds to a frequency of 1/365 on an empirical frequency distribution.[3] The table below is used to estimate which point on the empirical frequency distribution corresponds to a frequency of 1/365.

[1] Limited Maintenance Plan Option for Moderate PM10 Nonattainment Areas, pp 3
[2] PM-10 SIP Development Guideline, publication EPA 450/2 86-001
[3] PM-10 SIP Development Guideline, publication EPA 450/2 86-001, Table 6-1, pp.6-5

Tabular Estimation of PM10 Design Values[3]	
Number of Values	**Data Point to be Used**
1 - 347	Highest Value
348 - 695	Second Highest Value
696 - 1042	Third Highest Value
1043 - 1390	Fourth Highest Value

The statistical fit is calculated according to the approach is outlined on pages 18-20 of the Ozone guideline[4]. The design value is calculated by solving for the concentration of PM_{10} that is equal to a probability of 1/365[3]. The 95% confidence interval is reported with the statistical fit design value. The design values calculated using with the table look-up method all fall within the range of the 95% confidence interval of the statistical fit design values

[4] Guideline for the Interpretation of Ozone Air Quality Standards, EPA-450/4-79-003

Kent Design Values

The Kent, Washington design value is based on FRM and FEM 24-hour PM_{10} monitoring data from the James Street and Central Avenue site in Kent, Washington. The LMP Guidance directs the design value be based on the most recent five years of data[Error! Bookmark not defined.]. The five most recent years of FRM ata are from 1999 – 2003. From 2004 – 2007 FEM data was collected using a Tapered Element Oscillating Microbalance (TEOM). The most recent five year design value for Kent, 58±3 µg/m^3, included both FRM and FEM data and spanned the period 2003-2007. The 95% confidence interval of the statistical fit included the design value calculated using the table look-up method. The relevant values are shown in Table A.1 below.

Table A.1: Kent PM_{10} Maximums and 5-Year Design Values, 1999-2007

	ANNUAL	MAXIMUM	5-YEAR PERIOD	5-YEAR	5-YEAR DESIGN VALUE	5-YEAR DESIGN VALUE
YEAR	NO. OBSERVATIONS	AQS MONITORED VALUES, µg/m^3	**YEARS**	NO. OBSERVATIONS	TABLE LOOK-UP, µg/m^3	STATISTICAL FIT, µg/m^3
1999	52	51				
2000**	5	34				
2001	52	51				
2002	61	50				
2003	59	45	**1999-2003***	273	51	64±3
2004	184	42	**2000-2004***	179	50	54±4
2005	365	50	**2001-2005**	533	50	54±5
2006	365	69	**2002-2006**	788	55	57±3
2007	360	62	**2003-2007**	1149	58	57±3

**This year was not used calculate the design value

*This Design Value is missing data from the years marked with "**"

Table A.2: Kent, Washington Modeled PM_{10} 5-Year Design Values, 2008-2012

	ANNUAL	MAXIMUM	5-YEAR PERIOD	5-YEAR	5-YEAR DESIGN VALUE	5-YEAR DESIGN VALUE
YEAR	NO. DATA POINTS	MODELED VALUES, $\mu g/m^3$	**YEARS**	NO. DATA POINTS	TABLE LOOK-UP, $\mu g/m^3$	STATISTICAL FIT, $\mu g/m^3$
2008	323	41				
2009	364	143*				
2010	362	56				
2011	356	38				
2012	357	46	**2008 - 2012**	720	43	46±3

*This value occurred on July 6, 2009

Seattle Design Values

The Seattle, Washington design value is based on FRM and FEM 24-hour PM_{10} monitoring data from the 4401 East Marginal Way South site in Seattle, Washington. The five most recent years of FRM data are from 1999 – 2003. From 2004 – 2007 FEM data was collected using a TEOM. The most recent five year design value for Seattle, WA included both FRM and FEM data and spanned the period 2003-2007. The design value for 2003-2007 is 68±4μg/m^3 and was calculated using the statistical fit method. The 95% confidence interval on the statistical fit includes the design value calculated using the table look-up method, 69μg/m^3. The relevant values are shown in Table A.3 below.

Table A.3: Seattle, Washington PM_{10} Maximums and 5-Year Design Values, 1999-2007

	ANNUAL	MAXIMUM	5-YEAR PERIOD	5-YEAR	5-YEAR DESIGN VALUE	5-YEAR DESIGN VALUE
YEAR	NO. OBSERVATIONS	AQS MONITORED VALUES, μg/m^3	YEARS	NO. OBSERVATIONS	TABLE LOOK-UP, μg/m^3	STATISTICAL FIT, μg/m^3
1999	60	53				
2000	53	73				
2001	55	73				
2002	61	71				
2003	59	65	**1999-2003**	287	73	87±5
2004	184	57	**2000-2004**	410	71	80±6
2005	363	77	**2001-2005**	720	71	75±5
2006	352	80	**2002-2006**	1016	71	71±4
2007	364	69	**2003-2007**	1318	69	68±4

Table A.4: Seattle, Washington Modeled PM_{10} 5-Year Design Values, 2008 - 2012

	ANNUAL	MAXIMUM	5-YEAR PERIOD	5-YEAR	5-YEAR DESIGN VALUE	5-YEAR DESIGN VALUE
YEAR	NO. DATA POINTS	MODELED VALUES, µg/m^3	**YEARS**	NO. DATA POINTS	TABLE LOOK-UP, µg/m^3	STATISTICAL FIT, µg/m^3
2008	122	51				
2009	121	50				
2010	4	21				
2011	358	45				
2012	363	48	**2008 - 2012**	725	45	48±5

Tacoma Design Values

The Tacoma, Washington design value is based on FRM and FEM 24-hour PM_{10} monitoring data from the 2301 Alexander Avenue site in Tacoma, Washington. The five most recent years of FRM data are from 1999 – 2003. From 2004 – 2007 FEM data was collected using a TEOM. The monitoring dataset from 2004 is less than 75% complete and was not used in the five year design value calculation. The most recent five year PM_{10} design value for Tacoma, WA included both FRM and FEM data and spanned the period 2002-2007, 2004 was excluded. The table look-up design value, 68µg/m^3 falls within the 95% confidence interval of the statistical fit method design value, *72*±9µg/m^3. The relevant values are shown in Table A.5 below.

Table A.5: Tacoma, Washington PM_{10} and 5-Year Design Values, 1999-2007

	ANNUAL	MAXIMUM	5-YEAR PERIOD	5-YEAR	5-YEAR DESIGN VALUE	5-YEAR DESIGN VALUE
YEAR	NO. OBSERVATIONS	MONITORED VALUES, µg/m^3	YEARS	NO. OBSERVATIONS	TABLE LOOK-UP, µg/m^3	STATISTICAL FIT, µg/m^3
1999	50	72				
2000	59	67				
2001	60	58				
2002	60	94				
2003	60	68	**1999-2003***	290	94	88±7
2004**			**2000-2004***	238	94	89±9
2005	87	50	**2001-2005***	180	94	85±10
2006	363	69	**2002-2006***	422	69	76±9
2007	332	65	**2003-2007***	753	65	66±3
			2001-2007*	873	***68***	***72*±9**

** This year is less than 75% complete and was not used to calculate the design value

*This Design Value is missing data from the years marked with "**"

Table A.6: Tacoma, Washington Modeled PM_{10} 5-Year Design Values, 2008 - 2012

	ANNUAL	MAXIMUM	5-YEAR PERIOD	5-YEAR	5-YEAR DESIGN VALUE	5-YEAR DESIGN VALUE
YEAR	NO. DATA POINTS	MODELED VALUES, µg/m^3	YEARS	NO. DATA POINTS	TABLE LOOK-UP, µg/m^3	STATISTICAL FIT, µg/m^3
2008	348	40				
2009	347	84				
2010	334	53				
2011	374	36				
2012	349	71	**2008 - 2012**	1725	54	58±8

Motor Vehicle Regional Analysis

To qualify for the PM_{10} LMP option, an area should expect only limited growth in on-road motor vehicle PM_{10} emissions. This means the area must pass the Motor Vehicle Regional Analysis, found in Appendix B of the LMP Guidance. The results of the analysis must be less than 98 µg/m³, the Margin of Safety (MOS) value for the 24-hour PM_{10} standard.

The following methodology was used to determine whether increased emissions from on-road mobile sources could, in the next 10 years, increase concentrations in the maintenance areas and threaten the assumption of maintenance that underlies the LMP Guidance.

$$DV + (VMT_{pi} \times DV_{mv}) < MOS$$

Where:

DV = the area's design value based on the most recent 5 years of data in µg/m³

VMT_{pi} = the projected percent increase in vehicle miles traveled (VMT) over the next 10 years

DV_{mv} = motor vehicle design value based on on-road mobile portion of the attainment year inventory in µg/m³

MOS = margin of safety for the relevant PM_{10} standard for a given area: 40 µg/m³ for the annual standard or 98 µg/m³ for the 24-hour standard

Step 1. Determine the 5-year design value (DV)

As described above, a number of methodologies were used to determine the most recent 5-year design values based on monitored data. For the purposes of the motor vehicle regional analysis, the most conservative values were used in order to represent the highest possible emissions increase due to on-road mobile sources. The values used for this analysis are summarized in Table A.7, and represent the upper range of the highest design value for each maintenance area.

Table A.7: Design Values used for Motor Regional Analysis

PM_{10} Maintenance Area	Kent	Seattle	Tacoma
Design Value (DV) in µg/m³	**60**	**72**	**81**

Step 2. Determine the percent increase in maintenance area average daily VMT over the next ten years (VMT_{pi}).

The VMT values for 2010 and 2020 for the three maintenance areas were provided by the Puget Sound Regional Council (PSRC)[5]. The percent increase in VMT was determined using the difference between 2020 and 2010 modeled VMT per day, as summarized in Table A.8.

Table A.8: Projected 10-year Increase in VMT

	Kent	Seattle	Tacoma
2010 VMT	589,892	2,285,165	1,591,430
2020 VMT	642.401	2,540,361	1,778,486
10-year increase	52,509	255,196	187,056
Percent increase (VMT_{pi})	**9%**	**11%**	**12%**

[5] Puget Sound Regional Council. *2009 Air Quality Conformity Determination.* Per concurrence of the region's Air Quality Consultation Partners (EPA, Ecology, PSCAA, FHWA, FTA and WSDOT), starting in 2010 the region was no longer required to demonstrate conformity for PM10 in the year 2010, since it was a past year; only forecast years were thereafter analyzed. The 2009 documentation is therefore the last analysis of 2010 PM10 values.

Step 3. Determine the motor vehicle design value based on on-road mobile portion of the attainment year inventory (DV_{mv}).

The third paragraph of Attachment B of the LMP Guidance offers: "Please note that DV_{mv} is derived by *multiplying DV by the percentage of the attainment year inventory represented by on-road mobile sources*. This variable should be based on both primary and secondary PM_{10} emissions of the on-road mobile portion of the attainment year inventory, including re-entrained road dust."

The percentage of total on-road mobile (ORM) source emissions from vehicle exhaust, brakewear and tirewear, were presented in Table 5.2 of the Emissions Inventory. Using the equation below, these percentages were used to determine the motor vehicle design value (DV_{mv}), as summarized in Table A.9.

$$DV_{mv} = DV \times \text{ORM percent of inventory}$$

Table A.9: Calculation of Motor Vehicle Design Value

	Kent	Seattle	Tacoma
DV (µg/m³)	60	72	81
On-road vehicle exhaust, brakeware, tirewear percent of total ton/winter day	10%	12%	11%
Paved Road Dust percent of total ton/winter day	18%	22%	19%
Total ORM percent of ton/winter day	28%	34%	30%
Motor vehicle design value (MV_{dv}) (µg/m³)	**16.8**	**24.5**	**24.3**

Step 4. Comparison of Regional Analysis to Margin of Safety (MOS)

Qualification for the LMP approach is demonstrated when the motor vehicle regional analysis results in a value less than the MOS of 98 µg/m³ for the 24-hour PM_{10} standard. The variables and results for the equation for each of the three maintenance areas are shown in Table A.10. The results of the calculation is less than the MOS of 98 µg/m³ and therefore demonstrates that the Kent, Seattle, and Tacoma PM_{10} maintenance areas pass the motor vehicle regional analysis and qualify for the LMP approach.

Table A.10: Margin of Safety Comparison

	Kent	Seattle	Tacoma
DV (µg/m³)	60	72	81
VMT_{pi}	9%	11%	12%
DV_{mv} (µg/m³)	16.8	24.5	24.3
DV + (VMT_{pi} x DV_{mv})	61.5	74.7	83.9
MOS (µg/m³)	98	98	98

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101-3140

OCT 21 2008

Reply to: OAWT-107

Mr. Mike Ragan
Air Monitoring Coordinator
Washington Department of Ecology
P.O. Box 47600
Olympia, Washington 98504-7600

Re: 2008 Washington Ambient Air Monitoring Network Assessment

Dear Mr. Ragan:

We have evaluated the 2008 Washington Ambient Air Monitoring Network Assessment and Ecology's proposed air monitoring network for 2008-09. The proposed changes to the monitoring network are consistent with the network design criteria identified in 40 CFR Part 58, Appendix D. Therefore, I approve the Washington ambient air monitoring network, which is described in the enclosure.

The following monitors are designated "core" monitors because they are either: 1) required by 40 CFR Part 58, Appendix D; 2) have a design value near or above the new PM2.5 24-hour standard of 35 ug/m3; 3) have a design value above or near the new ozone 8-hour standard of 0.075 ppm, or ; 4) they are NCore pre-cursor gas monitors:

1. PM2.5 FRMs (or Approved Regional Method):
   a) Beacon Hill
   b) Duwamish (primary and co-located)
   c) Crown Zellerbach (primary and co-located)
   d) Tacoma/L Street
   e) Darrington
   f) Marysville
   g) Yakama
   h) Vancouver

2. PM2.5 speciation monitors:
   a) Seattle, Beacon Hill
   b) Tacoma, L Street
   c) Spokane, Ferry Street
   d) Vancouver, 4th Plain Boulevard
   e) Yakima, South 4th Avenue

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3. Ozone monitor:
   a) Mud Mountain Dam

4. Pre-cursor gas monitors
   a) Beacon Hill NCore site
   b) Cheeka Peak NCore site

"Core" monitors are those monitors in the network that must be operated with available PM2.5 monitoring funds. The "non-core" PM2.5 monitors in the Washington's network can be operated at Ecology's discretion with any remaining Federal or State funds. If you have any questions about our approval of the Washington monitoring network, please contact Keith Rose at (206) 553-1949 or at rose.keith@epa.gov.

Sincerely,

Mahbubul Islam

Mahbubul Islam, Manager
State and Tribal Program Unit
Office of Air, Waste and Toxics

Enclosure

cc: Chris Hall, OEA

Appendix B

2008 Ambient Air Monitoring Network Report

Washington State Department of Ecology

2008

Ambient Air Monitoring Network Report

Washington State Department of Ecology
300 Desmond Drive/PO Box 47600
Olympia, Washington 98504-7600

Publication number: 08-02-012

If you need this publication in another format, please call Tami Dahlgren at (360) 407-6800. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

Executive Summary

Purpose of the report

The Department of Ecology (Ecology) reviews its ambient air quality monitoring network each year to ensure that it collects adequate, representative, and useful air quality data. This report summarizes the results of the 2008 review which include:

- Identifying modifications to Ecology's ambient air monitoring network since the 2007 annual network report
- Identifying proposed modifications to the network for the upcoming year
- Documenting Ecology's ambient air quality monitoring needs, goals, and priorities

Background information

The United States Environmental Protection Agency (EPA) ambient air quality surveillance regulations -- Code of Federal Regulations, Title 40, Part 58 (40 CFR Part 58) -- require states to establish air quality surveillance systems in their State Implementation Plans (SIPs). An air quality surveillance system consists of a network of State and Local Air Monitoring Stations (SLAMS). These stations measure ambient concentrations of those air pollutants for which 40 CFR Part 50 sets standards.

