Photo Courtesy: USGS/Cascades Volcano Observatory

# Proposed State Implementation Plan Revision

## Tacoma-Pierce County Nonattainment Area

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# Proposed State Implementation Plan Revision

## Tacoma-Pierce County Nonattainment Area

*by*

*Washington State Department of Ecology*
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*Olympia, Washington*

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# List of Abbreviations and Other Terms

**$\mu g/m^3$:** Micrograms per cubic meter

**98th percentile:** The calculation for the 24-hour standard design value uses the 98th percentile from the daily measurements. A percentile is a measure used to rank information. For air pollution, the 98th percentile measurement is the measurement for the day that has pollution levels higher than 98% of the other days in the year. To determine the 98th percentile for a full year of sampling where 365 measurements are taken, we ignore the highest 2% of measurements – which means the highest 7 measurements are ignored (2% of 365 is 7). The 8th highest daily measurement is the 98th percentile.

**CAPC:** Clean Air Performance Commitment. An agreement signed by Ecology, EPA, PSCAA, and the Puyallup Tribe to use an innovative approach to achieving air quality goals in the nonattainment area.

**CDD:** Clean Data Determination. A CDD means the Nonattainment Area met the standard for fine particle pollution during the most recent three-year period (2009-2011)

**Design Value:** A calculation done on the monitoring data from a FRM monitor. EPA uses the design value to determine an area's compliance with federal health based air quality standards known as NAAQS.

**Ecology:** Washington State Department of Ecology

**Emissions Inventory:** Calculation of the amount of pollutants released into the air during a specific time period

**EPA:** United State Environmental Protection Agency

**FRM:** Federal reference method

**Interagency State Implementation Plan Environmental Justice Work Group:** An interagency work group organized by Ecology to integrate additional environmental justice concerns into the planning work related to the Nonattainment Area.

**LEP:** Limited English Proficient

**NAAQS:** National Ambient Air Quality Standard

**Nonattainment Area:** The Tacoma-Pierce County Nonattainment Area. A nonattainment area is an area that does not meet one or more of the federal health based air quality standards known as the NAAQS.

**$NO_X$:** Nitrogen oxide

**$PM_{2.5}$:** Another term for fine particles. Particles that are less than 2.5 micrograms in diameter

**Priority Communities:** Communities identified by the Interagency State Implementation Plan Environmental Justice Work Group as potentially having disproportionate effects from fine particle pollution or the strategies to reduce fine particle pollution

**PSCAA:** Puget Sound Clean Air Agency

**RCW:** Revised Code of Washington

**SIP:** State Implementation Plan

**SIP revision for the Tacoma-Pierce County Nonattainment Area:** Washington's proposed plan to improve air quality in the Tacoma-Pierce County Nonattainment Area

**$SO_2$:** Sulfur dioxide

**Tacoma-Pierce County Nonattainment Area:** Most of the greater Tacoma and the surrounding communities within Pierce County's urban growth area west of State Route 167. EPA designated this area nonattainment for the 2006 24-hour fine particle national ambient air quality standard in 2009

**Tacoma–South L Street:** The monitoring site in the Nonattainment Area with a monitor that uses the FRM. EPA uses data from the FRM monitor at Tacoma – South L Street to determine compliance with the federal health based fine particle standards.

**Task Force:** The Tacoma-Pierce County Clean Air Task Force.

**UGA:** Urban growth area

**WAC:** Washington Administrative Code

**Wapato Hills-Puyallup River Valley Nonattainment Area:** Tacoma-Pierce County Nonattainment Area. Ecology used this name when proposing the boundary for the Nonattainment Area in 2008.

**VOC:** Volatile Organic Compounds

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# Executive Summary

## Introduction

In 2009, the United States Environmental Protection Agency (EPA) designated part of Pierce County as a nonattainment area. This designation is due to unhealthy levels of fine particle pollution from 2006-2008 (74 FR 58688, Nov. 13, 2009). The Tacoma-Pierce County Nonattainment Area (Nonattainment Area) (also known as the Wapato Hills-Puyallup River Valley Nonattainment Area) covers most of the greater Tacoma area and the surrounding communities within Pierce County's urban growth area (UGA) west of State Route 167.

This proposed State Implementation Plan (SIP) revision details Washington's plan to improve air quality in the Nonattainment Area. The revision includes:

- A description of how the area will meet federal planning requirements for a nonattainment area.
- Local rules to help improve air quality.
- Information on activities and projects carried out as part of the planning process for the SIP revision.

## Why fine particle pollution is a problem

The tiny size of fine particle pollution (i.e., dust, soot, smoke) allows us to inhale it easily. The tiny particles travel deep into our lung and circulatory system. As a result, fine particles have both short- and long-term health effects including respiratory disease, decreased heart and lung function, asthma attacks, heart attacks, strokes, and premature death. Fine particle pollution affects everyone, but has the most harmful effect on children, older adults, and people with respiratory and cardiac diseases.

Fine particle pollution in the Nonattainment Area is worse during the winter months when low temperatures and still winds trap fine particles close to the ground. This causes air pollution to build up rapidly.

## Tracking fine particle pollution

The Washington State Department of Ecology (Ecology) and the Puget Sound Clean Air Agency (PSCAA) used data from three monitoring sites in the nonattainment area to track the levels and sources of fine particles. An emissions inventory, a calculation of the amount of pollutants released into the air during a specific time period, provided additional support about what the pollution is and where it comes from.

# Air quality in the Nonattainment Area

## Federal air quality standards

EPA has set two National Ambient Air Quality Standards (NAAQS) for fine particle pollution. These standards are:

- 24-hour standard–focuses on short-term health effects
- Annual standard–focuses on long-term health effects

## Clean Data Determination

When EPA designated the Nonattainment Area, the area did not meet the 2006 24-hour standard for fine particles. Recent monitoring data (2009–2011) shows that the Tacoma-Pierce County Area now meets the 2006 24-hour standard for fine particles. Based on that data, Ecology requested a Clean Data Determination (CDD) in 2012. On July 5, 2012, EPA acted on Ecology's request with a proposed CDD for the Tacoma-Pierce County Nonattainment Area (77 FR 39657). EPA received no comments on the proposal and we expect that EPA will finalize this determination in the near future.

A CDD remains in effect only as long as the area continues to meet the standard. The reduction strategies for fine particle pollution, outreach and community involvement, and environmental justice efforts described in this proposed SIP revision will be critical for continuing to meet the standard in the future.