Monitoring network requirements

SLAMS must meet requirements of 40 CFR Part 58 contained in:

- Appendix A (Quality Assurance Requirements)
- Appendix C (Ambient Air Quality Monitoring Methodology)
- Appendix D (Network Design Criteria)
- Appendix E (Probe and Path Siting Criteria)

States determine if they conform with Appendices A and C in part through periodic systems and performance audits (per Section 2.4 of Appendix A). States conform with Appendices D and E by conducting an annual network review of their air quality surveillance systems (per 40 CFR 58.20(d)). The annual network review:

- Determines if an ambient air quality monitoring network is achieving its required air monitoring objectives
- Identifies changes to the network needed to enable an organization to meet its objectives

Using monitoring data

Ecology uses its air monitoring data to:

- Determine compliance with the national ambient air quality standards (NAAQS)
- Determine maximum pollutant concentrations
- Forecast air quality
- Evaluate the effectiveness of air pollution control programs,
- Evaluate the effects of air pollution on public health,
- Track the progress of SIPS
- Support dispersion models
- Determine air quality trends
- Develop responsible and cost-effective pollution control strategies

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1 Introduction

The Code of Federal Regulations, Title 40, Part 58 (40 CFR Part 58) contains the federal Environmental Protection Agency's (EPA's) ambient air quality surveillance regulations. Section 58.20 requires states to establish air quality surveillance systems in their State Implementation Plans (SIPs). The air quality surveillance system consists of a network of monitoring stations designated as SLAMS. These stations measure ambient concentrations of those air pollutants for which standards exist in 40 CFR Part 50 and Part 58, Appendices A (Quality Assurance Requirements), C (Ambient Air Quality Monitoring Methodology), D (Network Design Criteria) and E (Probe and Path Siting Criteria). States determine compliance with Appendices A and C in part through periodic systems and performance audits (per Section 2.4 of Appendix A). States comply with Appendices D and E by conducting an annual network review of their air quality surveillance systems (per 40 CFR 58.20(d)). The annual network review determines if the network achieved its required air monitoring objectives and if it should be modified (e.g., termination, relocation or establishment of monitoring stations) to meet those objectives. The main purpose of this review is to ensure that an ambient air quality monitoring network collects adequate, representative, and useful air quality data. The ambient air quality data from Ecology's network is used for a variety of purposes including:

- Determining compliance with the national ambient air quality standards (NAAQS)
- Determining the location of maximum pollutant concentrations
- Determining the effectiveness of air pollution control programs
- Evaluating the effects of air pollution on public health
- Tracking the progress of SIPS
- Supporting dispersion models
- Developing responsible, cost-effective, control strategies
- Developing air quality trends

2 Regulatory Requirements and Other Data Needs

2.1 Appendix D Requirements

Appendix D of 40 CFR 58 describes concepts for designing the SLAMS network. It addresses monitoring objectives and the criteria for selecting the location and number of air monitoring stations. The concepts and guidance in Appendix D, as well as other non-regulatory EPA data needs, should be considered when evaluating the adequacy of the SLAMS network.

2.1.1 Monitoring Objectives and Spatial Scales

Appendix D calls for the design of SLAMS networks to meet a minimum of six basic objectives:

(1) Determine the highest pollutant concentrations expected in the area covered by the network
(2) Determine representative pollutant concentrations in areas of high population density
(3) Determine the impact of significant sources or source categories on pollutant concentrations in the ambient air
(4) Determine general background pollutant concentrations
(5) Determine the regional extent of pollutant transport between populated areas
(6) Determine the impacts (e.g., visibility impairment, vegetation effects) in more rural and remote areas on the secondary (i.e., welfare) standards

SLAMS networks should be designed to provide data for meeting the monitoring objectives described above and to assist EPA and states in solving environmental problems.

Appendix D also provides guidance on spatial scales of representativeness for stations in a SLAMS network (Table 1). Ideally, the monitor is located so that its sample represents the air quality over the entire area that the monitoring station is intended to represent (Table 2).

Table 1: Relationship Between Monitoring Objectives and Scale of Representativeness

Monitoring Objectives	Appropriate Siting Scales
Highest concentration	Micro, middle, neighborhood, urban
Population	Neighborhood, urban
Source impact	Micro, middle, neighborhood
General/Background	Neighborhood, urban, regional
Regional transport	Urban/regional
Welfare-related impacts	Urban/regional

Table 2: Summary of Spatial Scales for SLAMS

	Scales Applicable for SLAMS						
	SO_2	CO	O_3	NO_2	Pb	PM_{10}	$PM_{2.5}$
Micro.....	✓	✓			✓	✓	✓
Middle.....	✓	✓	✓	✓	✓	✓	✓
Neighborhood	✓	✓	✓	✓	✓	✓	✓
Urban.....	✓		✓	✓	✓	✓	✓
Regional.....	✓		✓		✓	✓	✓

2.1.2 Number of SLAMS Sites

Appendix D to 40 CFR Part 58 does not contain criteria for determining the total number of stations in the SLAMS network, except for requiring a minimum number of SLAMS lead, SO_2, and $PM_{2.5}$ sites. For lead, EPA requires state and local agencies to focus their network design efforts on establishing monitoring stations around lead stationary sources which generate or have the potential to generate exceedances of the quarterly lead NAAQS. Sources around which lead monitoring networks should be established are those emitting five or more tons per year or smaller stationary sources which may be problematic based on the size of the facility and their proximity to populated neighborhoods.
EPA recommends a minimum of two lead sites per source, one to measure stack impacts and the second to measure fugitive emissions. Other factors such as topography, source type, proximity and locations of nearby populations may affect the number of stations in the network.

SLAMS SO_2 monitoring requirements for counties not within the boundaries of any Consolidated Metropolitan Statistical Area/Metropolitan Statistical Area (CMSA/MSA) are based on the emissions of SO_2 in the airshed. A minimum number of SO_2 SLAMS sites are required for targeted sources of SO_2 emissions. Other than these requirements, the optimum size of a particular SLAMS network involves tradeoffs between data needs and available resources which can best be resolved during the network design process.

2.2 Appendix E Requirements

Appendix E contains siting criteria to be applied to ambient air quality analyzers or samplers after the general site location has been selected based on the monitoring objectives and spatial scales of representativeness presented in Appendix D and summarized in Section 2.1 of this document. The siting criteria presented in Appendix E are summarized in Table 3.

EPA believes that most sampling probes or monitors can be located so that they meet the Appendix E siting requirements. Some existing stations, however, may not meet these requirements and yet still produce useful data for some purposes. EPA will consider written requests from the State to waive one or more siting criteria for some monitoring stations provided that the State can demonstrate the following: (1) The site is as representative of the monitoring area as it would be if siting criteria were met; and (2) the siting criteria cannot be met because of physical constraints (e.g., inability to locate the station the necessary setback distance from roadways or obstructions). Waivers may be granted to existing SLAMS if one of these criteria is met; waivers may be granted for new SLAMS only if both criteria are met. Written requests for waivers must be submitted to the EPA Regional Administrator.

2.3 Other Ambient Air Monitoring Data Needs

Washington has a number of special purpose monitors (SPMs) deployed throughout the State for PM_{10}, $PM_{2.5}$, CO and NO_2, monitoring. They are used for a variety of purposes, including Washington's Air Quality Index program, ambient air quality assessment and special studies such as secondary aerosol and ozone precursor assessments SPM monitoring sites often utilize Federal Reference Method (FRM) sampling equipment, and are operated in accordance with CFR requirements for quality assurance and quality control. SPM designation for criteria pollutant monitoring sites allows Ecology to assess ambient particulate levels within regions of the State, while providing the flexibility to relocate the sites if it is determined there is no concern for NAAQS violations in the area (typically after three years of data collection). SPM sites may be added to Ecology's SLAMS network when a NAAQS exceedance has been recorded, or if elevated pollutant concentrations are consistently measured at the site.

Table 3: Summary of Probe and Monitoring Path Siting Criteria

Pollutant	Scale [maximum monitoring path length, meters]	Height from ground to probe or 80% of monitoring path (meters)	Horizontal and vertical distance from supporting structures to probe or 90% of monitoring path (meters)	Distance from trees to probe or 90% of monitoring path (meters)
SO_2	Middle [300m] Neighborhood, Urban, and Regional [1km]	3-15	>1	>10
CO	Micro, Middle [300m] Neighborhood [1km]	3±0.5; 3-15	>1	>10
O_3	Middle [300m] Neighborhood, Urban, and Regional [1km]	3-15	>1	>10
Ozone precursors	Neighborhood and urban [1km]	3-15	>1	>10

Pollutant	Scale [maximum monitoring path length, meters]	Height from ground to probe or 80% of monitoring path (meters)	Horizontal and vertical distance from supporting structures to probe or 90% of monitoring path (meters)	Distance from trees to probe or 90% of monitoring path (meters)
NO_2	Middle [300m] Neighborhood and Urban [1km]	3-15	>1	>10
PM_{10}	Micro; Middle, Neighborhood, Urban and Regional	2-7 (Micro); 2-15 (All other scales)	>2 (All scales, horizontal distance only)	>10 (All scales)

3 Network Review Procedure

3.1 Network Review Team and Preparation

Network report participants include Washington Department of Ecology Air Monitoring staff and where applicable, representatives from Washington's seven local air agencies. Sufficient information must be provided to determine compliance of the network with regulatory network design and siting requirements specified in 40 CFR Part 58, Appendices D and E as well as to determine compliance of the network design and siting requirements specified for all special ambient air monitoring networks.

3.2 Network Modifications

Modifications to the SLAMS network are addressed in 40 CFR 58.25, 58.36, and 58.46, respectively. Under Section 58.25, States are required to annually develop and implement schedules to modify the SLAMS network to eliminate any unnecessary stations or to correct any inadequacies indicated by the annual network review required by 58.20(d). As part of the annual network review, evaluations of the special networks established as partnership agreements between EPA and Ecology should also be conducted. Modifications to these networks should be recommended as a result of this annual report.

An important objective of the network modification process is determining whether or not sufficient ambient air quality information and data are being provided by the regulatory and other special monitoring networks to satisfy the principal data needs. If sufficient air quality data are not being collected, the deficient area must be identified and corrective action taken to resolve the problem. Conversely, if it is determined that excessive data are being collected (e.g., there are redundant sites resulting in data that agree closely), then efforts need to be taken to determine where dis-investment should be made and on what schedule.

Network modifications may be initiated by EPA or proposed by Ecology and agreed to by EPA. Network modifications may result from revisions to the Part 58 regulations, systems audits, site visits, or performance evaluations; special studies/saturation sampling, population increases/decreases; air quality concentrations consistently recorded below the NAAQS; loss of permission to use a site; demolition of a building which is used for monitoring; building construction; growth of trees; changes in roadways; change in neighborhood type of use, etc.

3.3 Determining Compliance with Appendix D and Special Monitoring Requirements

Ecology uses this review to determine whether it is meeting the number of monitors required by the Part 58 Appendix D design criteria requirements, and whether the monitors properly located based on the monitoring objectives and spatial scales of representativeness presented in Appendix D. For special monitoring networks, compliance determinations will be conducted in accordance with applicable program documents.

3.3.1 Number and Location of Monitors

For SLAMS, the number of monitors required and their locations are not specified in the regulations but rather are determined by EPA Region 10 and Ecology on a case-by-case basis. EPA and Ecology ensure that SLAMS meet the monitoring objectives specified in Appendix D. Adequacy of the network is be determined by using a variety of tools, including the following:

- Analyses of historical monitoring data
- Maps of emissions densities
- Dispersion modeling
- Special studies/saturation sampling
- Best professional judgment
- SIP requirements
- Revised monitoring strategies (e.g., new regulations, reengineering air monitoring network)
- Monitoring network maps and network descriptions with site objectives defined

Appropriate location of monitors can be determined on the basis of stated objectives. Maps, graphical overlays, and GIS-based information are extremely helpful in visualizing or assessing the adequacy of monitor locations. Plots of potential emissions and/or historical monitoring data versus monitor locations are especially useful. When questions arise about the adequacy of a particular location, modeling or special studies (including saturation monitoring studies) may be appropriate.

Monitor locations are based on the objectives specified in Appendix D, Section 3. Most often, these locations are those that have high concentrations and large population exposure. Population information may be obtained from the latest census data and ambient monitoring data from AQS. If the zip codes for various monitoring locations are obtained, use of electronic media census information and GIS-based information can be more easily combined with ambient monitoring data.

For special monitoring serving AQI, etc., program documents applicable to the network must be reviewed to determine the goals and specific siting criteria for the network. Compliance with monitoring objective determinations of the special network should be conducted using procedures similar to those used for Appendix D evaluations (i.e., are the number of monitors appropriate and are the monitors properly located).

3.4 Determining Compliance with Appendix E Requirements

Applicable siting criteria for SLAMS are specified in 40 CFR 58, Appendix E. The on-site visit itself consists of the physical measurements and observations needed to determine compliance with the Appendix E requirements, such as height above the ground level, distance from trees, paved or vegetative ground cover, etc.

4 Network Evaluation and Recommendations/Modifications

4.1 Carbon Monoxide (CO, 42101)

National Ambient Air Quality Standard (NAAQS):

- 1-hour average concentration not to exceed 35 ppm, on more than one occasion in a calendar year, measured at any monitoring site.
- 8-hour average concentration not to exceed 9 ppm for any 8-hour period, on more than one occasion in a calendar year, measured at any monitoring site.

Washington's carbon monoxide monitoring network is comprised of two sites statewide.

Table 4: Carbon Monoxide, 42101

AQS #	Site Name	Est.	Type	Scale	Sampling Freq.	Action for 2008
530330019	Bellevue, 148th	12/1/98	SLAMS	Micro	Continuous	Continue
530630049	Spokane, 3rd & Washington	1/1/97	SLAMS	Micro	Continuous	Continue

Additional Monitors: None

Recommendations/Modifications: Continue the Bellevue 148th and Spokane 3rd & Washington sites.

Bellevue, 148th - SLAMS
AQS # 530330019 Method code: 054
Address: 2421 148th NE, Bellevue LAT/LONG: 047 37' 54" / 122 08' 34"
Monitoring objective: Highest Concentration MSA: Seattle-Bellevue-Everett, WA

Comments
Bellevue 148th is micro scale SLAMS site established in 1998. It is located in a commercial area near a highly-traveled commuter roadway (SR520).
Exceedences
This site has not exceeded the standard in the past 3 years.

Spokane, 3rd & Washington - SLAMS
AQS # 530630049 Method code: 054
Address: W. 408 3rd Avenue, Spokane LAT/LONG: 047 39' 13" / 117 25' 07"
Monitoring objective: Highest Concentration MSA: Spokane, WA
Comments
3rd & Washington is a micro scale SLAMS site established in 1997. It is located in the downtown core of Spokane in a highly-traveled commercial area. The site is currently used for maintenance plan purposes. Spokane is a former CO nonattainment area.
Exceedences
This site has not exceeded the daily or annual standard for CO in the past 3 years.

4.2 Ozone (O_3, 44201)

National Ambient Air Quality Standards (NAAQS):

- 8-hour average of the 4th highest measured O_3 concentration averaged over three consecutive years, not to exceed 0.075 ppm at any given monitoring site.

Washington's ozone monitoring network is comprised of ten sites statewide.

Table 5: Ozone, 44201

AQS #	Site Name	Est.	Type	Scale	Sampling Freq.	Action For 2008
530330080	Seattle, Beacon Hill	4/1/97	SLAMS	Urban	Continuous	Continue
530330010	Issaquah, Lake Sammamish	12/1/75	SLAMS	Urban	Continuous	Continue
530330023	Enumclaw, Mud Mountain	7/8/98	SLAMS	Urban	Continuous	Continue
530330017	North Bend, North Bend Way	6/1/98	SLAMS	Urban	Continuous	Continue
530531008	LaGrande, Pack Forest	5/30/85	SLAMS	Urban	Continuous	Continue
530530012	Mt. Rainier, Jackson Visitor Center	7/13/98	SLAMS	NPS supported site	Continuous	Continue
530110011	Vancouver, Blairmount	4/1/90	SLAMS	Neighborhood	Continuous	Continue
530670005	Yelm, Northern Pacific	5/1/06	SLAMS	Urban	Continuous	Continue
530630001	Cheney, Turnbull	4/1/99	SLAMS	Urban	Continuous	Continue
530630046	Spokane, Greenbluff	4/1/90	SLAMS	Urban	Continuous	Continue

Additional Monitors: None

Recommendations/Proposed Modifications: Continue the above listed ozone sites.

Ozone

Seattle, Beacon Hill - NCore
AQS # 530330080 Method code: 056
Address: 4103 Beacon Avenue S., Seattle LAT/LONG: 047 34' 58" / 122 18' 30"
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA
Comments
Beacon Hill is an urban scale NCORE site located south of downtown Seattle, within a City of Seattle park/reservoir. In addition to ozone, the site is used for monitoring Trace level CO, SO2, NO2, $PM_{2.5}$, air toxics, speciation and other special studies. The Beacon Hill site is also a long-term trend site and research site.
Exceedences
This site has not exceeded the 8-hour standard.

Issaquah, Lake Sammamish - SLAMS
AQS # 530330010 Method code: 056
Address: 20050 SE 56th (Lk. Sammamish SP), Issaquah LAT/LONG: 047 33' 07" / 122 02' 40"
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA
Comments
Lake Sammamish is an urban scale site established in 1975 located east of Seattle, within Lake Sammamish State Park. The Lake Sammamish site is a long-term trends site.
Exceedences
This site has not exceeded the 8-hour standard in the past 3 years.

Enumclaw, Mud Mountain Dam - SLAMS
AQS # 530330023 Method code: 056
Address: 30525 SE Mud Mountain Road, Enumclaw LAT/LONG: 047 08' 28" / 121 56' 09"
Monitoring objective: Regional Transport MSA: Seattle-Bellevue-Everett, WA
Comments

Mud Mountain Dam is an urban scale State and Local Monitoring Site (SLAMS) established in 1998 and located 30 miles East of Seattle, outside of Enumclaw at the end of the ozone transport zone near the Cascade Mountains. Enumclaw Mud Mountain historically has been the highest reading site in the ozone network.

Exceedences

This site has exceeded the 8-hour standard in the past 3 years.

North Bend, North Bend Way - SLAMS

AQS # 530330017 Method code: 056
Address: 42404 SE North Bend Way, North Bend LAT/LONG: 047 29' 23" / 121 46' 24"
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA

Comments

North Bend Way is an urban scale site established in 1998 and located outside of North Bend, 25 miles East of Seattle. North Bend typically indicates some of the highest readings in the ozone network.

Exceedences

This site has not exceeded the 8-hour ozone standard in the past 3 years.

LaGrande, Pack Forest - SLAMS

AQS # 530531008 Method code: 056
Address: .6 mi North of LaGrande on SR 7, Pierce Co. LAT/LONG: 046 50' 33" / 122 18' 55"
Monitoring objective: Highest Concentration MSA: Tacoma, WA

Adequacy

LaGrande is a regional scale site established in 1985 and located in the UW Pack Forest. LaGrande has been a high concentration, transport and long term trend site.

Exceedences

This site has not exceeded the 8-hour ozone standard in the past 3 years.

Mt. Rainier, Jackson Visitor Center - SLAMS

AQS # 530530012 Method code: 056
Address: Jackson Visitor Center, Mount Rainier LAT/LONG: 046 47' 07" / 121 43' 58"
Monitoring objective: Background MSA: Tacoma, WA

Comments

The Jackson Visitor Center site is a regional scale site established in 1998. The site is part of an outreach project at the Jackson Visitors Center at Mt. Rainier National Park.

Exceedences

This site has not exceeded the 8-hour ozone standard in the past 3 years.

Vancouver, Blairmount - SLAMS

AQS # 530110011 Method code: 056
Address: 1500 SE Blairmount Drive, Vancouver LAT/LONG: 045 36' 37" / 122 30' 59"
Monitoring objective: Population Exposure MSA: Portland-Vancouver, OR-WA

Comments

Blairmount is an urban scale site established in 1990 and located in a residential area, near downtown Vancouver. The site represents the Portland/Vancouver airshed. It is part of the ozone maintenance planning effort of the Southwest Clean Air Agency (SWCAA).

Exceedences

This site has not exceeded the 8-hour ozone standard in the past 3 years.

Yelm, Northern Pacific - SLAMS

AQS # 530670005 Method code: 056
Address: NEW - 931 Northern Pacific Road, Yelm LAT/LONG: 046 57' 03" / 122 35' 43"
Monitoring objective: Population Exposure MSA: Olympia, WA

Comments
The Yelm site is urban scale site established in 2006 and located in a commercial/residential area in Yelm. The Yelm site represents ozone transport impacts in the Southern Puget Sound area.
Exceedences
This site has not exceeded the 8-hour ozone standard in the past 3 years.

Cheney, Turnbull - SLAMS
AQS # 530630001 Method code: 056
Address: S. 26010 Smith Road, Cheney LAT/LONG: 047 24' 55" / 117 31' 49"
Monitoring objective: Unknown MSA: Spokane, WA
Comments
Turnbull is a background/transport scale site established in 1999 and is located within the Turnbull Wildlife Refuge at Cheney, south of Spokane. It has been a high-concentration and background/transport site for the Spokane area. A CFR required site by population.
Exceedences
This site has not exceeded the 8-hour ozone standard in the past 3 years.

Spokane, Greenbluff - SLAMS
AQS # 530630046 Method code: 056
Address: E. 9814 Greenbluff Road, Spokane LAT/LONG: 047 49' 37" / 117 16' 31"
Monitoring objective: Unknown MSA: Spokane, WA
Comments
Greenbluff is an urban scale site established in 1990 and located in near Spokane. The site is used in conjunction with the Cheney site to identify ozone patterns for the Spokane area. It is a CFR-required site due to population size.
Exceedences
This site has not exceeded the 8-hour ozone standard in the past 3 years.

4.3 Nitrogen Dioxide (NO_2, 42602)

National Ambient Air Quality Standards (NAAQS):

- Annual arithmetic average concentration not to exceed 0.053 ppm at any monitoring site.

Washington no longer monitors nitrogen dioxide.

Table 6: Nitrogen Dioxide, 42602

AQS#	Site name	Est.	Type	Scale	Sampling Freq.	Action for 2008
N/A	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**None**

Additional Monitors: None

Recommendations/Proposed Modifications:

Nitrogen Dioxide (NO2)

4.4 Sulfur Dioxide (SO_2, 42401)

National Ambient Air Quality Standards (NAAQS)

- Annual arithmetic average concentration not to exceed 0.03 ppm at any monitoring site.
- 24-hour average concentration not to exceed 0.14 ppm at any monitoring site.
- 3-hour average concentration not to exceed 0.5 ppm at any monitoring site (secondary standard).

Washington no longer monitors sulfur dioxide.

Table 7: Sulfur Dioxide, 42401

AQS#	Site Name	Est.	Type	Scale	Sampling freq.	Action for 2008
N/A	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**None**

Additional Monitors: None

Recommendations/Proposed Modifications:

Sulfur Dioxide (SO2)

4.5 Particulate Matter 10 (PM_{10}, 81102)

National Ambient Air Quality Standard (NAAQS), 1987:

- Twenty-four hour average PM_{10} concentration not to exceed 150 $\mu g/m^3$ on more than one occasion per year when averaged over three years.
- Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the EPA revoked the annual PM_{10} standard in 2006 (effective December 17, 2006).

Washington's PM_{10} monitoring network consists of 5 sites statewide, including one collocated site.

Table 8: Particulate Matter 10 (PM_{10}, 81102)

AQS#	Site Name	Est.	Type	Scale	Sampling Type	Action for 2008
530332004	Kent, James & Central	5/87	SLAMS	Neighborhood	Continuous only	**Discontinued**
530330057	Seattle, E Marginal Way	8/71	SLAMS	Neighborhood	Continuous only	**Discontinued**
530530031	Tacoma, Alexander Ave	2/87	SLAMS	Neighborhood	Continuous only	**Discontinued**
530050002	Kennewick, Metaline Ave	10/94	SLAMS	Neighborhood	Continuous only	Continue
530770009	Yakima, S 4th	4/00	SLAMS	Neighborhood	1/6	Continue
530650004	Colville, S Oak	11/96	SPMS	Neighborhood	Continuous only	Continue
530710006	Burbank, Maple St	1/03	SPMS	Middle	Continuous only	Continue
530630016	Spokane, Ferry St	4/72	SLAMS	Middle	Continuous & 1/6	Continue both
530630016	Spokane, Ferry St	4/72	Collocated	Middle	Continuous & 1/12	Continue both

Additional Monitors: None

Recommendations/Proposed Modifications: Kent, James & Central; Seattle, Marginal Way; and Tacoma, Alexander Ave PM_{10} continuous devices were discontinued as of 12/31/2007. Continue all other PM_{10} sites as described.

Kennewick, Metaline Ave - SLAMS

AQS # 530050002 | Method code: 079
Address: 5929 West Metaline, Kennewick | LAT/LONG: 046 13' 06" / 119 12' 03"
Monitoring objective: Population Exposure | MSA: Richland-Kennewick-Pasco, WA

Comments

Metaline is a neighborhood scale site for PM_{10} established in 1994 and located in the downtown Kennewick area. It is representative of Kennewick which is subject to windblown dust.

Exceedences

This site has not exceeded the standard for PM_{10} in the past 3 years.

Yakima, S 4th - SLAMS

AQS # 530770009 | Method code: 079/063
Address: 402 South 4th Avenue, Yakima | LAT/LONG: 046 35' 42" / 120 30' 44"
Monitoring objective: Population Exposure | MSA: Yakima, WA

Comments

S 4th is a neighborhood scale site for PM_{10} established in 2000 and located in a commercial/residential area near downtown Yakima. The site is representative of the Yakima area which is a past PM_{10} nonattainment area.

Exceedences

This site has not exceeded the daily or annual standard for PM_{10} in the past 3 years.

Colville, S Oak - SLAMS

AQS # 530650004 | Method code: 079
Address: 215 South Oak, Colville | LAT/LONG: 048 32' 41" / 122 54' 13"
Monitoring objective: Population Exposure | MSA: Not in an urban area

Comments

S Oak is a neighborhood scale site for PM_{10} established in 1996 and located the commercial/residential area of Colville.

Exceedences

This site has not exceeded the standard for PM_{10} in the past 3 years.

Burbank, Maple St - SLAMS

AQS#530710006 | Method code: 079/063
Address: 755 Maple Street, Burbank | LAT/LONG: 046 12' 00" / 119 00' 30"
Monitoring objective: Population Exposure | MSA: Not in an urban area

Comments

Maple St is a middle-scale site for PM_{10} established in 2002 and located a residential area of Burbank. The site is within the previous Wallula PM_{10} nonattainment area and subject to windblown dust.

Exceedences

The Burbank/Wallula site has not exceeded the standard for PM_{10} in the past 3 years.

Spokane, Ferry St - SLAMS

AQS # 530630016 | Method code: 079/063
Address: E. 3530 Ferry Street, Spokane | LAT/LONG: 047 39' 39" / 117 21' 26"
Monitoring objective: Population Exposure | MSA: Spokane, WA

Comments

Ferry St is middle scale site for PM_{10} established in 1972 and located in a commercial area of Spokane. The site is representative of the Spokane area which is a past PM_{10} nonattainment area.

Exceedences

This site has not exceeded the standard for PM_{10} in the past 3 years.

Discontinued PM_{10} Sites

Kent, James & Central - SLAMS

AQS # 530332004 — Method code: 079
Address: 614 Railroad Avenue N., Kent — LAT/LONG: 047 23' 10" / 122 13' 55"
Monitoring objective: Population Exposure — MSA: Seattle-Bellevue-Everett, WA

Seattle, E Marginal Way - SLAMS

AQS # 530330057 — Method code: 079
Address: 4752 East Marginal Way South, Seattle — LAT/LONG: 047 33' 31" / 122 20' 19"
Monitoring objective: Highest Concentration — MSA: Seattle-Bellevue-Everett, WA

Tacoma, Alexander Ave - SLAMS

AQS #530530031 — Method code: 079
Address: 2301 Alexander Avenue, Tacoma — LAT/LONG: 047 15' 56" / 122 23' 09"
Sampling: Continuous correlated
Monitoring objective: Population Exposure — MSA: Seattle-Bellevue-Everett, WA

4.6 Particulate Matter 2.5 ($PM_{2.5}$, 88101, 88502)

National Ambient Air Quality Standard (NAAQS):

- Twenty-four hour average $PM_{2.5}$ concentrations not to exceed 35 µg/m^3 for a three-year average of annual 98th percentiles at any population-oriented monitoring site in a monitoring area.
- Three-year annual average $PM_{2.5}$ concentration not to exceed 15 µg/m^3 from a single community-oriented monitoring site or the spatial average of eligible community-oriented sites in a monitoring area.

Washington's $PM_{2.5}$ monitoring network consists of thirty-seven sites statewide, including two collocated sites.

Table 9: Particulate Matter ($PM_{2.5}$, 88101, 88502)

AQS#	Site Name	Type	Sample Type	Sampling Freq.	Action for 2008
530272002	Aberdeen Division St	SLAMS	Continuous	Continuous	Continue
530330037	Bellevue, Bellevue Way	SLAMS	Continuous	Continuous	Continue
530730015	Bellingham, Yew Street	SLAMS	Continuous	Continuous	Continue
530610020	Darrington, Fir St	SLAMS	SEQ/Continuous	1/3	Continue
530330023	Enumclaw, Mud Mountain Dam	SLAMS	Continuous	Continuous	Continue
530050002	Kennewick, Metaline Ave	SLAMS	Continuous	Continuous	Continue
530332004	Kent, James & Central	SLAMS	Continuous	Continuous	Continue
530750005	LaCrosse, Hill St	SLAMS	Continuous	Continuous	Continue
530330024	Lake Forest Park, Ballinger Way	SLAMS	Continuous	Continuous	Continue
530150015	Longview, 30th Ave	SLAMS	Continuous	Continuous	Continue

AQS#	Site Name	Type	Sample Type	Sampling Freq.	Action for 2008
530610005	Lynnwood, 212th	SLAMS	Continuous	Continuous	Continue
530611007	Marysville, 7th Ave	SLAMS	SEQ/Continuous	1/1	Continue
530090009	Shelton, Mt View Dr	SLAMS	Continuous	Continuous	Continue
530351005	Meadowdale, Blackbird Dr	SLAMS	Continuous	Continuous	Continue
530210002	Mesa, Pepoit Way	SLAMS	Continuous	Continuous	Continue
530251002	Moses Lake, Balsam St	SLAMS	Continuous	Continuous	Continue
530570014	Mt. Vernon, S Second St	SLAMS	Continuous	Continuous	Continue
530330017	North Bend, North Bend Way	SLAMS	Continuous	Continuous	Continue
530670013	Lacey, College St	SLAMS	Continuous	Continuous	Continue
530090009	Port Angeles, W 14th St	SLAMS	Continuous	Continuous	Continue
530310003	Port Townsend, San Juan Ave	SLAMS	Continuous	Continuous	Continue
530750003	Pullman, Dexter Ave	SLAMS	Continuous	Continuous	Continue
530531018	Puyallup, 128th St	SLAMS	Continuous	Continuous	Continue
530530028	Woodinville, 133rd Ave	SLAMS	Continuous	Continuous	Continue
530010003	Ritzville, Alder St	SLAMS	Continuous	Continuous	Continue
530750006	Rosalia, Josephine St	SLAMS	Continuous	Continuous	Continue
530330080	Seattle, Beacon Hill	NAMS	SEQ/Continuous	1/3	Continue
530330057	Seattle, E Marginal Way	SLAMS	SEQ/Continuous	1/3	Continue
530330057	Seattle, E Marginal Way	Collocated	SEQ	1/12	Continue
530330048	Seattle, Olive St	SLAMS	Continuous	Continuous	Continue
530630016	Spokane, Ferry St	SLAMS	SEQ/Continuous	1/3	Continue
530630016	Spokane, Ferry St	Collocated	SEQ	1/12	Continue
530630047	Spokane, Monroe Street	SLAMS	Continuous	Continuous	Continue
530190001	Starbuck, 6th Ave	SLAMS	Continuous	Continuous	Continue
530530031	Tacoma, Alexander Ave	SLAMS	Continuous	Continuous	Continue
530530029	Tacoma, S L Street	SLAMS	SEQ/Continuous	1/3	Continue
530110013	Vancouver, 4th Plain	SLAMS	Continuous	1/1	Continue
530710005	Walla Walla, 12th St	SLAMS	Continuous	Continuous	Continue
530770009	Yakima, S 4th Ave	SLAMS	Continuous	1/3	Continue

Additional Monitors: None
Recommendations/Modifications: Seattle Beacon Hill FRM sampling frequency was reduced to 1/3. Marysville FRM sampling frequency was increased to 1/1. Continue all other sites as described.

$PM_{2.5}$

Aberdeen, Division St - SLAMS
AQS #530272002 Method code: 771
Address: 359 North Division, Aberdeen LAT/LONG: 046 58' 21" / 123 49' 54"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Not in an urban area
Comments
The Aberdeen site is neighborhood scale and meets criteria for a SLAMS site. The site represents impacts to the Aberdeen and Grays Harbor area from wood burning and mobile sources.

Bellevue, Bellevue Way - SLAMS
AQS #530330037 Method code: 771
Address: 305 Bellevue Way, Bellevue LAT/LONG: 047 36' 47" / 122 12' 06"
Sampling: Continuous correlated

Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA

Comments

The Bellevue Way site is neighborhood scale and is representative of mobile source and smoke impacts in the area.

Bellingham, Yew Street - SLAMS

AQS #530730015 Method code: 771

Address: 2420 Yew Street, Bellingham LAT/LONG: 048 45' 46" / 122 26' 25"

Sampling: Continuous correlated

Monitoring objective: Population Exposure MSA: Bellingham, WA

Comments

Bellingham, Yew Street site is neighborhood scale and is impacted by wood burning and mobile sources in the Bellingham/Whatcom County area.

Darrington, Fir St - SLAMS

AQS #530610020 Method code: 118/771

Address: 1085 Fir St, Darrington LAT/LONG: 048 14' 49" / 121 36' 11"

Sampling: Continuous correlated, in progress

Monitoring objective: Population Exposure MSA: Not in an urban area

Comments

Darrington is neighborhood scale residential site. The primary monitoring objective is to characterize air quality conditions impacting the town of Darrington and the nearby residents. Special Purpose Monitoring (SPM) conducted since 2004 has documented numerous exceedances of the 24 hour NAAQS. This site has an FRM and is suitable for comparison to the $PM_{2.5}$ NAAQS.

Enumclaw, Mud Mountain Dam - SLAMS

AQS #530330023 Method code: 771

Address: 30525 SE Mud Mountain Rd, Enumclaw LAT/LONG: 047 08' 28" / 121 56' 09"

Sampling: Continuous correlated

Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA

Comments

Enumclaw, Mud Mountain Dam is a neighborhood scale site which meets SLAMS criteria. It is a transport/background site for the Puget Sound.

Kennewick, Metaline Ave - SLAMS

AQS #530050002 Method code: 771

Address: 5929 W Metaline, Kennewick LAT/LONG: 046 13' 06" / 119 12' 03"

Sampling: Continuous correlated

Monitoring objective: Population Exposure MSA: Richland, Kennewick, Pasco, WA

Comments

Kennewick is neighborhood scale and meets SLAMS criteria. The site is impacted from mobile sources and is geographically representative of the Tri-Cities area.

Kent, James & Central - SLAMS

AQS #530332004 Method code: 712/713

ADDRESS: 614 N Railroad, Kent LAT/LONG: 047 23' 10" / 122 13' 55"

Sampling: Continuous correlated

Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA

Comments

Kent is neighborhood scale site in the South Puget Sound that is impacted from mobile sources, light industry, wood smoke. The site is representative of the Kent Valley area.