# What is in the SIP revision

## CDD requirements

This SIP revision contains planning requirements that are still required under a CDD. In the future, Ecology will make separate submissions to EPA for:

- Nonattainment permitting requirements.
- Air quality criteria for transportation conformity.
- A maintenance plan and redesignation request.

## Clean Air Performance Commitment

In April 2010, Ecology signed an agreement with EPA, PSCAA, and the Puyallup tribe to use an innovative approach to achieving air quality goals in the nonattainment area. This agreement, referred to as the Clean Air Performance Commitment (CAPC), should:

- Achieve the same or greater environmental improvements more quickly than the traditional process.
- Create a more flexible/adaptable process for implementing controls, while incorporating measures to ensure accountability.
- Implement targeted local control measures that complement national measures.

- Provide early and meaningful opportunities for public involvement.
- Focus on environmental justice concerns in the nonattainment area.

## Public involvement

This SIP revision includes a description of public involvement activities and the efforts to identify environmental justice concerns in the Nonattainment Area.

### Tacoma-Pierce County Clean Air Task Force

PSCAA established the Tacoma-Pierce County Clean Air Task Force (Task Force) to involve the public in developing community-based solutions to reduce fine particle pollution in the nonattainment area. The Task Force recommended:

- Increased enforcement during burn bans.
- Requiring removal of uncertified wood stoves and inserts.
- Work to reduce other source of fine particle pollution.

### Interagency work group

Ecology organized an interagency work group to integrate additional environmental justice concerns into the planning work for the Nonattainment Area. The work group developed the following goals:

- Reduce health risks from fine particle pollution in priority communities (communities identified as potentially having disproportionate effects from fine particle pollution or the strategies to reduce fine particle pollution).
- Consider social and environmental effects on priority communities when determining how to reduce fine particle air pollution.
- Build meaningful public participation in the SIP development and decision making processes. Design a communication strategy that informs and engages priority communities.
- Direct resources and incentives to priority communities.
- Track progress and lessons learned in the Tacoma-Pierce County Nonattainment Area for future planning work throughout Washington.

# Public comment period

Ecology will accept public comments on the proposed SIP revision during a public comment period from September 10 to October 19, 2012, and at a public hearing on October 17, 2012. Ecology will review, respond to, and incorporate comments before finalizing the SIP revision. After submitting the final SIP revision to EPA, Ecology will begin developing the maintenance plan and redesignation request.

Ecology welcomes all comments on the proposed SIP revision. However, we are particularly interested in comments on:

- 2008 Emissions Inventory for the Nonattainment Area.
- Ecology's decision to include the entire PSCAA Regulation 1-13 Solid Fuel Burning Devices in the State Implementation Plan.[1]

[1] Ecology will respond to comments about including the PSCAA's proposed rule in the SIP revision. We will NOT respond to comments on the content of the PSCAA proposed rule. The PSCAA comment period for their rule ends September 26, 2012. Direct your comments about the rule content directly to PSC AA at <www.pscleanair.org> by that date. Ecology included the proposed PSCAA Regulation 1-13 in the SIP revision. If PSCAA adopts the rule without significant change, Ecology will include the final Regulation 1-13 in the final SIP revision sent to EPA.

# Area Description

The Tacoma-Pierce County Nonattainment Area (Nonattainment Area) lies approximately 20 miles south of Seattle, Washington. It covers most of the greater Tacoma area and the surrounding communities within Pierce County's UGA west of SR 167. Figure 1 shows an outline of the Nonattainment Area and the approximate location of the monitoring sites in the area.

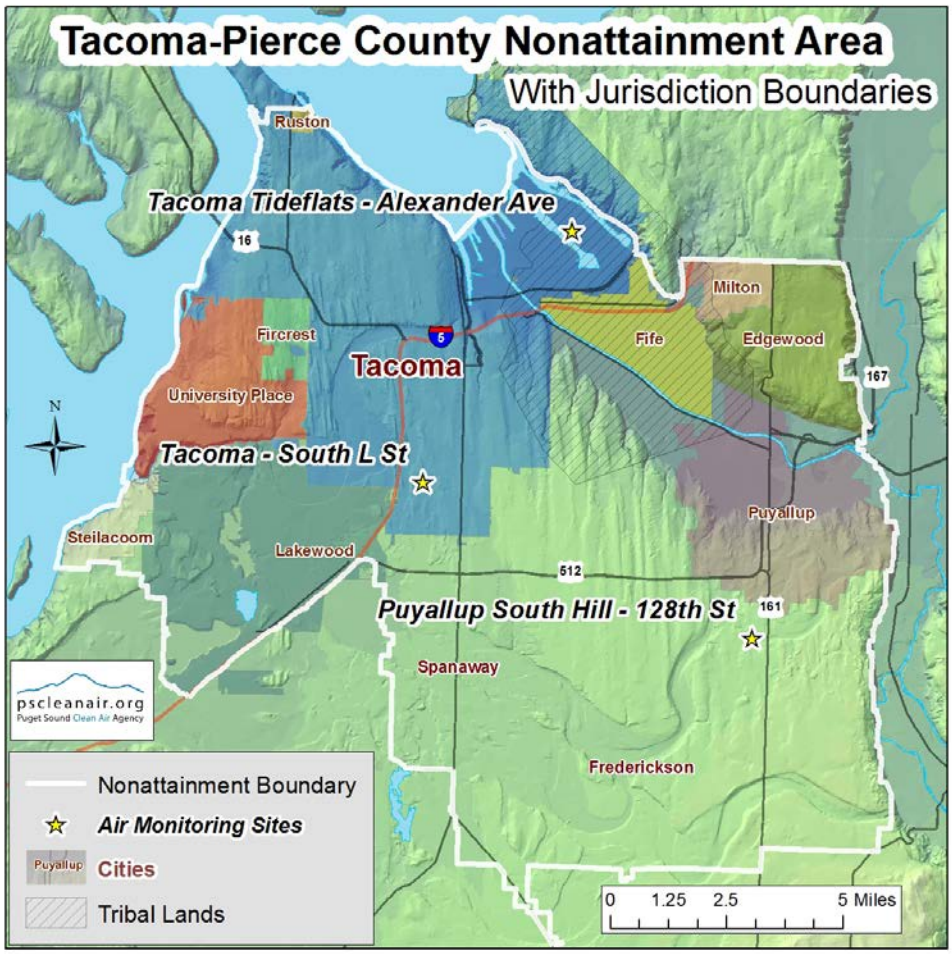


**Figure 1: Map of Tacoma-Pierce County Nonattainment Area.**

The topography surrounding the Nonattainment Area influences its meteorology. Important topographical features include:

- Puget Sound to the north and west.
- Cascade Mountains to the east and southeast.
- Puyallup River Valley running through the area.

# Meteorology

In the Nonattainment Area, summers are cool and comparatively dry while winters are mild, wet, and cloudy. In November and December, the wettest months, precipitation is frequently recorded on over 20 days each month. Usual wind flow is from west-southwest. However, high levels of fine particle pollution are associated with very light east-southeast surface winds, as well as calm conditions.

Elevated fine particle levels (greater than 20 micrograms per cubic meter ($\mu g/m^3$)) typically occur between October and March when temperatures are low (less than 50 degree Fahrenheit) and winds are light (less than 1.5 miles per hour). Figure 2 shows that the highest levels of fine particle pollution occur during the winter months, October–February 2000–2010.[2]

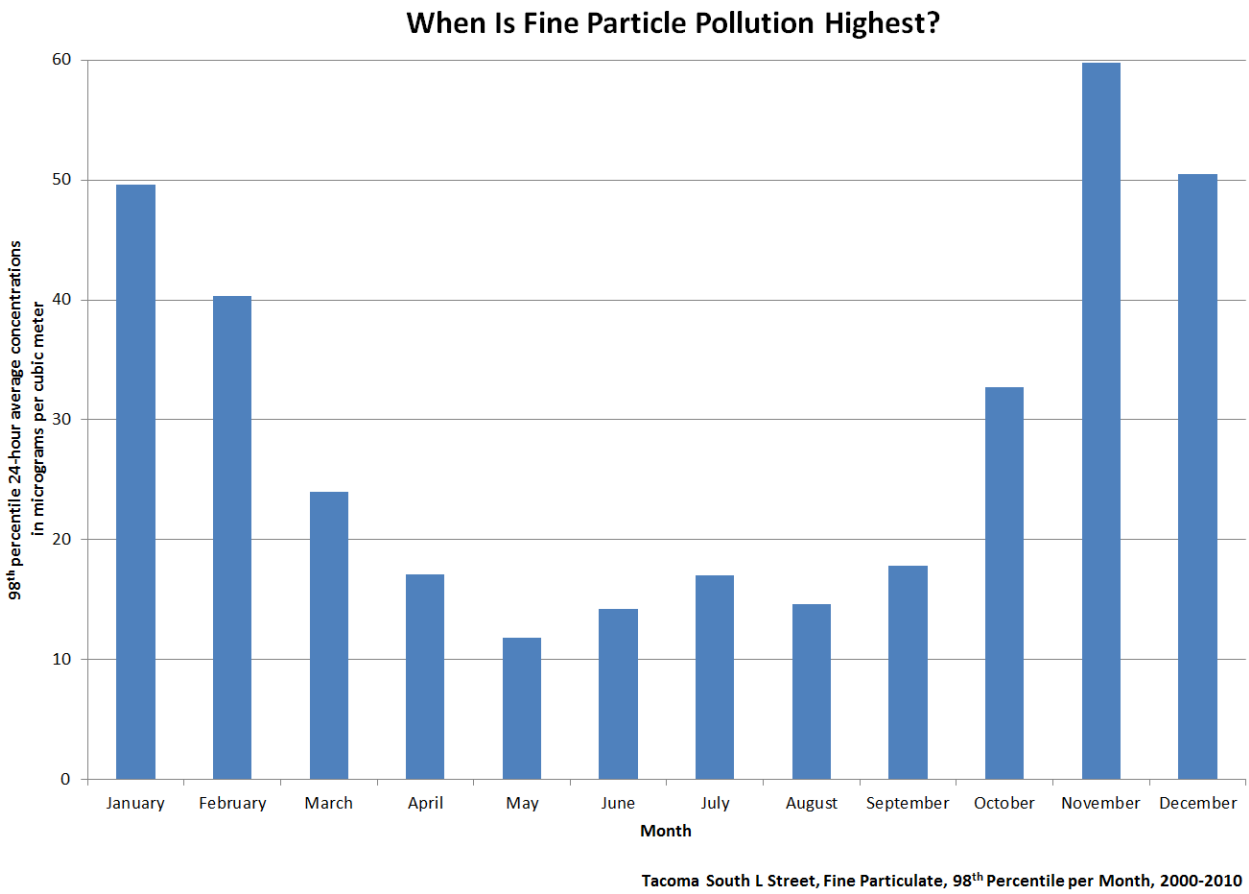


**Figure 2: 98th Percentile 24-hour Fine Particle Pollution Levels by Month, Tacoma–South L Street Monitor from 2000–2010**

[2] Figure 2 shows the 98th percentile concentration for each month using 10 years of data. The figure illustrates when fine particle levels are highest. This is not the form of the federal air quality standard, but is used here for demonstration purposes only. The Monitoring Section, p. 4, of this document describes the method for calculating the design value.

On days with high levels of fine particle pollution, levels rose rapidly beginning about 3 to 4 pm and peak between 12 midnight and 1 a.m. A smaller increase is often observed between 6 a.m. and 8 a.m. Outside of the home heating season (non-winter months of April–September), there is little variation of the fine particle concentration throughout the day with the exception of July days with firework celebrations. Figure 3 shows the winter day pattern of fine particle levels.