LaCrosse, Hill St - SLAMS
AQS #530750005 Method code: 771
Address: 100 Hill Street, LaCrosse LAT/LONG: 046 48' 55" / 117 52' 26"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Not in an urban area
Comments
LaCrosse is neighborhood scale small-community monitor in Eastern Washington. The site is impacted by smoke and burning in the LaCrosse community. The site provides valuable modeling and mapping information.

Lake Forest Park, Ballinger Way - SLAMS
AQS #530330024 Method code: 702/704
Address: 17171 Bothell Way NE, Lake Forest Park LAT/LONG: 047 45' 18" / 122 16' 50"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA
Comments
Lake Forest Park is neighborhood scale site is impacted by wood smoke.

Longview, 30th Ave - SLAMS
AQS #530150015 Method code: 771
Address: 1324 30th Ave, Longview LAT/LONG: 046 08' 22" / 122 57' 43"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Longview, WA
Comments
Longview is a neighborhood scale site which is impacted by mobile sources and wood smoke. It is representative of the Longview/Kelso area.

Lynnwood, 212th - SLAMS
AQS #530610005 Method code: 771
Address: 6120 212th SW, Lynnwood LAT/LONG: 047 48' 23" / 122 19' 00"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA
Comments
Lynnwood is neighborhood scale site. The Lynnwood site is impacted by wood smoke.

Marysville, 7th Ave - SLAMS
AQS #530611007 Method code: 118/712/713
Address: 1605 7th ST, Marysville LAT/LONG: 048 03' 18" / 122 10' 33"
Sampling: 1/3 & continuous correlated
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA
Comments
Marysville is a neighborhood scale site impacted by wood smoke, mobile sources, and light industry. It is representative of the Marysville/North Snohomish County area. The site has an FRM and is suitable for comparison to the $PM_{2.5}$ NAAQS.

Shelton, Mt View Dr - SLAMS
AQS #530450004 Method code: 771
Address: 901 Mt View Dr, Shelton LAT/LONG: 047 13' 33" / 123 06' 53"
Sampling: Continuous correlated
Monitoring objective: Population Exposure UA: Not in an urban area
Comments
Shelton is a neighborhood scales site established in 2001. Shelton is impacted by wood smoke.

Meadowdale, Blackbird Dr - SLAMS
AQS # 530351005 Method code: 771
Address: 7252 Blackbird Dr NE, Bremerton LAT/LONG: 047 37' 51" / 122 38' 28"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Bremerton, WA
Comments
Meadowdale, Blackbird Dr is a middle-neighborhood scale residential site. It provides air quality information to a population of 280,000 residents.

Mesa, Pepoit Way - SLAMS
AQS #530210002 Method code: 771
Address: 200 Pepiot Way, Mesa LAT/LONG: 046 34' 32" / 119 00' 25"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Richland, Kennewick, Pasco, WA
Comments
Mesa is a neighborhood scale small-community site in Eastern Washington. Mesa is impacted by smoke from burning in the area.

Moses Lake, Balsam St - SLAMS
AQS #530251002 Method code: 771
Address: 412 S Balsam St, Moses Lake LAT/LONG: 047 07' 50" / 119 16' 22"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Richland, Kennewick, Pasco, WA
Comments
Moses Lake is a neighborhood scale small-community site in Eastern Washington. Moses Lake is impacted by smoke from burning in the area.

Mt. Vernon, S Second St - SLAMS
AQS #530570015 Method code: 771
Address: 1600 South Second St, Mount Vernon LAT/LONG: 048 24' 37" / 122 20' 16"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Not in an urban area
Comments
Mt. Vernon is a neighborhood scale small-community site. It is impacted by wood smoke. The continuous monitor is representative of area.

North Bend, North Bend Way - SLAMS
AQS #530330017 Method code: 771
Address: 42404 SE North Bend Way, North Bend LAT/LONG: 047 29' 23" / 121 46' 24"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA
Comments
North Bend is a neighborhood scale transport/background $PM_{2.5}$ site for the Puget Sound that is impacted by wood smoke.

Lacey, College St - SLAMS
AQS #530670013 Method code: 771
Address: 1900 College St SE, Lacey LAT/LONG: 047 01' 43" / 122 49' 15"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Olympia, WA
Comments

Lacey, College St is a neighborhood scale site that is impacted by wood smoke. The site is representative of the Olympia/Thurston County area.

Port Angeles, W 14th St - SLAMS

AQS #530090009 Method code: 771
Address: 1139 W 14th St., Port Angles LAT/LONG: 048 06' 59" / 123 27' 52"
Sampling: Continuous correlated
Monitoring objective: Population Exposure UA: Not in an urban area

Comments

Port Angeles is a neighborhood scale site adjacent to Olympic National Park, a Class 1 Area. Port Angeles is impacted by smoke related activities.

Port Townsend, San Juan Ave - SLAMS

AQS #530310003 Method code: 771
Address: 3939 San Juan Avenue, Port Townsend LAT/LONG: 048 07' 45" / 122 46' 46"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA:

Comments

Port Townsend is neighborhood scale and meets the criteria for a SLAMS site. The site is impacted by wood burning and is representative of the area.

Pullman, Dexter Ave - SLAMS

AQS #530750003 Method code: 771
Address: 240 SE Dexter, Pullman LAT/LONG: 046 43' 28" / 117 10' 46"
Sampling: Continuous correlated
Monitoring objective: Population Exposure UA: Not in an urban area

Comments

Pullman is a neighborhood scale site is in Eastern Washington that is impacted by smoke from burning.

Puyallup, 128th St - SLAMS

AQS #530531018 Method code: 771
Address: 9616 128th St E, Puyallup LAT/LONG: 047 08' 24" / 122 18' 01"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA

Comments

Puyallup is a neighborhood scale site that is impacted by wood in the South Hill area.

Ritzville, Alder St - SLAMS

AQS #530010003 Method code: 771
Address: 109 W Alder, Ritzville LAT/LONG: 047 07' 43" / 118 22' 55"
Sampling: Continuous correlated
Monitoring objective: Population Exposure UA: Not in an urban area

Comments

Ritzville is a neighborhood scale small-community located in Eastern Washington. The site is impacted by smoke from burning activities in the area.

Rosalia, Josephine St - SLAMS

AQS #530750006 Method code: 771
Address: 906 S Josephine Avenue, Rosalia LAT/LONG: 047 13' 52" / 117 22' 08"
Sampling: Continuous correlated
Monitoring objective: Population Exposure UA: Not in an urban area

Comments

Rosalia is a neighborhood scale small-community site located in Eastern Washington. It is impacted by smoke from burning in the area.

Seattle, Beacon Hill - NCore

AQS #530330080 Method code: 118/771/702/704
Address: 4103 Beacon Avenue S., Seattle LAT/LONG: 047 34' 58" / 122 18' 30"
Sampling: 1/1 & correlated continuous
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA

Comments

Seattle, Beacon Hill is an urban scale NCORE site.

Seattle/Duwamish - SLAMS

AQS #530330057 Method code: 118/771
Address: 4401 E Marginal Way S., Seattle LAT/LONG: 047 33' 31" / 122 20' 19"
Sampling: 1/3 & correlated continuous
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA

Comments

Seattle, E Marginal Way is a neighborhood scale site located in the Duwamish River Valley. It is impacted by mobile and industrial sources. This site is equipped with an FRM and is suitable for comparison to the $PM_{2.5}$ NAAQS.

Seattle, Olive St - SLAMS

AQS #530330048 Method code: 771
Address: 1624 Boren Avenue, Seattle LAT/LONG: 047 36' 55" / 122 19' 48"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA

Comments

Seattle, Olive Street was established in 2002 as a micro scale $PM_{2.5}$ site adjacent to Interstate 5 designed to measure the effects of mobile source diesel emissions. This site is <u>not</u> suitable for comparison to the $PM_{2.5}$ NAAQS.

Spokane, Ferry St - SLAMS

AQS #530630016 Method code: 118/702/704
Address: E 3530 Ferry, Spokane LAT/LONG: 047 39' 39" / 117 21' 26"
Sampling: 1/3 & continuous
Monitoring objective: Population Exposure MSA: Spokane, WA

Comments

Spokane, Ferry St is a neighborhood scale site impacted by wood smoke and light industrial sources. This site is equipped with an FRM and is suitable for comparison to the $PM_{2.5}$ NAAQS.

Spokane, Monroe Street - SLAMS

AQS #530630047 Method code: 771
Address: N 4601 Monroe St., Spokane LAT/LONG: 047 42' 03" / 117 25' 30"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Spokane, WA

Comments

Spokane, Monroe Street is a neighborhood scale site that meets SLAMS designation criteria. It is impacted by wood smoke and is representative of the area.

Starbuck, 6th Ave- SLAMS

AQS # 530130001 Method code: 771
Address: 6th & Tucannon Road, Starbuck LAT/LONG: 046 31' 05" / 118 07' 36"

Sampling: Continuous correlated
Monitoring objective: Population Exposure UA: Not in an urban area
Comments
Starbuck is a neighborhood scale small-community site located in Eastern Washington that is impacted by smoke from burning activities in the area.

Tacoma, Alexander Ave - SLAMS
AQS #530530031 Method code: 771
Address: 2301 Alexander Avenue, Tacoma LAT/LONG: 047 15' 56" / 122 23' 09"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA
Comments
Tacoma, Alexander Ave is a neighborhood scale site impacted by wood smoke and industrial point sources on the Tacoma tideflats. The site is representative of the NE Tacoma/Fife area.

Tacoma, S L St - SLAMS
AQS #530530029 Method code: 118/712/713
Address: 7802 South L St., Tacoma LAT/LONG: 047 11' 11" / 122 27' 06"
Sampling: 1/3 & continuous correlated
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA
Comments
Tacoma, L Street is a neighborhood scale site impacted by wood smoke sources. This site is equipped with an FRM and is suitable for comparison to the $PM_{2.5}$ NAAQS.

Vancouver, 4th Plain - SLAMS
AQS #530110013 Method code: 118/771
Address: 8205 E 4th Plain Boulevard, Vancouver LAT/LONG: 045 38' 55" / 122 35' 16"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Portland-Vancouver, OR-WA
Comments
Vancouver, 4th Plain is a neighborhood scale site impacted by wood smoke sources. The site is equipped with an FRM and is suitable for comparison to the $PM_{2.5}$ NAAQS.

Walla Walla, 12th St - SLAMS
AQS #530710005 Method code: 771
Address: 200 S 12th, Walla-Walla LAT/LONG: 046 03' 32" / 118 21' 06"
Sampling: Continuous correlated
Monitoring objective: Population Exposure UA: Not in an urban area
Comments
Walla Walla is a neighborhood scale small-community site located in Eastern Washington. It is impacted by smoke from burning activities in the area.

Woodinville, 133rd Ave- SLAMS
AQS #530330028 Method code: 771
Address: 17401 133rd Avenue NE, Woodinville LAT/LONG: 47.754/-122.161
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Seattle-Bellevue-Everett, WA
Comments
Woodinville is a neighborhood scale site impacted by area wood smoke.

Yakima, S 4th Ave - SLAMS
AQS #530770009 Method code: 118/771

Address: 402 South 4th Avenue, Yakima LAT/LONG: 046 35' 42" / 120 30' 44"
Sampling: Continuous correlated
Monitoring objective: Population Exposure MSA: Yakima, WA
Comments
Yakima is a neighborhood scale site impacted by smoke from burning sources in the area. The site is equipped with an FRM and is suitable for comparison to the $PM_{2.5}$ NAAQS.

4.7 $PM_{2.5}$ - Other

Wenatchee, Alaska Way - SLAMS
AQS # 530070006 Method code: 771
Address: 600 Alaska Street, Wenatchee LAT/LONG: 047 25' 06" / 120 19' 14"
Sampling: Continuous
Monitoring objective: Population Exposure UA: Not in an urban area
Comments
Wenatchee, Alaska Way is a neighborhood scale site established in 1994 as a PM_{10} site. It is located in a residential area of Wenatchee that is impacted by wood smoke. The nephelometer at Wenatchee was correlated with an FRM since the last network report and is now reporting near-real-time $PM_{2.5}$.

Ellensburg, Ruby St - SLAMS
AQS # 530370002 Method code: 771
Address: 201 North Ruby Street, Ellensburg LAT/LONG: 046 59' 37" / 120 32' 42"
Sampling: Continuous
Monitoring objective: Population Exposure MSA: Not in an urban area
Comments
Ellensburg is a neighborhood scale site established in 1995 as a PM_{10} site. It is located in a residential area of Ellensburg impacted by wood smoke. The nephelometer at Ellensburg was correlated with an FRM since the last network report and is now reporting near-real-time $PM_{2.5}$.

Clarkston, STP – SLAMS
AQS # 530030004 Method code: 771
Address: 13th Street and Port Way, Clarkston LAT/LONG: 046 25' 32"/ 117 3' 35"
Sampling: Continuous
Monitoring objective: Population Exposure UA: Not in an urban area
Comments
Clarkston is a neighborhood scale site established in 1993 as a PM_{10} site. It is located in a mixed/residential area of Clarkston. With placement of an FRM, this site is suitable for comparison to the $PM_{2.5}$ NAAQS. The nephelometer was correlated with an FRM since the last network report and is now reporting near-real-time $PM_{2.5}$.

4.7.1 Other – Contracted Sites USFS

Chelan, Woodin Ave
AQS#530070007- USFS Method code: 771
Address: 428 W. Woodin Avenue, Chelan LAT/LONG: 047 50' 18" / 120 01' 23"
Sampling: Continuous
Monitoring objective: Other

Leavenworth, Evans St
AQS#530070010- USFS
Address: 330 Evans Street, Leavenworth
Sampling: Continuous
Monitoring objective: Other
Method code: 771
LAT/LONG: 047 35' 56” / 120 39' 53”

Twisp, Glover St
AQS#53047009- USFS
Address: 118 South Glover Street, Twisp
Sampling: Continuous
Monitoring objective: Other
Method code: 771
LAT/LONG: 48° 21' 51” / 120 12' 40”

Naches, Hwy 12
AQS#530770007- USFS
Address: 10237 Hwy 12, Naches
Sampling: Continuous
Monitoring objective: Other
Method code: 771
LAT/LONG: 046 43' 47” / 120 42' 13”

Winthrop, W Chewuch Rd
AQS#530470010-FS
Address: 24 West Chewuch Road, Winthrop
Sampling: Continuous
Monitoring objective: Other
Method code: 771
LAT/LONG: 048 28' 38” / 120 11' 26”

4.7.2 Other – Contracted Sites Tribal/EPA

Toppenish, Ward Rd (Yakama)
AQS#530770015
Address: 141 Ward Road, Toppenish
Sampling: Continuous
Method code: 771
LAT/LONG: 046 23’ 07” / 120 18' 49”
Monitoring objective: Other

Oakville, Howanut Dr (Chehalis)
AQS#530270008
Address: 252 Howanut Drive, Oakville
Sampling: Continuous
Method code: 771
LAT/LONG: 046 49' 23” / 123 09' 40"
Monitoring objective: Other

Skokomish, Tribal Center Rd (Skokomish)
AQS#530450006
Address: N. 533 Tribal Center Road, Shelton
Sampling: Continuous
Method code: 771
LAT/LONG: 047 19' 33” / 123 09' 01”
Monitoring objective: Other

Usk, LeClerc Rd N (Kalispel)
AQS# 530510007
Address: 1981 LeClerc Road North, Usk
Sampling: Continuous
Method code: 771
LAT/LONG: 048 20' 45” / 117 16' 20”
Monitoring objective: Other

Wellpinit, Ford-Wellpinit Rd (Spokane)
AQS#530650002
Method code: 702/704

Address: 5298 Ford-Wellpinit Road, Wellpinit LAT/LONG: 047 53' 19" / 117 59' 19"
Sampling: Continuous Monitoring objective: Other

Neah Bay, (Makah)
AQS#53000914 Method code: 771
Address: 159 Waada View, Neah Bay LAT/LONG: 048 22' 19" / 124 35' 43"
Sampling: Continuous Monitoring objective: Other

Taholah, Chitwhin Dr (Quinault)
AQS#530270009 Method code: 771
Address: 600 Chitwin Drive, Taholah LAT/LONG: 047 20' 37" / 124 17' 13"
Sampling: Continuous Monitoring objective: Other

Puyallup, 66th Ave (Puyallup)
AQS#530530022 Method code: 771
Address: 5722 66th Avenue E. Puyallup LAT/LONG: 047 12' 19" / 122 20' 19"
Sampling: Continuous Monitoring objective: Other

4.7.3 Other Contracted Local Air Agencies

Cheeka Peak (Olympic Region Clean Air Agency)
AQS#530090013 Method code: 771, 056,
Address: Cheeka Peak, Jefferson County LAT/LONG: 048 17' 12"/ 124 37' 13"
Sampling: Continuous Monitoring objective: Other

Port of Vancouver (Southwest Clean Air Agency)
AQS#530110018 Method code: 050,040
Address: 6305 NW Old Lower River Rd, Vancouver
LAT/LONG: 045 39' 01'/ 122 44' 24"
Sampling: Continuous Monitoring objective: Other

4.8 Trace Gas Monitoring

NCore – Precursor Gas & Multi-Pollutant Monitoring – From an emission source perspective, multiple pollutants and their precursors are released simultaneously (e.g., a combustion plume with nitrogen, carbon, hydrocarbon, mercury, sulfur gases, and particulate matter). Meteorological processes that shape pollutant movement, atmospheric transformations, and removal act on all pollutants. Numerous chemical and physical interactions underlie the dynamics of particle and ozone formation and the adherence of air toxics on surfaces of particles.