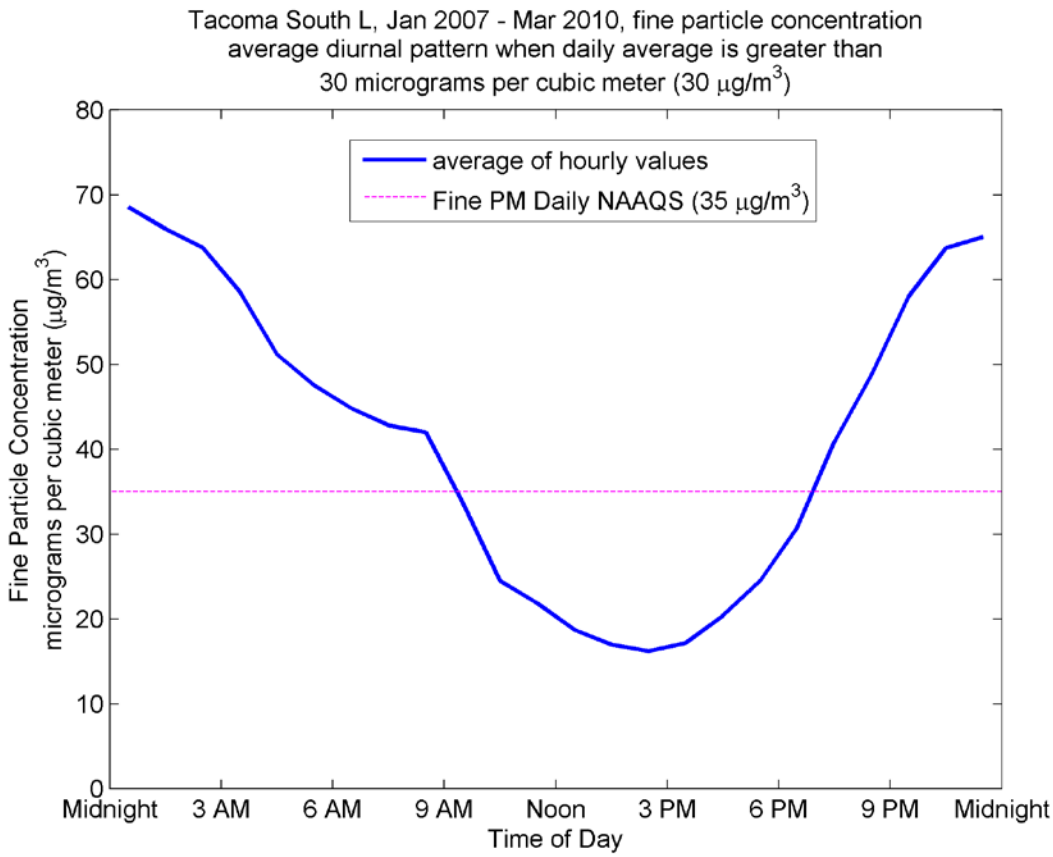


**Figure 3: Winter 24-hour Pattern of Fine Particle Levels, Tacoma–South L Street**

# Monitoring

PSCAA currently operates three monitoring sites in the Nonattainment Area at the following locations:

- Tacoma–South L Street
- Puyallup–128th Street
- Tacoma Tideflats–Alexander Avenue

Figure 1, in the Area Description section, shows a map of the monitoring locations.

EPA uses the data from the Tacoma–South L Street monitor to determine compliance with federal health-based fine particle standards. Tacoma–South L Street is the only site of the three with a monitor that uses the Federal Reference Method (FRM). The FRM specifies the various federal requirements a compliance monitor and its site must meet before EPA can compare its data to the fine particle standard. The other two sites provide additional information that help PSCAA characterize fine particle levels throughout the Nonattainment Area. PSCAA uses information from all three sites to determine when levels of fine particle pollution are elevated. They then determine whether actions, such as calling a burn ban, are necessary to reduce levels.

The FRM monitor at Tacoma – South L Street site is at an elevation of 341 feet above sea level. It collects information about fine particle levels in 24 hour increments. EPA uses this 24-hour data to calculate "design values". Before January 2010, the monitor collected a sample once every three days, the minimum required by the FRM. Currently, the monitor collects a sample every day of the year. The design value calculated from the information is compared to either the annual or the 24-hour federal standard.

## Calculating the design value

For the daily standard, EPA uses the yearly 98th percentile from three years in a row to calculate an average. This average is called the design value. EPA compares the design value to the 24-hour NAAQS for fine particles, which is 35 $\mu g/m^3$. If the design value is above 35 $\mu g/m^3$, the area does not meet the standard. When calculating the average, EPA rounds the final number before comparing it to the standard (35.4 = 35, 35.6 = 36). For the annual standard, EPA calculates the design value for the annual standard by averaging all available FRM data from three years in a row.

The calculation for the 24-hour standard design value uses the 98th percentile from the daily measurements. A percentile is a measure used to rank information. For example, if we lined up 100 people from shortest to tallest, the person in the 98th percentile would be the person taller than 98 percent of the people (second tallest).

For air pollution, the 98th percentile measurement is the measurement for the day that has pollution levels higher than 98 percent of the other days in the year. To determine the 98th percentile for a full year of sampling where 365 measurements are taken, we ignore the highest

two percent of measurements—which means the highest seven measurements are ignored (two percent of 365 is seven). The eighth highest daily measurement is the 98th percentile.

Fine particle measurements throughout the Nonattainment Area suggest the highest levels of fine particle pollution occur in the core of the Nonattainment Area, within about three kilometers of the Tacoma–South L Street monitor. While not as high as the Tacoma–South L Street monitor, monitors at other sites in the Nonattainment Area show elevated levels of fine particles.[3]

EPA designated the Tacoma-Pierce County Area as nonattainment because the 24-hour design value from 2006–2008 was 44 µg/m$^3$. This is higher than the 2006 24-hour fine particle standard of 35 µg/m$^3$. Figure 4 shows the 98th percentile values used to calculate the 24-hour design value. The 24-hour design value is rounded to a whole number (44.0666 = 44).

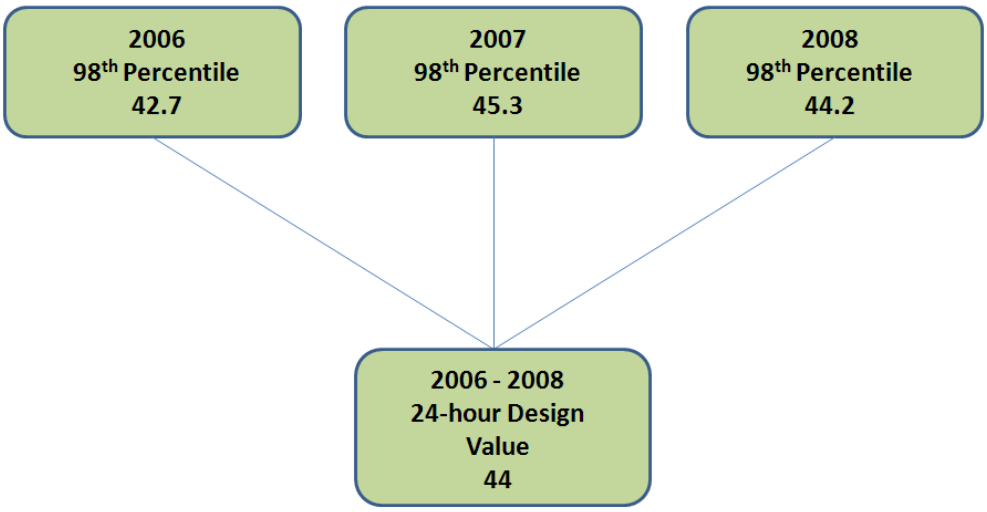


**Figure 4: Calculation of the 2006–2008 24-hour Design Value for Tacoma–South L Street**

[3] Please find additional information in *Tacoma-Pierce County Clean Air Task Force–Report and Recommendations to Puget Sound Clean Air Agency and Summary Technical Report in Support of $PM_{2.5}$ CAPC process for Tacoma*. Links are included in the "Additional Resources" section at the end of this document.