Overwhelming programmatic and scientific interactions across pollutants have demanded a movement toward integrated air quality management. Collocated air monitoring benefits health assessments and emissions strategy development. Health studies with access to multi-pollutant data will be better positioned to identify confounding effects of different pollutants, particularly when concentration, composition, and population types are included. Air quality models and source attribution methods used for strategy development also benefit from the multi-pollutant approach. Modelers will be able to perform more robust evaluations by checking performance on several variables to ensure the model produces results for correct reasons and not through compensating errors. As emission sources are characterized by a multiplicity of pollutant releases, related source apportionment models yield more

conclusive results from use of multi-pollutant measurements. Multi-pollutant measurements also streamline monitoring operations and offer increased diagnostic capabilities to improve instrument performance.

The multi-pollutant monitoring provided for these needs by starting to fill the measurement gaps that have accumulated over the years. The objective of this strategy is to provide for the following important needs;

- Improved data flow and timely reporting to the public
- Future NAAQS compliance determinations and revisions
- Support for development of emissions strategies
- Assess effectiveness of air pollution control programs
- Data for scientific and health-based studies.

Seattle, Beacon Hill
AQS #530330080
Address: 4103 Beacon Avenue S., Seattle
LAT/LONG: 047 34' 58" / 122 18' 30"
Monitoring objective: Special Studies
MSA: Seattle-Bellevue-Everett, WA
Comments
Seattle Beacon Hill is an urban scale site for carbon monoxide and ozone. Seattle Beacon Hill also measures chemical speciated particulate matter, volatile organic air toxics, carbonyls and semi-volatile (PAH) toxics. In addition, data from this site supports the Particulate Research Center activities.

Cheeka Peak (ORCAA)

AQS#530090013
Method code: 771, 056,
Address: Cheeka Peak, Jefferson County
LAT/LONG: 048 17’ 12”/ 124 37' 13”
Sampling: Continuous
Monitoring objective: Other

Carbon Monoxide
Precursor or trace level Carbon monoxide is in operation at the Beacon Hill and Cheeka Peak sites.
Sulfur Dioxide
Precursor or **t**race level sulfur dioxide is in operation at the Beacon Hill and Cheeka Peak sites.
Reactive Nitrogen Compounds
Precursor or trace level NOy is in operation at the Beacon Hill and Cheeka Peak sites.

4.9 Toxics/Speciation Monitoring

Toxics

Collocated National Air Toxics Trend Site (NATTS) - In addition to the STN and NCore Precursor Gas Monitoring Programs currently underway, Beacon Hill is also a designated National Air Toxics Trend Site (NATTS). The primary objectives of Washington’s National Air Toxics Trends Site Monitoring Program include but are not limited to:

- Provide long-term air toxic monitoring data in order to establish and track trends.
- Evaluate the air toxic program’s progress by characterizing air toxics concentrations, and determining their spatial and temporal differences between cities and regions over time.
- Provide representative air toxic data to support exposure assessments (i.e. determine health risks).
- Determine where air toxics emissions come from (source apportionment).
- Provide air toxic data for evaluating modeling results that are used for exposure assessments.
- Assess the effectiveness of the air toxic program’s emission reduction and control strategies.

Seattle, Beacon Hill
AQS #530330080 Method code: 593/560/574
Address: 4103 Beacon Avenue S., Seattle LAT/LONG: 047 34' 58" / 122 18' 30"
Monitoring objective: Special Studies MSA: Seattle-Bellevue-Everett, WA
Comments

Seattle Beacon Hill is a designated National Air Toxics Trends Site (NATTS). Seattle Beacon Hill monitoring station was nominated by the National Air Toxics Committee and chosen by EPA headquarters to represent urban scale air toxics in the Pacific Northwest. As part of NATTS designation the site was selected to receive continuing funding for long-term air toxics monitoring. It is currently the only designated urban scale NATTS located in the Pacific Northwest.

Speciation

National Speciation Trends Network (STN) - The $PM_{2.5}$ Chemical Speciation Program continues to have a significant role in the new Monitoring Strategy. Washington's STN site is located at Jefferson Park on Beacon Hill in Seattle. The primary goal of the $PM_{2.5}$ speciation monitoring is to:

- Provide long-term data in order to establish and track tends.
- Determine the spatial and temporal differences of $PM_{2.5}$ composition between cities and regions over time.
- Provide representative $PM_{2.5}$ speciation data to support exposure assessments (i.e. determine health risks).
- Determine where $PM_{2.5}$ emissions come from (source apportionment).
- Evaluate modeling results that are used for exposure assessments.
- Assess the effectiveness of the program's emission reduction and control strategies.

Seattle, Beacon Hill
AQS #530330080 Method code:
Address: 4103 Beacon Avenue S., Seattle LAT/LONG: 047 34' 58" / 122 18' 30"
Monitoring objective: Special Studies MSA: Seattle-Bellevue-Everett, WA

Supplemental Speciation Sites - In addition to the Beacon Hill STN site, the State operates four supplemental speciation sites. These supplemental sites are located at:

Spokane, Ferry St (SCRAA)
AQS #530630016 Method code:
Address: E 3530 Ferry, Spokane LAT/LONG: 047 39' 39" / 117 21' 26"
Monitoring objective: Special Studies MSA: Spokane, WA

Tacoma, L Street (PSCAA)
AQS #530530029 Method code:
Address: 7802 South L St., Tacoma LAT/LONG: 047 11' 11" / 122 27' 06"
Monitoring objective: Special Studies MSA: Seattle-Bellevue-Everett, WA

Vancouver, 4th Plain (SWCAA)
AQS #530110013 Method code:
Address: 8205 E 4th Plain Boulevard, Vancouver LAT/LONG: 045 38' 55" / 122 35' 16"
Monitoring objective: Special Studies MSA: Portland-Vancouver, OR-WA

Yakima, S 4th (YRCAA)

AQS #530770009
Address: 402 South 4th Avenue, Yakima
Monitoring objective: Population Exposure

Method code:
LAT/LONG: 046 35' 42" / 120 30' 44"
MSA: Yakima, WA

5 References

1. Code of Federal Regulations, Title 40, Part 58, Appendix A,B,C,D,E, U.S. Government Printing Office, 1999.

2. Code of Federal Regulations, Title 40, Part 50, U.S. Government Printing Office, 1999.

3. Code of Federal Regulations, Title 40, Part 53, U.S. Government Printing Office, 1999.

4. Code of Federal Regulations, Title 40, Part 58, U.S. Government Printing Office, 1999.

5. U.S. EPA, Revised Requirements for Designation of Reference and Equivalent Methods for $PM_{2.5}$ and Ambient Air Quality Surveillance for Particulate Matter -Final Rule. 40 CFR Parts 53 and 58. Federal Register, 62(138):38763-38853. July 18, 1997.

6. Guidance for Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10}, J.G. Watson, et. Al., U.S. EPA/OAQPS, December 15, 1997.

7. SLAMS/NAMS/PAMS Network Review Guidance, EPA-454/R-98-003, March 1998.

8. Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD), EPA-450/4-87-007, May 1987.

9. Guideline on Ozone Monitoring Site Selection, EPA-454/R-98-002, August 1998.

Appendix C

Emission Inventory Documentation

C. Emission Categories

Ecology developed an inventory of annual and winter weekday PM_{10} emissions estimates for the LMP. For this LMP, the seven sources in the original 1994 plan were inventoried, but were reorganized as described in Table C.1 and Table C.2. The seven sources are: Residential Wood Combustion, Paved Road Dust, Unpaved Road Dust, Onroad Mobile, Port and Marine, Locomotives, and Industrial. Other categories inventoried in the original maintenance plan were deemed insignificant, and were not inventoried.

Table C.1: List of 2011 Emission Categories

2011 Emission Categories
Onroad Mobile
Residential Wood Combustion
Port and Marine
Locomotives
Paved Road Dust
Unpaved Road Dust
Industrial

Table C.2: 1994 emission categories with their respective 2011 representative emission category

1994 Emissions Categories	2011 Representative Emission Categories
Gasoline Exhaust	Onroad Mobile
Diesel Exhaust	Port and Marine, Onroad Mobile
Ships	Port and Marine
Locomotives	Locomotives
Wood Burning	Residential Wood Combustion
Road Dust	Paved Road Dust, Unpaved Road Dust
Allowable Industrial	Industrial

Ecology's draft 2011 triennial emissions inventory (2011 EI) was used for all categories except industrial emissions, where actual emissions submitted to PSCAA and Ecology were used.

Fugitive dust emissions from coal trains were estimated and are included in the total locomotive emissions category.

Other sources are deemed insignificant, including outdoor burning, construction dust, secondary particulate matter, aircraft emissions, wildfires, cigarette smoke, and commercial charbroiling. Outdoor burning is prohibited in the three maintenance areas, so emissions would be minimal. Neither Ecology nor PSCAA have local information on emissions for construction dust, cigarette smoke, or commercial charbroiling, but they are assumed to be minimal in these areas. Smoke from wildfires in Puget Sound is rare and was considered negligible. Some of these values are included in the 2011 NEI, however the emission estimates have large uncertainties because the data was collected nationally and was not developed specifically for local areas, or for sub-county regions like the Seattle, Tacoma, and Kent Maintenance Areas.

Method for Emission Estimates

All the non-industrial source emissions were estimated by multiplying an activity level, such as wood combusted or Vehicle Miles Traveled (VMT), by an emission factor in mass per activity.

Emissions = Activity level x Emission FactorSpatial Allocation Methods

Spatial surrogates were used to approximate emissions inside the maintenance areas from county data. For sources without specific coordinates, spatial surrogates were used to approximate both the location and magnitude of the emissions. Maintenance areas (MA) emissions are estimated as:

$$\mathbf{E_{MA} = E_{County} * Surrogate_{MA} / Surrogate_{County}}$$

Where E_{MA} = emissions in the maintenance area, E_{County} = emissions in county,

$Surrogate_{MA}$ = surrogate activity in the maintenance area, and $Surrogate_{County}$ = surrogate activity in county.

The spatial surrogates and data sources used are shown in Table C.3 below.

Table C.3: Spatial surrogate and sources of data for sub-county region (maintenance area) estimates

Emission Category	Spatial Surrogate	Source
Onroad Mobile	Percent of VMT within the maintenance area vs. the county	Puget Sound Regional Council Estimates
Residential Wood Combustion	Percent of households within the maintenance area vs. the county	Puget Sound Regional Council Estimates
Port and Marine	Percent of Port of Seattle and Tacoma area within the maintenance area	2011 Draft Ecology EI (from 2011 Puget Sound Marine Emission Inventory)
Locomotives	*Rail yards*: N/A --- used entire county *Passenger rail*: used proportion of county rail that goes through the maintenance area *Fugitive dust from coal trains*: used proportion of rail within the maintenance area vs. the entire route from the Powder River coal basin *Line haul*: used the actual rail segments in the maintenance area and then applied activity information	2011 Draft Ecology EI
Paved Road Dust	Percent of VMT within the maintenance area vs. the county	Puget Sound Regional Council Estimates
Unpaved Road Dust	Percent of VMT within the maintenance area vs. the county	Puget Sound Regional Council Estimates
Industrial	N/A --- source coordinates were used	Source Emission Data Reported to PSCAA and Ecology

Temporal Allocation Methods

The 2011 EI estimates were available as annual and winter season emissions for King and Pierce County. These estimates were temporally allocated to a winter weekday, and spatially allocated to the maintenance areas as described below.

Annual emissions data were adjusted to tons per average winter day for the maintenance area for each source category. Methods for each category are described below.

Residential Wood Combustion

Residential wood combustion (RWC) emissions are based on Ecology's draft 2011 Emission Inventory. RWC consists of home heating and recreational use of woodstoves, fireplaces, fireplace inserts and central furnaces. Activity parameters for the 2011 EI include the type of wood burning devices [certified (catalytic and noncatalytic) woodstoves, uncertified woodstoves and fireplaces], the amount and species of wood burned from each device and seasonal, daily and hourly usage rates. Most of this information was obtained through the 2007 National Research Center Survey.[1] Emission factors were taken from AP 42, the 2002 NEI, and the particulate matter size distribution from the California Air Resources Board (CARB).

Wood burning devices include central furnaces, fireplaces, pellet stoves, and certified and uncertified woodstoves and inserts. Close to three quarters of all wood burning devices in the state are fireplaces or uncertified woodstoves and inserts.

For residential wood combustion, seasonal activity fractions from the NRC survey were used to calculate emissions for a winter day.[1] To quantify winter day emissions, the three month fraction (November, December, January) of the annual emissions was 68%. Then the emissions were further divided to a per day (92 winter days in November, December, and January). Table C.4 shows county annual and winter emissions by device type and by county. Table C.5 shows the population data used for as the surrogate to estimate emissions for the maintenance area. Table C.6 shows the final results.

1 Puget Sound Clean Air Agency Indoor Wood-burning Emission Inventory Survey of King, Kitsap, Pierce and Snohomish Counties, Report of Results, Prepared by National Research Center, Inc., 3005 30th Street, Boulder, CO 80301, November 2007.

Table C.4: Tons of PM_{10} by wood burning device, King and Pierce County

Device	King County		Pierce County	
	Annual tons	Winter tons	Annual tons	Winter tons
Fireplace: general	2,176	1,480	358	244
Woodstove: fireplace inserts; non-EPA certified	596	405	250	170
Woodstove: fireplace inserts; EPA certified; non-catalytic	205	139	155	105
Woodstove: fireplace inserts; EPA certified; catalytic	71	48	54	36
Woodstove: freestanding, non-EPA certified	601	409	341	232
Woodstove: freestanding, EPA certified, non-catalytic	206	140	211	144
Woodstove: freestanding, EPA certified, catalytic	72	49	73	50
Woodstove: pellet-fired, general	15	10	6	4
Other: All Combustor Types	51	35	23	15
Total	**3,993**	**2,715**	**1,470**	**1,000**

Source: 2011 Draft Ecology EI

Table C.5: PM_{10} Maintenance Area Population Data

Area Name	Area Population	County Population	Fraction of County
Kent	16,841	1,931,249	0.00872
Seattle	8,216	1,931,249	0.00425
Tacoma	3,594	795,225	0.00452

Source: PSRC 2011

Table C.6: Tons of PM_{10} by wood burning device in each maintenance area:

Device	Kent			Seattle			Tacoma		
	Annual tons	Winter tons	Tons/ winter day	Annual tons	Winter tons	Tons/ winter day	Annual tons	Winter tons	Tons/ winter day
Fireplace: general	19.0	12.9	0.14	9.2	6.3	0.07	1.6	1.1	0.01
Woodstove: fireplace inserts; non-EPA certified	5.2	3.5	0.04	2.5	1.7	0.02	1.1	0.8	0.01
Woodstove: fireplace inserts; EPA certified; non-catalytic	1.8	1.2	0.01	0.9	0.6	0.01	0.7	0.5	0.01
Woodstove: fireplace inserts; EPA certified; catalytic	0.6	0.4	0.00	0.3	0.2	0.00	0.2	0.2	0.00
Woodstove: freestanding, non-EPA certified	5.2	3.6	0.04	2.6	1.7	0.02	1.5	1.0	0.01
Woodstove: freestanding, EPA certified, non-catalytic	1.8	1.2	0.01	0.9	0.6	0.01	1.0	0.7	0.01
Woodstove: freestanding, EPA certified, catalytic	0.6	0.4	0.00	0.3	0.2	0.00	0.3	0.2	0.00
Woodstove: pellet-fired, general	0.1	0.1	0.00	0.1	0.0	0.00	0.0	0.0	0.00
Other: All Combustor Types	0.4	0.3	0.00	0.2	0.1	0.00	0.1	0.1	0.00
Total	**34.8**	**23.7**	**0.26**	**17.0**	**11.5**	**0.13**	**6.6**	**4.5**	**0.05**

Paved Road Dust

Dust emissions are generated as vehicles pass along paved roadways and disturb the layer of loose material on or near the road surface. This material contains particulate matter from soil, brake and tire wear, exhaust, and other substances. The paved road dust calculation excludes emissions from exhaust and brake and tire wear. These vehicle emissions are estimated as on-road mobile sources emissions. VMT on unpaved roads was estimated using data from the County Road Administration Board (CRAB) and WSDOT. The Road Dust equations in AP-42 were used to calculate emission factors. The measures of activity and spatial allocation will be based on VMT in the maintenance areas. Temporal allocation is identical to the on-road category, which was defined as December, January, and February. Table C.7 shows the fraction of the total county VMT within the maintenance area and respective PM_{10} emissions.

Table C.7: Paved road dust PM_{10} emissions with the fraction of the maintenance areas vehicle miles traveled

	King County Emissions, in Tons					Maintenance Area Emissions, in Tons	
Maintenance Area	Annual	Winter	Days / winter	Tons / winter day	Maintenance Area Fraction	Annual	Tons / winter day
Seattle	3522.2	875.9	90	9.73	0.0540	190.1	0.525
Kent	3522.2	875.9	90	9.73	0.0116	40.9	0.113
Tacoma	1329.4	333.6	90	3.71	0.0787	104.6	0.292

Onroad Mobile Sources

On-road mobile source emissions are those generated by operating vehicles on public roadways. The LMP Emission Inventory will be based on Ecology's "Washington State Base Year 2011 County Inventories." Winter day emissions were estimated for each county using EPA's Motor Vehicle Emission Simulator (MOVES) model version 2010b, using a combination of default and local data as input parameters. Total PM_{10} emissions included primary PM_{10} from running exhaust and start exhaust, as well as brakewear and tirewear particulate.

The number of vehicle miles traveled (VMT) are used in MOVES. The MOVES input files require summations of VMT statistics by several different road and vehicle classifications, which were developed using national Department of Transportation's Highway Performance Monitoring System (HPMS) as obtained from the Washington State Department of Transportation (WSDOT). HPMS is a system of traffic counts collected over several urban and rural sampling areas. WSDOT makes estimates of county VMT by roadway (functional) classifications.

Fleet characteristics, including vehicle population and age distribution, were derived from local data. Registration data from the Washington Department of Licensing (DOL) was supplemented with transit and intercity bus data from the Federal Transit Administration (FTA) and public school bus data from the Washington State Office of the Superintendent of Public Instruction (OSPI).

MOVES defaults were used for gasoline and diesel fuel parameters, which reflect current regulations regarding sulfur content and Reid vapor pressure. All transit buses in Pierce County were assumed to operate using compressed natural gas (CNG).

MOVES defaults were used for meteorological data. MOVES defaults are based on historical meteorological observations from local monitors for each county.

All input parameters are described in Section 3.1 of the 2011 EI. The model parameters and data sources are summarized in Table C.8 below.

Table C.8: MOVES Model Parameters and Data Sources

Parameter	Data Source
County vehicle population	Washington State Department of Licensing (DOL), Federal Transit Administration (FTA), Washington State Office of the Superintendent of Public Instruction (OSPI)
County VMT	Department of Transportation's Highway Performance Monitoring System (HPMS) obtained from the Washington State Department of Transportation (WSDOT)
Temporal allocation to month and day of week	WSDOT
Vehicle age distribution	DOL, FTA, OSPI
Average speed distribution	MOVES defaults
Road type distribution	HPMS obtained from WSDOT
Fuel supply and formulation	MOVES defaults
Meteorology data	MOVES defaults

Winter emissions were allocated for December, January, and February.

Table C.9 shows the fraction of the total county VMT within the maintenance area and respective PM_{10} emissions.

Table C.9: Onroad mobile PM_{10} emissions with the fraction of the maintenance areas vehicle miles traveled

	King County Emissions, in Tons					Maintenance Area Emissions, in Tons	
Maintenance Area	Annual	Winter	Days / winter	Tons / winter day	Maintenance Area Fraction	Annual	Tons / winter day
Seattle	1868.1	475.7	90	5.29	0.0540	100.8	0.285
Kent	1868.1	475.7	90	5.29	0.0116	21.7	0.061
Tacoma	761.52	198.27	90	2.20	0.0787	59.9	0.173

Unpaved Road Dust

Similar to paved roads, dust emissions are generated as vehicles pass along unpaved roadways and disturb the layer of loose material on or near the road surface. This material contains particulate matter from soil, brake and tire wear, exhaust, and other substances.

The unpaved road dust calculation excludes emissions from exhaust and brake and tire wear since they are estimated as on-road mobile sources emissions. The unpaved road dust estimate assumes a dry day, when you would have the highest potential of dust emissions and highest potential contribution to a high PM_{10} event. Additionally, this estimate assumes uniform unpaved roads and uniform traffic volume in the maintenance area as outside the maintenance area. This result could be an overestimate, as there is a higher unpaved road density outside the maintenance areas.

The Road Dust equations in AP-42 were used to calculate emission factors[2]. Winter emissions were allocated for December, January, and February. Table C.10 shows the fraction of the total county VMT within the maintenance area and respective PM_{10} emissions.

Table C.10: Unpaved road dust PM_{10} emissions with the fraction of the maintenance areas vehicle miles traveled

	King County Emissions, in Tons					Maintenance Area Emissions, in Tons	
Maintenance Area	**Annual**	**Winter**	**Days / winter**	**Tons / winter day**	**Maintenance Area Fraction**	**Annual**	**Tons / winter day**
Seattle	2474.6	1091.4	90	12.13	0.0540	133.6	0.655
Kent	2474.6	1091.4	90	12.13	0.0116	28.7	0.141
Tacoma	295.7	130.4	90	1.45	0.0787	23.3	0.114

2 US EPA, *AP 4 Compilation of Air Pollutant Emission Factors*, http://www.epa.gov/ttn/chief/ap42/index.html

Port and Marine

To estimate port and marine activity, the 2011 Ecology Emission Inventory used the 2011 inventory prepared for the Puget Sound Maritime Air Forum by Starcrest Consulting Group, LLC.[3] The inventory is a bottom-up, activity-based emissions inventory which provides detailed information on the five major source categories associated with the marine activities: ocean-going vessels, harbor vessels, cargo handling equipment, on-road heavy-duty vehicles, and rail operations. It was an update to a similar inventory prepared by Starcrest for the 2005 inventory. Activity level and emission rates are described in the source inventory documentation.

Port and marine emissions were multiplied by the fraction within the maintenance area. Table C.11 shows the fractions of the port areas within the maintenance areas. For winter day estimates, the emissions were assumed to be uniform throughout the year. Table C.12 shows the annual emissions. The Kent maintenance area has no port or marine activities to estimate.

Table C.11: Fraction of Port Areas in Maintenance Areas

Maintenance Area	Fraction of Port Area	Name of Port
Seattle	65%	Port of Seattle
Tacoma	100%	Port of Tacoma
Kent	NA	NA

3 *2011 Puget Sound Maritime Air Emissions Inventory*. Prepared by: Starcrest Consulting Group, LLC, Starcrest consulting Group, LLC, Poulsbo, Washington 98370. September 2012.

Table C.12: PM_{10} emissions breakdown in tons of port and marine emissions within each maintenance area by subcategory

Port and Marine Emission Category	Annual Emissions in tons	Tons/winter day
Seattle Maintenance Area		
Ocean-going vessels hoteling	33.3	0.091
Harbor craft cruising	77.1	0.211
Off-hwy diesel cargo handling equipment	10.77	0.030
Off-hwy gas cargo handling equipment	0.001	0.000
Off-hwy LPG cargo handling equipment	0.04	0.000
ARGO Railyard: Off-highway Diesel /Construction & Mining Equipt /Rubber Tire Loaders/Terminal Tractors/Indust Equip	0.5	0.001
BNSF SIG Railyard: Off-highway Diesel /Construction & Mining Equipt /Rubber Tire Loaders/Terminal Tractors/Forklifts	0.5	0.001
Seattle Total	**122.2**	**0.334**
Tacoma Maintenance Area		
Ocean-going vessels hoteling	36.1	0.099
Harbor craft cruising	30.9	0.085
Off-hwy diesel cargo handling equipment	10.0	0.027
Off-hwy gas cargo handling equipment	0.01	0.000
Off-hwy LPG cargo handling equipment	0.01	0.000
Tacoma Total	**77.0**	**0.211**

Locomotives

Four types of locomotive emissions were estimated for the emission inventory. These are listed in Table C.13.

Table C.13: List of emission sources and methods used to estimate locomotive emissions

Emission Source	Data Source	Estimation method
Fugitive dust from coal trains	US Energy Information Administration	Cope (2001) emission factor[10]
Rail yards	BNSF and Union Pacific	Used total county rail yard emissions
Line haul trains	BNSF and Union Pacific	With rail segments within the maintenance areas, used county activity data from EPA shapefile
Passenger trains	Amtrak	Proportion of county emissions with length of rail through the maintenance area

To estimate locomotive activity, the 2011 Ecology Emission Inventory used the emissions from Class I line haul and switch yard locomotives using EPA guidance and other information.[4] U.S. Class I railroads are line haul freight railroads with operating revenue in excess of $319.3 million (amount changes over time). Two Class I railroads operate in Washington: Burlington Northern Santa Fe Railway (BNSF) and Union Pacific Railroad (UP). Amtrak was also included in this inventory. Class 2 and 3 railroad locomotive emissions were not inventoried. A special AIRQUEST (formerly Northwest Regional Technical Center) project conducted by the Oregon Department of Environmental Quality (ODEQ) found that emissions from Class 2 and 3 railroad locomotives were a small percentage of total locomotive emissions.[5,6]

BNSF and UP provided activity and emissions information for 2011. Amtrak provided passenger rail activity information for 2011. Spatial surrogates for passenger rail were based on the length of rail in each county.

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4 Procedures for Emission Inventory Preparation, Vol. IV: Mobile Sources. EPA-450/4-81-026d (Revised), Section 6.0. 1992.

5 Regional Technical Center Demonstration Project: Summary Report. Idaho Department of Environmental Quality, Oregon Department of Environmental Quality, Washington Department of Ecology, US EPA Region 10, Washington State University, University of Washington. January 11, 2002 (draft).

6 Oregon 1996 Railroad Emissions Inventory Project, Emission Estimate Methodology Documentation. Oregon Department of Environmental Quality. August 2001.

Activity level is measured in gallons of diesel consumed by locomotives. All of the railroads provided county fuel use for line haul and switch yard locomotives for 2011.[7] EPA rail activity shape fractions were used to allocate emissions to the segments of rail within the maintenance areas.

The spatial surrogate for fugitive dust from coal trains was the length of the rail through the maintenance area vs. the entire length of the route from the Powder Basin.

To quantify winter day emissions, locomotives were assumed to operate uniformly year-round per EPA guidance.[8]

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7 BNSF, UP and Amtrak Railway Company 2011 Estimation of Locomotive Emissions. Email transmittal of information from Kelly Harvey (BNSF), Michael Germer (UP), and Delia Ann Pfleckl (Amtrak) to Sarah Clouse Washington State Department of Ecology. March 2012. County fuel use and emissions.

8 Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume II, table 6-11. EPA-454/R-92-026, March 1992.

Estimate of fugitive dust from coal trains

Fugitive coal dust emissions from rail transport were estimated using the suggested approach described by Cope and Bhattacharyya, 2001.[9] The emission factor is described below:

Rail Coal Dust Emission Factor (kg dust/tonne of coal transported) = $0.1*(0.62*D)^{0.6}*((365-P)/365)*(SD/D)*((100-CE)/100)*SF$

Where: D = total rail distance from origin to destination (km)

P = number of precipitation days

SD = segment distance through the maintenance area (km)

CE = coal dust control efficiency (i.e. surfactant efficiency)

SF = scaling factor from TSP to PM_{10}

The reported tons of coal exported in 2011 that would have travelled through the maintenance areas was 4,854,451.[10] The proportional segment distances through the maintenance areas were calculated through ArcGIS 9.3 and listed in Table C.14. Table C.14 shows the values for the variables above for each maintenance area.

Table C.14: Values used in the rail coal dust emission factor equation

Variable	Value	Units	Source
D	2414	km	10
P	177	days	2011 EI – KSEA
CE	21.25 (0 for 9 months, and then 85 for last 3 months of 2011 with adopted surfactant requirement)	%	10
SF	0.5	none	9
SD	3.80 – Kent 10.51 – Seattle 3.01 – Tacoma	km	Estimated with GIS

9 Cope, Douglas; Bhattacharyya Kamal. "A Study of Fugitive Coal Dust Emissions in Canada", prepared for the Canadian Council of Ministers of the Environment, 2001.

10 Kotchenruther, Robert. "Fugitive Dust from Coal Trains: Factors Effecting Emissions and Estimating $PM_{2.5}$", EPA Region 10, Annual NW-AIRQUEST Meeting, June 2013.

Rail Yards

As rail yards are only reported by county, we can't adequately separate the emissions from the major railyards in King County and Pierce County, therefore all the county emissions were used without a spatial surrogate for activity within the Seattle and Tacoma maintenance areas.

Line Haul and Passenger Rail

Table C.15 shows the emissions from each locomotive category. Table C.16 shows the maintenance area fraction of the rail line of the total county rail for estimating passenger, line haul, and coal dust emissions. Table C.17 shows the fraction of county rail activity in the maintenance area for line haul estimates.

Table C.15: Estimated annual locomotive PM_{10} emissions by category

Locomotive Emission Category	Annual Emissions in tons	Tons/winter day
Kent Maintenance Area		
Passenger	0.1	0.000
Coal	12.5	0.034
Line Haul	1.2	0.003
Kent Total	**13.8**	**0.038**
Seattle Maintenance Area		
Passenger	0.3	0.001
Coal	34.4	0.094
Line Haul	2.4	0.007
Rail Yards	6.4	0.018
Seattle Total	**43.5**	**0.120**
Tacoma Maintenance Area		
Passenger	0.02	0.000
Coal	9.9	0.027
Line Haul	1.6	0.004
Rail Yards	1.9	0.005
Tacoma Total	**13.4**	**0.037**

Table C.16: Maintenance area fraction of the rail line of the total county rail for estimating passenger and coal dust emissions

Maintenance Area	Length of County Passenger and Coal Train Line in miles	Length of Maintenance Area Portion in miles	Fraction of County Passenger and Coal Train Lengths in Maintenance Area
Kent	40.18	2.36	0.0587
Seattle	40.18	6.53	0.163
Tacoma	71.79	1.87	0.0260

Table C.17: Fraction of county rail activity in the maintenance area for line haul estimates.

Maintenance Area	Fraction of County Rail Activity in Maintenance Area
Kent	0.060
Seattle	0.118
Tacoma	0.104

Industrial

The federal Clean Air Act defines point sources as any stationary source having the potential to emit 100 tons per year of a criteria pollutant. These sources require Air Operating (Title V) Permits.

Sources that emit more than 25 tons, but less than 100 tons per year of PM_{10}, must register with the Puget Sound Clean Air Agency. These registered sources must report their PM_{10} emissions if over 25 tons per year. Although not required, many other sources report their PM_{10} emissions. Table C.18 summarizes the all the industrial sources that report PM_{10} emissions since 1994.

Table C.18: The number of industrial sources (active or inactive) reporting PM_{10} emissions between 1994 and 2011.

Maintenance Area	Air Operating Permit Sources	Other reporting sources	Total
Seattle	8	17	25
Tacoma	5	17	22
Kent	1	6	7
Grand Total	**14**	**40**	**54**

To have a more complete inventory, we used reported emissions from both air operating permit sources and other reporting registered sources. All these sources fall within PSCAA's jurisdiction, except for Simpson Tacoma Kraft, which Ecology provided.

In the Inventory Preparation Plan, we originally proposed to create our industrial inventory using the maximum emissions from each emission segment since 1994. However, EPA commented that only a future year inventory would need such a conservative estimate. They also suggested that the best inventory for a limited maintenance plan is a base year planning inventory, which would better represent actual emissions. Therefore, we used actual reported emissions for 2011 from the reporting industrial sources.

Table C.19 below shows the added maximums from each segment since 1994 (including sources that no longer emit or report), as was previously proposed in the Inventory Preparation Plan, along with the actual emissions in 1994 and 2011. Industrial emissions have lowered significantly since 1994.

Table C.19: PM_{10} Emissions from all industrial sources from 1994 to 2011:

Maintenance Area	1994 Allowable Emissions (tons)	Max of emissions each emission segment since 1994 (tons)	1994 actual emissions (tons)	2011 actual emissions (tons)
Seattle	955	866	510	127
Tacoma	1,624	1212*	544*	243
Kent	N/A	1.0	0.1	0.5

* Since data for Simpson Tacoma Kraft is missing for 1994 and 1995, 1996 data was used for the 1994 actuals. The Simpson Tacoma Kraft maximum was estimated using 1996-2011 emissions.

Table C.20: Estimated annual emissions by reporting industrial source

Maintenance Area	Source	2011 Emissions (tons)	Tons/winter day
Seattle	Saint-Gobain Containers, Inc (Verallia)	64.9	0.178
Seattle	CertainTeed Gypsum Manufacturing Inc	31.4	0.086
Seattle	Ash Grove Cement Co, E Marginal	30.7	0.084
Seattle	Puget Sound Coatings Machinists DSR	0.3	0.001
Seattle	Kinder Morgan Liquids Terminal, LLC	0.1	0.000
Seattle	**Total**	**127.3**	**0.349**
Kent	Rexam Beverage Can Co	0.4	0.001
Kent	Hytek Finishes Co	0.1	0.000
Kent	**Total**	**0.5**	**0.001**
Tacoma	Simpson Tacoma Kraft Co	97.0	0.266
Tacoma	Graymont Western US Inc	85.1	0.233
Tacoma	Georgia-Pacific Gypsum LLC	26.8	0.073
Tacoma	Simpson Lumber Company, LLC	22.2	0.061
Tacoma	US Oil & Refining Co	12.3	0.034
Tacoma	**Total**	**243.4**	**0.666**

Appendix D

Inventory Preparation and Quality Assurance Plan Kent, Seattle and Tacoma PM_{10} Maintenance Area

D. Introduction

The Kent, Seattle, and Tacoma Washington PM_{10} maintenance areas were designated Group 1 PM_{10} areas in 1987 by the Environmental Protection Agency (EPA) for having a greater than 95% probability of violating the 24-hour PM_{10} standard, 150 $\mu g/m^3$. These areas were then classified as nonattainment areas in 1990 as required for Group I areas by the 1990 Amendments to the Clean Air Act (CAA). Monitoring data shows that Kent, Seattle, and Tacoma have been in attainment of the standard since 1987, 1990 and 1989 respectively. The area was reclassified to attainment for the 24-hour PM_{10} standard in March 2001 when EPA approved the first 10-year maintenance plan for Kent, Seattle, and Tacoma. The maintenance plan for the second 10-year period was due before March 2011. Once approved by EPA, the second ten year plan will fulfill the final maintenance planning requirement of the Clean Air Act. This Inventory Preparation and Quality Assurance Plan (IP/QA Plan) is in support of the development of the required second 10-year PM_{10} maintenance plan.