# Clean Data

Monitoring data from 2009–2011 shows the Tacoma-Pierce County Area met the 2006 24-hour federal standard for fine particles. Based on that data, Ecology requested a CDD. A CDD means the Nonattainment Area met the standard for fine particle pollution during the most recent three-year period (2009–2011). On July 5, 2012, EPA acted on Ecology's request with a proposed CDD for the Tacoma-Pierce County Nonattainment Area (77 FR 39657). EPA received no comments on the proposal and we expect that EPA will finalize this determination in the near future.

As shown below in Table 1, fine particle levels were very low in 2010 largely because of unusually favorable meteorological conditions. Since the CDD remains in effect only as long as the area continues to meet the standard, the reduction strategies for fine particle pollution, outreach and community involvement, and environmental justice efforts described in the subsequent chapters will be critical for continuing to meet the standard in the future. Lastly, the SIP strengthening rules contained in Appendix B will be a key foundation for any future maintenance plan or redesignation request as described below.

Table 1 shows the monitoring data from 2007–2011. It includes 98th percentile and design values. The design value for 2009–2011 meets the 2006 24-hour standard for fine particles of 35 $\mu g/m^3$.

**Table 1: Tacoma-South L Street 98th Percentiles and 24-hour Design Values for 2007–2011**

| | | Design Value | | |
|---|---|---|---|---|
| **Year** | **98th Percentile** | **2007-2009** | **2008-2010** | **2009-2011** |
| 2007 | 45.3 | 46 | | |
| 2008 | 44.2 | | 38 | |
| 2009 | 47.6 | | | 35 |
| 2010 | 21.4 | | | |
| 2011 | 35.7 | | | |

The focus of this SIP revision is on planning requirements that are still required under a CDD. Ecology will make separate submissions to EPA for the nonattainment permitting requirements and air quality criteria for transportation conformity.

# Emissions Inventory

An emissions inventory calculates the amount of pollutants released into the air. It looks at a specific geographic area over a specific time span. The inventory also calculates how much of each pollutant comes from each type of pollution causing activity. We refer to each type of activity as a source category.

For the Nonattainment Area, the federal Clean Air Act requires Ecology to prepare a comprehensive, accurate, current inventory of actual emissions for fine particles ($PM_{2.5}$), sulfur dioxide ($SO_2$), nitrogen oxides ($NO_X$), volatile organic compounds (VOCs), and ammonia. Appendix A contains the entire 2008 emissions inventory for the Tacoma-Pierce County Nonattainment Area and a description of the methodology Ecology used for the calculations.

The 2008 Nonattainment Area inventory estimates fine particle levels for the whole year and also for a single winter day. We used data from 2008 because it is the latest year of the National Emissions Inventory.[4] The 24-hour standard focuses on emissions on a single day. Additionally, elevated concentrations of fine particles have typically occurred between October and March. Therefore, we developed a winter day inventory as well.

Figure 5 shows the percentage of fine particles from each source category in the winter day inventory. Seventy-four percent of emissions in the Nonattainment Area come from residential wood combustion (wood smoke) emitted from wood stoves and fireplaces.

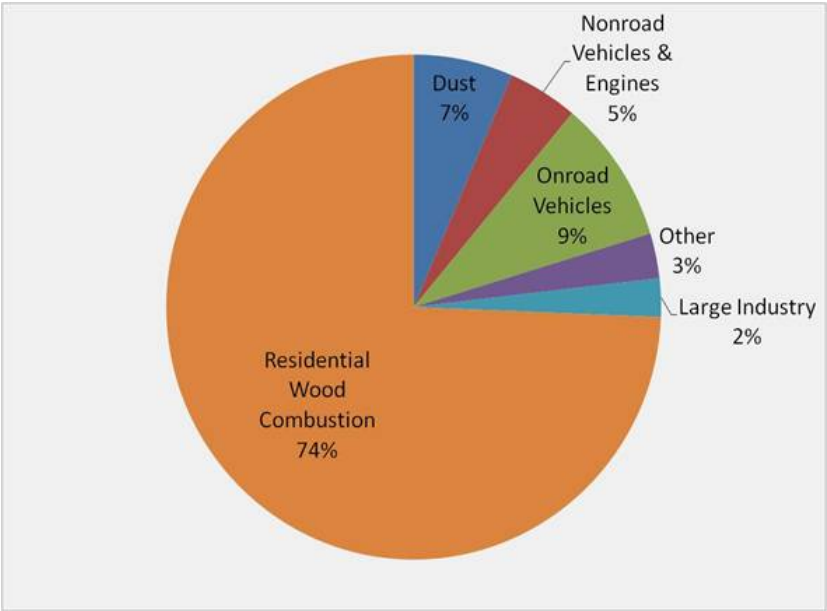


**Figure 5: Tacoma-Pierce County Nonattainment Area Winter Day Fine Particle Emissions by Source Category, 2008**

[4] <http://www.epa.gov/ttnchie1/net/2008inventory.html>

Table 2 shows the Nonattainment Area emissions in pounds by source category.

| Table 2: Tacoma-Pierce County Nonattainment Area 2008 Fine Particle Emissions (Pounds) | | |
|---|---|---|
| **Source Category** | **Yearly Emissions** | **Winter Day Emissions** |
| Residential wood combustion | 2,398,078 | 24,492 |
| Onroad vehicles | 822,879 | 3,041 |
| Dust | 971,337 | 2,135 |
| Nonroad vehicles & engines | 594,863 | 1,503 |
| Other | 297,770 | 949 |
| Large industry | 296,358 | 812 |

# Outreach and Community Involvement

The CAPC included an agreement to conduct education and outreach efforts to engage communities in the Nonattainment Area in planning and emission reduction efforts. As the lead agency, PSCAA sought extensive public input about strategies to reduce fine particle pollution in the Nonattainment Area. They gathered input in two main ways:

- Representative community participation in the Tacoma-Pierce County Clean Air Task Force.
- Response from outreach to the public.

## Tacoma-Pierce County Clean Air Task Force

The CAPC included an agreement to organize a comprehensive stakeholder process. As the lead agency for this task, PSCAA established the Tacoma- Pierce County Clean Air Task Force (Task Force). The Task Force helped ensure that strategies to reduce fine particle pollution in the Nonattainment Area included community-designed solutions and reflected community values. They met 11 times from May to December 2011 to identify, evaluate, and recommend pollution-reducing strategies. Task Force membership represented the Tacoma and Pierce County communities. Task Force members participated on behalf of:

- Health care organizations.
- Utilities.
- Economic interests.
- Neighborhood councils and community groups.
- Joint Base Lewis McChord.
- Wood-burning and non-wood-burning residents.
- State and local agencies.

The input provided by the Task Force ensures that the pollution-reducing strategies will have support and durability from a range of stakeholders within the community. In addition, PSCAA will continue to use the Task Force as a sounding board for strategy implementation.

## Public outreach

PSCAA began outreach in July 2010 to raise general awareness about the nonattainment problem and gather public input on draft strategies for pollution reduction. PSCAA did the following:

- Direct mailing–sent postcards to all 222,000 households in the Nonattainment Area.
- Targeted mailing–sent letters to 3,000 prior applicants and participants in previous wood stove replacement programs.

- Open houses–held two public meetings in the Nonattainment Area: Tacoma (October 20, 2011) and Puyallup (October 24, 2011). Attendance totaled more than 200 people.
- Online and print advertising–placed ads in major print media outlets within the Nonattainment Area, including one Spanish-language publication on Joint Base Lewis-McChord, and on *The News Tribune* website.
- Online comment–invited public input via an online survey tool, generating more than 400 responses. The public submitted approximately 60 additional comments by phone and U.S. mail.
- Outreach to community groups–gave presentations to more than 30 community and neighborhood groups, as well as elected officials. Newsletter articles were placed in community publications.
- Social media–posted information on the PSCAA monthly electronic newsletter, Facebook, and Twitter to reach out to approximately 9,000 total subscribers and friends.

PSCAA has ongoing public outreach activities. These include a major public awareness and social marketing campaign planned for fall 2012 and beyond. The campaign will promote participation in the wood stove removal and replacement programs and raise awareness about increased enforcement during burn bans.

# Strategies to Reduce Fine Particle Pollution

The Task Force began to identify possible solutions to reduce fine particle pollution in the area after gaining an understanding of air quality issues and federal requirements. The Task Force considered more than 60 strategies related to all three major categories of sources: residential wood combustion, cars and trucks, and industrial sources. The Task Force concluded that the Nonattainment Area should implement a range of strategies for non-wood smoke sources. This includes supporting, continuing, and expanding when possible, programs that reduce particle pollution from gasoline vehicles, diesel vehicles, industrial sources, and ships. The Task Force report included in Appendix E has additional details about these programs.

The Task Force also agreed that the focus for reductions should be residential wood combustion. They considered fireplaces, freestanding wood stoves, and fireplace inserts. The Task Force reached consensus on two main strategies:

- **Increased enforcement during burn bans.** This includes significantly increasing the number of inspectors in the field during a burn ban and, if possible, enforcing the burn bans at dusk and night.
- **Required removal of uncertified wood stoves and inserts.** This includes setting a date by which all households must remove uncertified devices and providing financial assistance to low income households.

Regarding fireplaces, the Task Force recommended that PSCAA require cleaner technologies on fireplaces as a contingency measure. Contingency measures are a required component of an attainment plan or maintenance plan. They would not become effective unless the Nonattainment Area does not meet air quality goals outlined in those plans. The technologies include catalysts, starters, or filters (although we are not aware of a successful demonstration of filters as effective).

Appendix E contains PSCAA's board endorsement of the Task Force recommendations with a few modifications. The appendix also includes the full Task Force report as an attachment. The Additional Resources section at the end of this document contains links to additional technical information that supports a focus on reducing emissions from residential wood combustion.

In 2012, the Washington legislature considered and passed a bill that was developed based on the Task Force's recommendations. Substitute House Bill 2326 Chapter 219, Laws of 2012[5] authorized the following as potential strategies for reducing fine particle pollution in the Nonattainment Area:

- Call stage-one burn bans sooner and at lower levels of particle pollution. A stage-one burn ban restricts all types of outdoor fires and the use of fireplaces and uncertified woodstoves, unless they are the only adequate source of heat.

[5] See <http://apps.leg.wa.gov/documents/billdocs/2011-12/Pdf/Bills/Session%20Laws/House/2326-S.SL.pdf>.

- Prohibit the use of uncertified wood stoves in the Nonattainment Area including requiring disclosure, removal, or decommissioning of uncertified stoves after January 1, 2015.
- Prohibit the use of fireplaces (as a contingency measure only).
- Provide city, county, and jurisdictional health departments the option to assist with enforcement activities.

PSCAA is currently updating their rules to make changes needed to implement the two main strategies. PSCAA's proposed changes do the following:

- Clarifies the definition of "adequate source of heat" to ensure only those who qualify obtain a PSCAA approved exemption.
- Sets the date by which all households in the Nonattainment Area must remove uncertified wood stoves and inserts: September 30, 2015.

Ecology is planning to submit PSCAA's regulation 1-13–Solid Fuel Burning Device Standards for inclusion in Washington's SIP. The inclusion of PSCAA's rule strengthens Washington's SIP. Since PSCAA is currently revising its rule, we have included proposed language in Appendix B. For additional information on PSCAA's rulemaking process, please see <www.pscleanair.org>. If PSCAA adopts the rule without significant change, Ecology will include the final Regulation 1-13 in its final SIP revision and submittal.

# Environmental Justice

EPA defines Environmental Justice as *the fair treatment and meaningful involvement of all people . . . with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.*[6]

The CAPC included an agreement to focus on environmental justice concerns in the Nonattainment Area. Additionally, in response to the ongoing environmental injustice challenges nationally, EPA recently released Plan EJ 2014. Plan EJ 2014 guides EPA's integration of environmental justice into its programs and policies including rulemaking, permitting, compliance, and enforcement. In May 2011, Ecology began looking at more ways to integrate environmental justice into the planning work related to the Nonattainment Area.