The Kent PM_{10} maintenance area is shown in Figure 1. PM_{10} was monitored at James Street and Central Avenue using a measured Federal Reference Method (FRM) between 1988 and 2003 and a measured Federal Equivalent Method (FEM) from July 2004 through December 2007. The area has been in compliance with the standard since 1987. Measured Federal Equivalent Method (FEM) PM_{10} values were so low that the monitor was removed with EPA approval at the end of 2007. Since then, continuous, non-reference method monitoring of $PM_{2.5}$ has been conducted in Kent with a nephelometer, which has been correlated with a co-located PM_{10} monitor to provide estimated PM_{10} values.

The Seattle PM_{10} maintenance area is shown in Figure 2. PM_{10} was monitored at both 4401 and 4752 East Marginal Way South using a measured FRM between June 1988 and December 2003 and a measured FEM between October 2004 through 2007. The area has been in compliance with the standard since 1990. Measured Federal Equivalent Method (FEM) PM_{10} values were so low that the monitor was removed with EPA approval at the end of 2007. Since then, continuous, reference and non-reference method monitoring of $PM_{2.5}$ has been conducted at the Seattle monitoring site and correlated with a co-located PM_{10} monitor to provide estimated PM_{10} values.

The Tacoma PM_{10} maintenance area is shown in Figure 3. PM_{10} was monitored at 2301 Alexander Avenue site in Tacoma, Washington. The area has been in compliance with the standard since 1990. Measured Federal Equivalent Method (FEM) PM_{10} values were so low that the monitor was removed with EPA approval at the end of 2007. Since then continuous monitoring of $PM_{2.5}$ has been conducted at the Tacoma monitoring site and correlated with a co-located PM_{10} monitor to provide estimated PM_{10} values.

Puget Sound Clean Air Agency (PSCAA) will prepare the maintenance plan in coordination with The Washington State Department of Ecology (Ecology). The Kent, Seattle and Tacoma areas qualify for the Limited Maintenance Plan (LMP) approach because they satisfy all the criteria outlined in the *Limited Maintenance Plan Option for Moderate PM10 Nonattinment Areas* document. The areas have been in compliance for over 20 years, calculated design values for the most recent 5 years of 24-hour monitoring data are below 98µg/m^3. The Kent, Seattle, and Tacoma, Washington conservative design values are 58µg/m^3, 71µg/m^3, and 71µg/m^3 respectively. The three maintenance areas expect only limited growth in on-road motor vehicle PM_{10} emissions, and they are expected to pass a motor vehicle regional emissions analysis test, which will be demonstrated using methodology in Attachment B of the LMP guidance once the EI is finalized. A LMP assumes there is low risk of exceeding the standard and the demonstration of maintenance is presumed to be satisfied. A LMP includes a base year (attainment) inventory, but does not require a projected year inventory. PSCAA proposes using existing information from draft excerpts of Ecology's Washington State Base Year 2011 County Inventories[1] (2011 EI) to create the emission inventory (EI) for the most significant emission sources.

The following sections describe the planned approach to the LMP EI and the basis for selecting that approach. PSCAA and Ecology are submitting this IP/QA Plan for EPA approval.

[1] Draft excerpts from the Washington State Base Year 2011 County Inventories, email transmittal from Sally Otterson to Sara Harrold, 8/19/2013

Geographic Area

The City of Kent is located on the eastern side of the Green River Valley between the Cities of Tukwilla and Auburn. The PM_{10} sources in this region come from residential wood burning, light industry, and mobile sources. The valley floor is roughly two to three miles in width and is bound by hills which rise 300-400 ft. in elevation. These hills act to trap pollutants under stable meteorological conditions (inversions). These conditions exist most frequently during the late fall and winter and are associated with the majority of particulate matter violations. Figure D.1, below, shows the Kent PM_{10} maintenance area and the location of the monitoring site.The Seattle PM_{10} maintenance area is comprised of the Duwamish industrial and commercial area immediately south of the downtown district and includes the Port of Seattle. The monitoring site has been in place since 1971 and is located in the center of the Duwamish industrial valley near the Port of Seattle. The site is a neighborhood scale site that is representative of South Seattle neighborhoods and ambient exposure in the industrial valley. The site is influenced by a very complex mixture of mobile sources, port and marine sources, industrial sources, winter home heating wood smoke, and other pollution sources. The site is 80 meters west of E. Marginal Way, which is a main arterial for many large haul trucks, as well as service vehicles and personal automobiles. Figure D.2 shows the Seattle maintenance area.

The Tacoma PM_{10} maintenance area is comprised of the industrial area of Tacoma, including the Port of Tacoma, a Kraft pulp mill and other industrial operations. The monitoring site has been in place since 1987 in the industrial area near the Port of Tacoma. The site is neighborhood scale located near several industrial air pollution sources. The sources that impact the area are a mixture of mobile sources, port and marine sources, industrial sources, and winter home heating from wood burning. The site is also within the Puyallup Indian Reservation. Figure D.3 shows the Tacoma maintenance area.

Our emission inventory will be based on sources located within the maintenance areas only.

Figure D.1: The Kent, WA PM10 Maintenance area

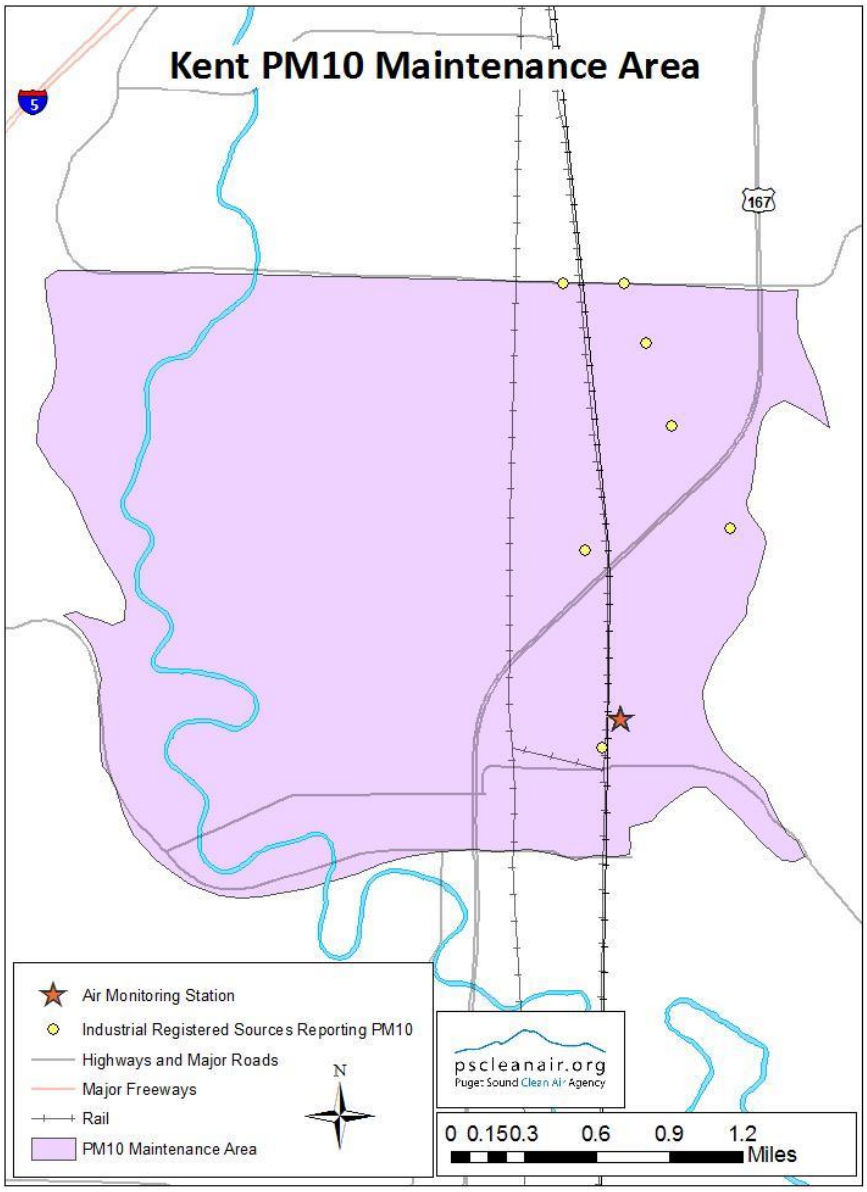


Figure D.2: The Seattle, WA PM_{10} Maintenance area

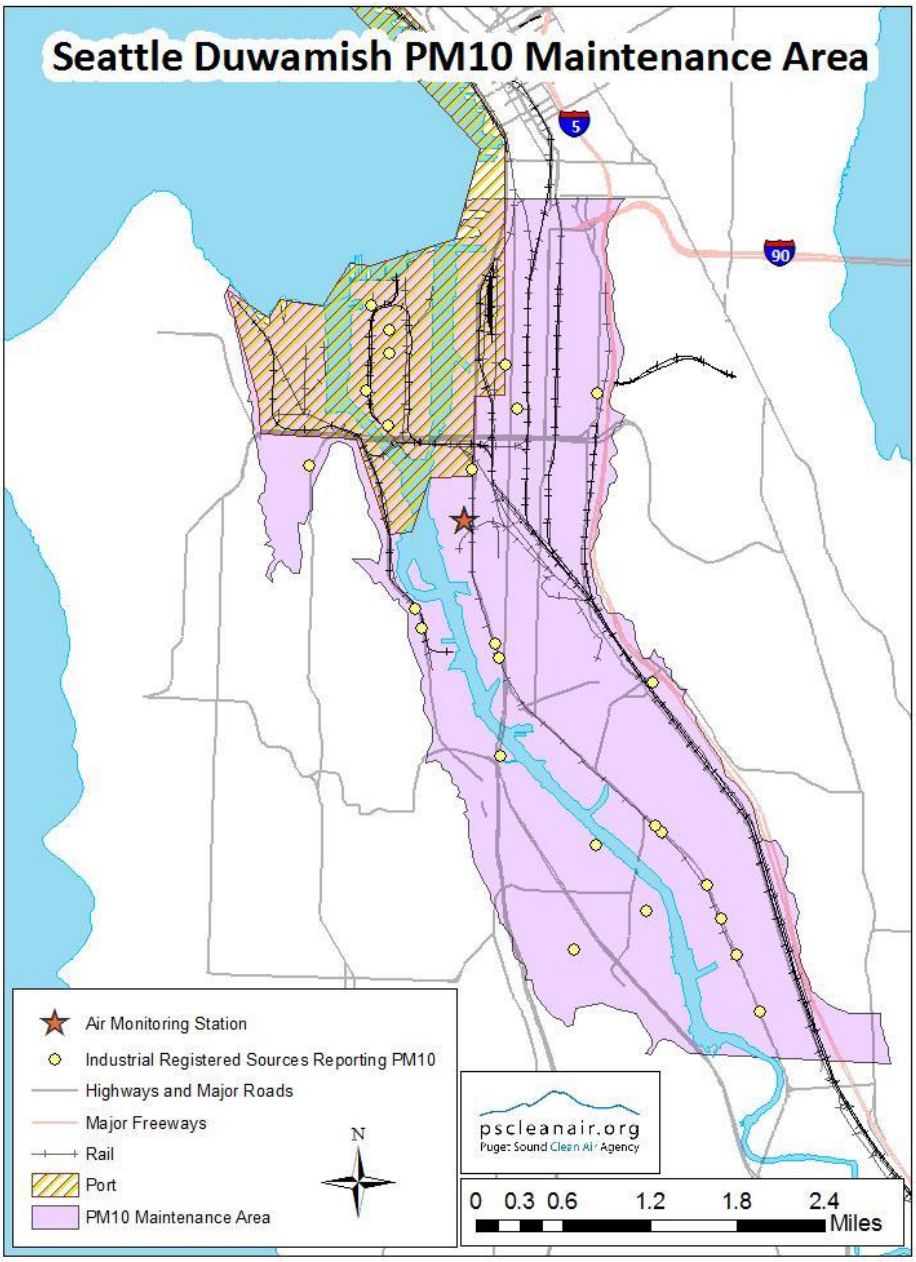
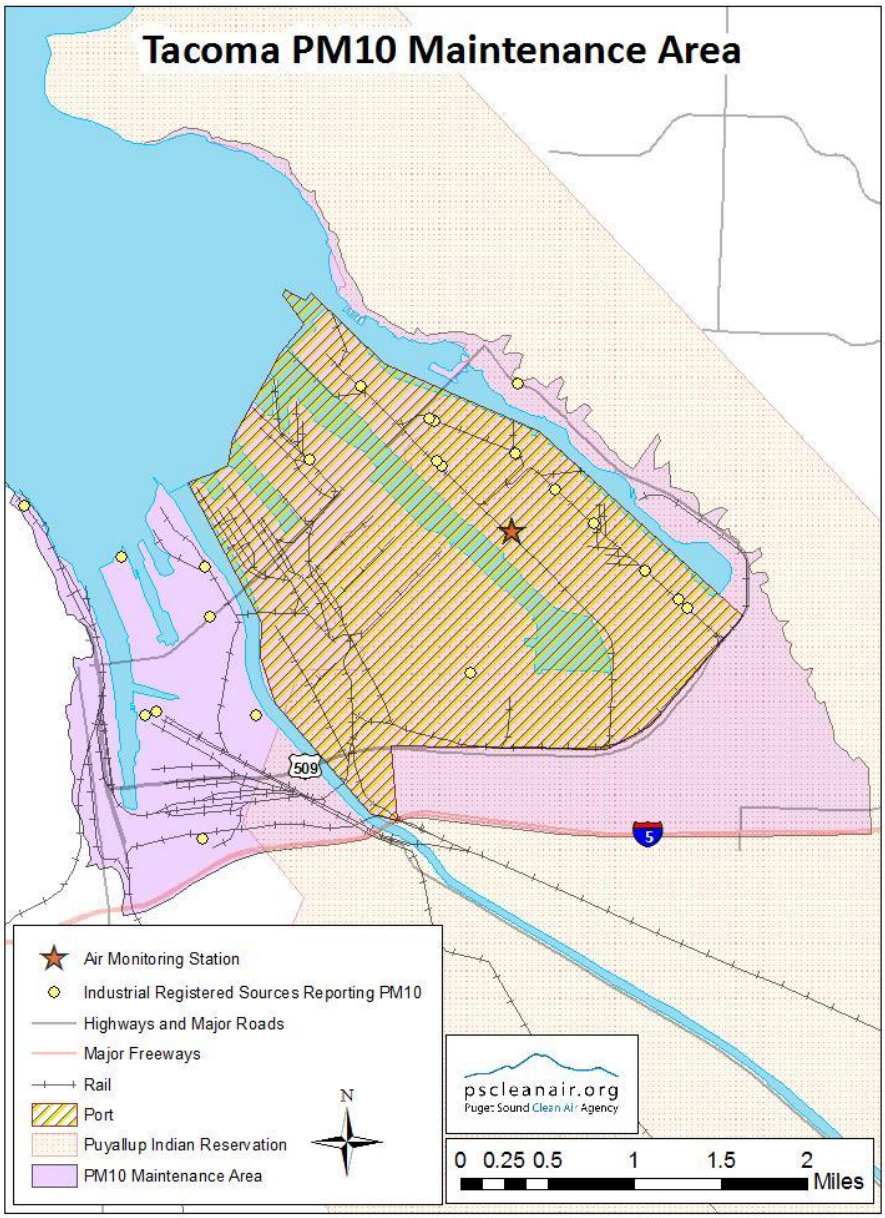


Figure D.3: The Tacoma, WA PM_{10} maintenance area



Temporal Resolution

Historical exceedances of the 24-hour PM_{10} standard occurred primarily during cold days from October through March. Therefore, the inventory will address average winter daily emissions in the maintenance area in addition to annual emissions.

Inventory Development

Ecology and PSCAA will develop an emission inventory using readily available data. We will document the estimation methods and gather information from the relevant inventory reports. We will begin with existing county data and temporally and spatially allocate it to the Kent, Seattle, and Tacoma maintenance areas. The emission inventory will include annual and winter day emissions. Detailed descriptions of the county wide 2011 emission inventory estimates are attached in Appendix A.