To complement the Tacoma-Pierce County Clean Air Task Force's efforts, Ecology organized an interagency work group to integrate additional environmental justice concerns. The work group developed the following goals:

- Reduce health risks from fine particle pollution in priority communities. Priority communities are those the interagency work group identified as potentially having disproportionate effects from fine particle pollution or the strategies to reduce fine particle pollution.
- Consider social and environmental effects on priority communities when determining how to reduce fine particle air pollution.
- Build meaningful public participation in the SIP development and decision making processes. Design a communication strategy that informs and engages priority communities.
- Direct resources and incentives to priority communities.
- Track our progress and lessons learned in the Nonattainment Area for future planning work throughout Washington.

To provide additional guidance on how to fulfill the above priorities, the interagency work group developed Appendix C, *Best Practices for Environmental Justice in the Tacoma-Pierce County Nonattainment Area.* This document identifies priority communities, Ecology resources, partners and stakeholders, and other resources in the Nonattainment Area. It also includes an Action Plan, which lists possible options for addressing environmental justice concerns in the area.

Ecology developed the questionnaire in Appendix D to help Ecology and PSCAA track the actions taken in the Nonattainment Area to integrate environmental justice. Ecology will work collaboratively with PSCAA to complete the questionnaire. The questionnaire will:

- Track challenges faced in addressing environmental justice.
- Recommend actions the agencies would like to incorporate into their efforts, if given additional resources.

[6] EPA's Environmental Justice Website at <http://www.epa.gov/environmentaljustice/>.

# Next Steps

This SIP revision does not remove the nonattainment designation from the Tacoma-Pierce County Nonattainment Area. The following steps must occur before EPA removes the nonattainment designation:

- Ecology will fulfill the planning requirements that are still required under a CDD. Ecology will do this when they submit the finalized version of this SIP revision to EPA.
- Ecology will make separate submissions focusing on nonattainment permitting requirements and air quality criteria for transportation conformity.
- EPA must approve Ecology's submissions.
- Ecology will develop a maintenance plan that ensures the area will continue to meet the 2006 24-hour fine particle standard. Ecology will submit the maintenance plan and a letter requesting redesignation of the area to "attainment."
- EPA must approve of Ecology's maintenance plan and request for redesignation to remove the "nonattainment" designation. This would begin a 20-year planning cycle designed to make sure that the area remains below the federal standards.

# Appendix A. 2008 Baseline Emissions Inventory and Documentation

DEPARTMENT OF
ECOLOGY
State of Washington

# APPENDIX A: TACOMA-PIERCE COUNTY NONATTAINMENT AREA EMISSION INVENTORY DOCUMENTATION


Prepared by

Washington State Department of Ecology
Air Quality Program
Olympia, Washington



August 2012

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# 1 INTRODUCTION

As part of developing a state implementation plan (SIP) revision the Washington State Department of Ecology (Ecology) submitted an emission inventory (EI) preparation plan (IPP) and prepared an inventory of direct fine particles and its precursors (per 40 CFR 51 Section 1008(a)). Ecology prepared winter day and annual inventories for a 2008 base year. Periodic statewide 3-year cycle inventories based on actual emissions are also required. This requirement is met by the National Emissions Inventory (NEI).[1]

The responsibility of the EI was a joint effort by Ecology and Puget Sound Clean Air Agency (PSCAA). Ecology performed most of the calculations, ran the models, and wrote the documents while much of the Nonattainment Area-specific information (i.e., sources of pollutants, survey data, etc.) needed for that task was provided by PSCAA. Puget Sound Regional Council (PSRC) provided traffic and economic forecasting data.

This document is the documentation for the 2008 base year EI, per United States Environmental Protection Agency (EPA) inventory guidance.[2] The following sections describe the approach to the EI's and the basis for selecting that approach.

## 1.1 Temporal Resolution

Past exceedances of the 24-hour fine particle standard have occurred primarily during cold days in the months of October through March. Analysis of the fine particle Federal Reference Method (FRM) data showed 16 monitored exceedances of the 24-hr fine particle standard during 2007–2009. All the exceedances occurred during the winter months of November–February. The exceedances generally occurred on days when temperatures, particularly the daily low, were colder than average. Therefore, the design day that the inventory was based on is representative of a cold, winter-like day. Average November-February minimum and maximum temperatures during 2006-2010 were 35°F and 49°F, respectively.

Table 1 below shows:

- Exceedances that occurred at the Tacoma - South L Street monitor.
- The minimum and maximum temperatures recorded on each exceedance date.

| Table 1: Tacoma – South L-Street Fine Particle Exceedances, 2006–2010 | | | |
|---|---|---|---|
| **Date** | **FRM $PM_{2.5}$ µg/m3** | **Min. Temp (°F)** | **Max. Temp (°F)** |
| 12/16/2006 | 68 | 26 | 39 |
| 12/28/2006 | 42.7 | 27 | 40 |
| 12/31/2006 | 50.2 | 30 | 48 |
| 1/12/2007 | 44.7 | 12 | 30 |
| 1/15/2007 | 58.6 | 16 | 36 |
| 1/30/2007 | 38.2 | 24 | 48 |
| 2/2/2007 | 46.7 | 23 | 45 |
| 11/23/2007 | 45.3 | 22 | 50 |
| 1/24/2008 | 44.2 | 20 | 50 |
| 1/25/2008 | 49.7 | 18 | 49 |
| 12/5/2008 | 39.2 | 31 | 55 |
| 12/23/2008 | 49.2 | 27 | 35 |
| 1/19/2009 | 39.3 | 25 | 52 |
| 2/3/2009 | 36.8 | 25 | 64 |
| 12/3/2009 | 49.9 | 24 | 45 |
| 12/9/2009 | 47.6 | 11 | 36 |
| 12/12/2009 | 50.7 | 18 | 39 |
| 12/24/2009 | 43.3 | 27 | 47 |
| 12/27/2009 | 44.4 | 23 | 47 |

Several source categories use hourly or daily minimum and maximum temperatures in the emissions calculations. To meet this need, a daily temperature profile was developed based on monitored temperatures and fine particle concentrations.

Seventy-four (74) days were identified between Jan. 1, 2006, and December 31, 2010, on which the daily fine particle concentration exceeded 25 µg/$m^3$. Each hour's temperatures for the 74 days were pooled. The 25$^{th}$, 50$^{th}$ (median), and 75$^{th}$ percentile for each hour was calculated to produce three design day temperature profiles. Emissions were calculated for each profile to ensure they are representative of temperatures observed when concentrations exceed 25 µg/$m^3$. The three profiles were developed for air quality rollback modeling. In the end, modeling was not required for the SIP Revision. A single profile is used for the 2008 base year inventory, and it is the 50$^{th}$ (median) percentile. References to all three profiles are retained in this document for informational purposes.