We propose seven emissions categories be included in this LMP for the Seattle and Tacoma maintenance areas and six emission categories for the Kent maintenance area. The categories are based on a review of emission categories listed in the first, 1997, maintenance plan. Table D.1 shows the breakdown of average daily PM_{10} emissions in 1994. We will use the same emission categories as the 1997 maintenance plan with the exception of *Allowable Industrial*. We propose to use reported emissions from both registered and air operating permit sources in the LMP. The methodology we plan to use for industrial point sources is outlined in section 2.4.

Table D.1: 1994 PM_{10} Average Daily Emissions from the 1997 maintenance plan

1994 Emissions Categories	Emissions Per Day (kg/day)			Percent of Daily Emissions (%)		
	Kent	Seattle	Tacoma	Kent	Seattle	Tacoma
Wood Burning	77	65	90	42.1	2.3	2.0
Road Dust	30	55	37	16.4	1.9	0.8
Gasoline Exhaust	30	105	50	16.4	3.7	1.1
Diesel Exhaust	45	223	122	24.3	7.8	2.8
Ships	n/a	15	26	n/a	0.5	0.6
Locomotives	1	20	13	0.5	0.7	0.3
Allowable Industrial	n/a	2,374	4,035	n/a	83.1	92.3

Emission Categories

The most significant sources of PM_{10} in the Kent maintenance area are *Residential Wood Combustion (i.e., Wood Burning), Diesel and Gasoline Exhaust, and Road Dust.* Smaller contributions come from *Locomotives*. The *Port and Marine* category is not applicable to the Kent maintenance area. The Seattle and the Tacoma PM_{10} maintenance areas are dominated by *Industrial Emissions* as well as *Port and Marine sources, On-road Mobile, and Locomotives* with some influence from *Residential Wood Combustion*. Table D.2 outlines the emission categories that will be included in the LMP emission inventory. Inventory values for all of these source categories are available from Ecology's 2011 EI[2] for King County and Pierce County.

Table D.2: Emission Categories to be used in this LMP

1994 Emissions Categories	2011 Emission Categories
Gasoline Exhaust	On-road Mobile
Diesel Exhaust	Port and Marine, On-road Mobile
Ships	Port and Marine
Locomotives	Locomotives
Wood Burning	Residential Wood Combustion
Road Dust	Paved Road Dust, Unpaved Road Dust
Allowable Industrial	Industrial

[2] The categories are defined in the 2005 Emission Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations.

On-road Mobile Sources

On-road mobile source emissions are those generated by operating vehicles on public roadways. The LMP Emission Inventory will be based on Ecology's "Washington State Base Year 2011 County Inventories." Winter day emissions were estimated for each county using EPA's Motor Vehicle Emission Simulator (MOVES) model version 2010b, using a combination of default and local data as input parameters. Total PM_{10} emissions included primary PM_{10} from runnning exhaust and start exhaust, as well as brakewear and tirewear particulate.

The number of vehicle miles traveled (VMT) are used in MOVES. The MOVES input files require summations of VMT statistics by several different road and vehicle classifications, which were developed using national Department of Transportation's Highway Performance Monitoring System (HPMS) as obtained from the Washington State Department of Transportation (WSDOT). HPMS is a system of traffic counts collected over several urban and rural sampling areas. WSDOT makes estimates of county VMT by roadway (functional) classifications.

Fleet characteristics, including vehicle population and age distribution, were derived from local data. Registration data from the Washington Department of Licensing (DOL) was supplemented with transit and intercity bus data from the Federal Transit Administration (FTA) and public school bus data from the Washington State Office of the Superintendent of Public Instruction (OSPI).

MOVES defaults were used for gasoline and diesel fuel parameters, which reflect current regulations regarding sulfur content and Reid vapor pressure. All transit buses in Pierce County were assumed to operate using compressed natural gas (CNG).

MOVES defaults were used for meteorological data. MOVES defaults are based on historical meteorological observations from local monitors for each county.

All input parameters are described in Section 3.1 of the 2011 EI. The model parameters and data sources are summarized in Table D.3 below.

Table D.3: MOVES Model Parameters and Data Sources

Parameter	Data Source
County vehicle population	Washington State Department of Licensing (DOL), Federal Transit Administration (FTA), Washington State Office of the Superintendent of Public Instruction (OSPI)
County VMT	Department of Transportation's Highway Performance Monitoring System (HPMS) obtained from the Washington State Department of Transportation (WSDOT)
Temporal allocation to month and day of week	WSDOT
Vehicle age distribution	DOL, FTA, OSPI
Average speed distribution	MOVES defaults
Road type distribution	HPMS obtained from WSDOT
Fuel supply and formulation	MOVES defaults
Meteorology data	MOVES defaults

Port and Marine Emission Estimates

The 2011 inventory prepared for the Puget Sound Maritime Air Forum by Starcrest Consulting Group, LLC was used to estimate emissions from ships in Puget Sound.[3] The inventory is a bottom-up, activity-based emissions inventory which provides detailed information on the five major source categories associated with the marine activities: ocean-going vessels, harbor vessels, cargo handling equipment, on-road heavy-duty vehicles, and rail operations. It was an update to a similar inventory prepared by Starcrest for the 2005 inventory. Activity level and emission rates are described in the source inventory documentation.

Locomotives

Emissions from Class I line haul and switch yard locomotives were estimated using EPA guidance and other information.[4] U.S. Class I railroads are line haul freight railroads with operating revenue in excess of $319.3 million (amount changes over time). Two Class I railroads operate in Washington: Burlington Northern Santa Fe Railway (BNSF) and Union Pacific Railroad (UP). Amtrak was also included in this inventory. Class 2 and 3 railroad locomotive emissions were not inventoried. A special AIRQUEST (formerly Northwest Regional Technical Center) project conducted by the Oregon Department of Environmental Quality (ODEQ) found that emissions from Class 2 and 3 railroad locomotives were a small percentage of total locomotive emissions.[5, 6]

BNSF and UP provided activity and emissions information for 2011. Amtrak provided only activity information for 2011.

Activity level is measured in gallons of diesel consumed by locomotives. All of the railroads provided county fuel use for line haul and switch yard locomotives for 2011.[7]

Most of the activity information is available in the maintenance areas and no spatial surrogate is necessary. Spatial surrogates for passenger rail and coal line will be based on the length of rail in each county.

Locomotives were assumed to operate uniformly year-round per EPA guidance.[8]

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3 2011 Puget Sound Maritime Air Emissions Inventory. Prepared by: Starcrest Consulting Group, LLC, Starcrest Consulting Group, LLC, Poulsbo, Washington 98370. September 2012.
4 Procedures for Emission Inventory Preparation, Vol. IV: Mobile Sources. EPA-450/4-81-026d (Revised), Section 6.0. 1992.
5 Regional Technical Center Demonstration Project: Summary Report. Idaho Department of Environmental Quality, Oregon Department of Environmental Quality, Washington Department of Ecology, US EPA Region 10, Washington State University, University of Washington. January 11, 2002 (draft).
6 Oregon 1996 Railroad Emissions Inventory Project, Emission Estimate Methodology Documentation. Oregon Department of Environmental Quality. August 2001.
BNSF, UP and Amtrak Railway Company 2011 Estimation of Locomotive Emissions. Email transmittal of information from Kelly Harvey (BNSF), Michael Germer (UP), and Delia Ann Pfleckl (Amtrak) to Sarah Clouse Washington State Department of Ecology. March 2012. County fuel use and emissions.
8 Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume II, table 6-11. EPA-454/R-92-026, March 1992.

Fugitive coal dust emissions from rail transport will be estimated using the suggested approach described by Cope and Bhattacharyya, 2001.[9]

Industrial Emissions

The federal Clean Air Act defines point sources as any stationary source having the potential to emit 100 tons per year of a criteria pollutant. These sources require Air Operating (Title V) Permits.

Sources that emit more than 25 tons but less than 100 tons per year of PM_{10} must register with the Puget Sound Clean Air Agency. These registered sources must report their PM_{10} emissions if over 25 tons per year. Although not required, many other sources report their PM_{10} emissions.

Table D.4 The number of industrial sources (active or inactive) reporting PM_{10} emissions between 1994 and 2011.

Table D.4: The number of industrial sources (active or inactive) reporting PM10 emissions between 1994 and 2011.

Maintenance Area	Air Operating Permit Sources	Other reporting sources	Total
Seattle	8	17	25
Tacoma	5	17	22
Kent	1	6	7
Grand Total	**14**	**40**	**54**

For a more complete inventory, we propose to use reported emissions from both air operating permit sources and other reporting registered sources. All these sources fall within PSCAA's jurisdiction, except for Simpson Tacoma Kraft. Ecology will provide PSCAA available emissions data for Simpson Tacoma Kraft by Source Classification Code (SCC) code or facility back to 1994.

Typically, the maximum allowable emissions are used in maintenance plan demonstrations. We propose to us a similarly conservative estimate grounded by historical emission data.

We propose to use the maximum actual emissions since 1994 for each SCC or facility for all the reported emissions from air operating permit sources and other registered sources in our emission estimate. That is, we would include every maximum emission from each segment from each point source even if the maximum of different segments is on different years. This gives the most conservative estimate of emissions from each industrial source.

[9] Cope, Douglas; Bhattacharyya Kamal. "A Study of Fugitive Coal Dust Emissions in Canada", prepared for the Canadian Council of Ministers of the Environment, 2001.

We've determined with our professional judgment that the maximum reported actual emissions result in a more representative estimate than allowable emissions do. Specifically, only air operating permit sources are included in allowable emissions, and our proposed approach also includes the 40 other sources (see Table D.1) that would not be captured anywhere else. Similarly, the maximum actual emissions represent real potential emissions rather than a theoretical estimate that is often never reached in practice.

Table D.5 below demonstrates that our proposed industrial emission estimate approach is comparable to the allowable emission estimate.

Table D.5: PM_{10} Emissions from all industrial sources from 1994 to 2011:

Maintenance Area	1994 Allowable Emissions (tons)	Max of emissions each emission segment since 1994 (tons)	1994 actual emissions (tons)	2011 actual emissions (tons)
Seattle	955	866	510	127
Tacoma	1,624	1212*	544*	243
Kent	N/A	1.0	0.1	0.5

* Since data for Simpson Tacoma Kraft is missing for 1994 and 1995, 1996 data was used for the 1994 actuals. The Simpson Tacoma Kraft maximum was estimated using 1996-2011 emissions.

Since the last maintenance plan was written in 1994, many sources have stopped reporting their emissions. These industrial sources either reduced their emissions below 25 tons per year or they are no longer active. To remain conservative in our estimate, we propose to include these sources in the inventory as well.

Since Simpson Tacoma Kraft data is missing for 1992-1994, we propose to use the maximum reported emissions back to 1996 instead of 1994.

Nonpoint Source Emission Estimates

Residential Wood Combustion, Unpaved Road Dust, and Paved Road Dust are nonpoint sources. These emissions are typically estimated by multiplying an activity level, such as wood combusted or Vehicle Miles Traveled (VMT), by an emission factor in mass per activity.

Emissions = Activity level x Emission Factor

Estimation methods and data sources for these nonpoint sources are described below.

Residential Wood Combustion

Residential wood combustion (RWC) emissions will be based on the "Washington State Base Year 2011 County Inventories." Residential wood combustion consists of home heating and recreational use of woodstoves, fireplaces, fireplace inserts, and pellet stoves. Other residential wood burning devices were not inventoried. The measure of activity for residential wood combustion is the amount of wood burned. Residential wood combustion activity for King County and Pierce County was estimated using data from a survey conducted by the National Research Center in 2007 (NRC2007). Criteria pollutant emission factors in pounds of pollutant per ton of wood burned were taken from version 1 of EPA's 2011 Residential Wood Combustion tool.

Spatial and Temporal Allocation

Spatial allocation will be based on the number of households in the maintenance area for the year 2011. Temporal allocation was completed by Ecology and is based on a relationship between temperature and ambient fine particulate concentrations. For more detail please see the Ecology 2011 Emission Inventory in Appendix A.

Paved Road Dust

Dust emissions are generated as vehicles pass along paved roadways and disturb the layer of loose material on or near the road surface. This material contains particulate matter from soil, brake and tire wear, exhaust, and other substances. The paved road dust calculation excludes emissions from exhaust and brake and tire wear. These vehicle emissions are estimated as on-road mobile sources emissions**.** VMT on unpaved roads was estimated using data from the County Road Administration Board (CRAB) and WSDOT. The Road Dust equations in AP-42 were used to calculate emission factors[10]. The measures of activity and spatial allocation will be based on VMT in the maintenance areas. Temporal allocation is identical to the on-road category.

Unpaved Road Dust

Similar to paved roads, dust emissions are generated as vehicles pass along unpaved roadways and disturb the layer of loose material on or near the road surface. This material contains particulate matter from soil, brake and tire wear, exhaust, and other substances. The unpaved road dust calculation excludes emissions from exhaust and brake and tire wear since they are estimated as on-road mobile sources emissions. The Road Dust equations in AP-42 were used to calculate emission factors[11].

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[10] Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources. AP42. Section 13.2.1 Paved (11/06) and Section 13.2.2 Unpaved (11/06). (Note that the methodology for calculating Road Dust for the maintenance plan was different. The alternative method correlated relative humidity and entrained road dust using a WSDOT 2006 algorithm.)
[11] Ibid. 10

Spatial Allocation Methods

Spatial surrogates are used to approximate emissions inside the three maintenance areas from county data. For sources without specific coordinates, spatial surrogates are used to approximate both the location and magnitude of the emissions. Maintenance area (MA) emissions are estimated as:

$$E_{MA} = E_{County} * Surrogate_{MA} / Surrogate_{County}$$

Where E_{MA} = emissions in the maintenance area, E_{County} = emissions in county,

$Surrogate_{MA}$ = surrogate activity in the maintenance area, and $Surrogate_{County}$ = surrogate activity in county.

The spatial surrogates and data sources used are shown in Table D.6 below.

Table D.6: Spatial Surrogates

Sector and Category	Spatial Surrogate	Data Source
Nonpoint Sources		
Woodstoves and Fireplaces	Households or Population	Puget Sound Regional Council (PSRC)
Paved Road Dust	VMT	PSRC
Unpaved Road Dust	VMT	WSDOT
On-Road Mobile Services		
All Vehicles	Road VMT	PSRC
Non-Road Sources		
Marine and Port	Port Area in Maintenance Area	2011 Puget Sound Maritime Air Emission Inventory
Locomotives – Line Haul	Line Haul shape fractions, with activity level	EPA Rail Activity Use Shape File
Locomotives - Passenger	Fraction of rail in maintenance area	County Rail Shape Files

Temporal Allocation Methods

Annual emissions data will be adjusted to tons per average winter day for the maintenance area for each source category. Methods for each category are described below.

Residential Wood Combustion

Residential wood combustion activity for King County and Pierce County was estimated using data from a survey conducted by the National Research Center in 2007 (NRC2007). Temporal allocation was based on a relationship between temperature and ambient fine particulate concentrations. Briefly, analysis of several $PM_{2.5}$ and meteorological monitoring sites showed a strong linear relationship between ambient temperature and ambient fine particulate concentrations at temperatures below 50 degrees Fahrenheit.[12] Heating degree days (based on 50 degrees = HDD_{50}) were calculated for each day during the NRC2007 survey period (Sept. 2006 - Aug. 2007).[13] The season total HDD_{50} were divided by the annual HDD_{50} to estimate seasonal fractions.

On-road Mobile Sources

VMT is not temporally uniform. WSDOT provided adjustment factors for month, day-of-week, and hour (weekday and weekend).[14]

Road Dust

VMT is not temporally uniform. WSDOT provided adjustment factors for month, day-of-week, and hour (weekday and weekend).[15]

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[12] Clint Bowman, Ecology, On a Possible Wood Stove Signature in PM2.5 Observations, October 2008.

[13] Tacoma South L-Street meteorological site.

[14] Email from Guorong Liu, Washington State Department of Transportation to Sally Otterson, Washington State Department of Ecology. Transmitting spreadsheets with monthly, day-of-week, and hourly adjustment factors. Seasonal Factor_08.xls, Day of Week Factor_08.xls, Hourly Factor_08.xls. Nov. 24, 2009. Ibid. i

[15] Ibid. i

Quality Assurance and Quality Control

We are using existing data that has already been quality checked. Ecology uses the data quality objectives of accuracy, completeness, comparability, and representativeness. Ecology and PSCAA staff will perform quality assurance on the spatial and temporal allocation of emissions from the existing inventory.

External Audits

The state is willing to be audited by EPA, and make changes to this inventory preparation and quality assurance plan if warranted.

Responsibility

Since we are using available data, the inventory process will be simplified. PSCAA will create the inventory with assistance from Ecology and PSRC. Both agencies will participate in inventory review and quality assurance activities outlined in this plan.

Schedule

The section below shows the schedule for document submittal to EPA Region 10. We will submit the final inventory according to this Inventory Preparation and Quality Assurance (IP/QA) Plan.

Draft SIP Development Plan (PSCAA)	August 16, 2013
Draft Inventory Preparation Plan (IPP) (PSCAA)	August 23, 2013
Draft Plan Development and Supporting Technical Work (PSCAA)	August 30, 2013
SIP to Ecology (and EPA) (PSCAA)	September 12, 2013
Ecology, EPA Review and PSCAA revisions (All)	September 12 – 27, 2013
Public comment period (incl. public notice, press release etc) (Ecology)	September 27 – Nov. 7, 2013
Ecology signature and submittal to EPA (Ecology)	Week of December 2, 2013