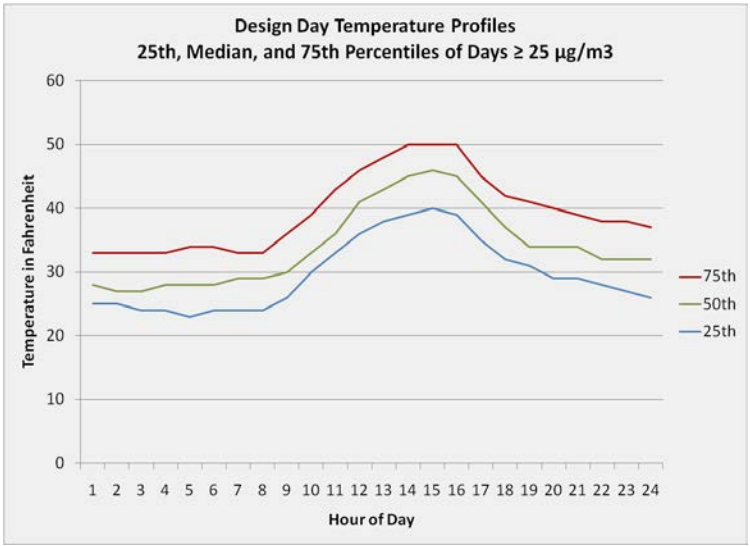


**Figure 1: Design Day Temperature Profiles**

| Table 2: Design Day Temperature Profiles in Fahrenheit | | | |
|---|---|---|---|
| **Hour** | **75th Percentile** | **50th Percentile** | **25th Percentile** |
| 0 | 33 | 28 | 25 |
| 1 | 33 | 27 | 25 |
| 2 | 33 | 27 | 24 |
| 3 | 33 | 28 | 24 |
| 4 | 34 | 28 | 23 |
| 5 | 34 | 28 | 24 |
| 6 | 33 | 29 | 24 |
| 7 | 33 | 29 | 24 |
| 8 | 36 | 30 | 26 |
| 9 | 39 | 33 | 30 |
| 10 | 43 | 36 | 33 |
| 11 | 46 | 41 | 36 |
| 12 | 48 | 43 | 38 |
| 13 | 50 | 45 | 39 |
| 14 | 50 | 46 | 40 |
| 15 | 50 | 45 | 39 |
| 16 | 45 | 41 | 35 |
| 17 | 42 | 37 | 32 |
| 18 | 41 | 34 | 31 |
| 19 | 40 | 34 | 29 |
| 20 | 39 | 34 | 29 |
| 21 | 38 | 32 | 28 |
| 22 | 38 | 32 | 27 |
| 23 | 37 | 32 | 26 |

## 2 EMISSIONS SUMMARIES

Annual emissions and winter weekday emissions for the 50th percentile temperature profile are presented here. Tables, charts, and maps are included. Tables show source types by major sector group. Sectors are abbreviated as PT – Point Sources, NP – Nonpoint Sources, NR – Nonroad Sources, OR – Onroad Sources. Nonattainment Area is abbreviated as NAA. Abbreviations for each source are shown in the table below.

**Table 3: Abbreviations Used in Emissions Summaries**

| Sector | Source Type | Abbreviation |
|---|---|---|
| PT1 | Point Sources – Major | MAJOR |
| PT2 | Point Sources – Minor | MINOR |
| NP | Architectural Coatings | ARCH |
| NP | Commercial Cooking | COOK |
| NP | Consumer & Commercial Solvents | SOLV |
| NP | Dust – Construction | DUST |
| NP | Dust – Paved Roads | PAV |
| NP | Fertilizer Application | FERT |
| NP | Gas Stations and Gas Cans | GAS |
| NP | Livestock Waste | LIVE |
| NP | Residential Fuel, except Wood | FUEL |
| NP | Residential Fuel, Wood – Certified Stoves & Inserts | RWC-C |
| NP | Residential Fuel, Wood – Firelogs | RWC-LG |
| NP | Residential Fuel, Wood – Fireplaces | RWC-FP |
| NP | Residential Fuel, Wood – Pellet Stoves | RWC-PL |
| NP | Residential Fuel, Wood – Uncertified Stoves & Inserts | RWC-U |
| OR | Onroad | ONRD |
| NR | Locomotives | RR |
| NR | Marine – Harbor Craft | HARB |
| NR | Marine – Ocean-going Vessels | OCEAN |
| NR | Marine – Pleasure Craft | BOAT |
| NR | Nonroad – Commercial | COMM |
| NR | Nonroad – Construction | CNSTR |
| NR | Nonroad – Industrial | IND |
| NR | Nonroad – Lawn and Garden | LAWN |
| NR | Nonroad – Railroad Equipment | RAIL |
| NR | Port of Tacoma, non-Marine | PORT |

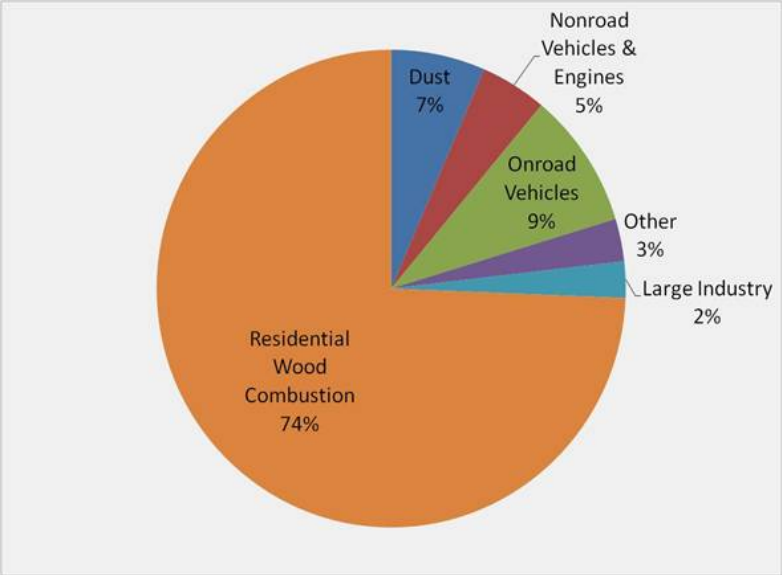


**Figure 2: Fine particle Winter Day Emissions, 2008**

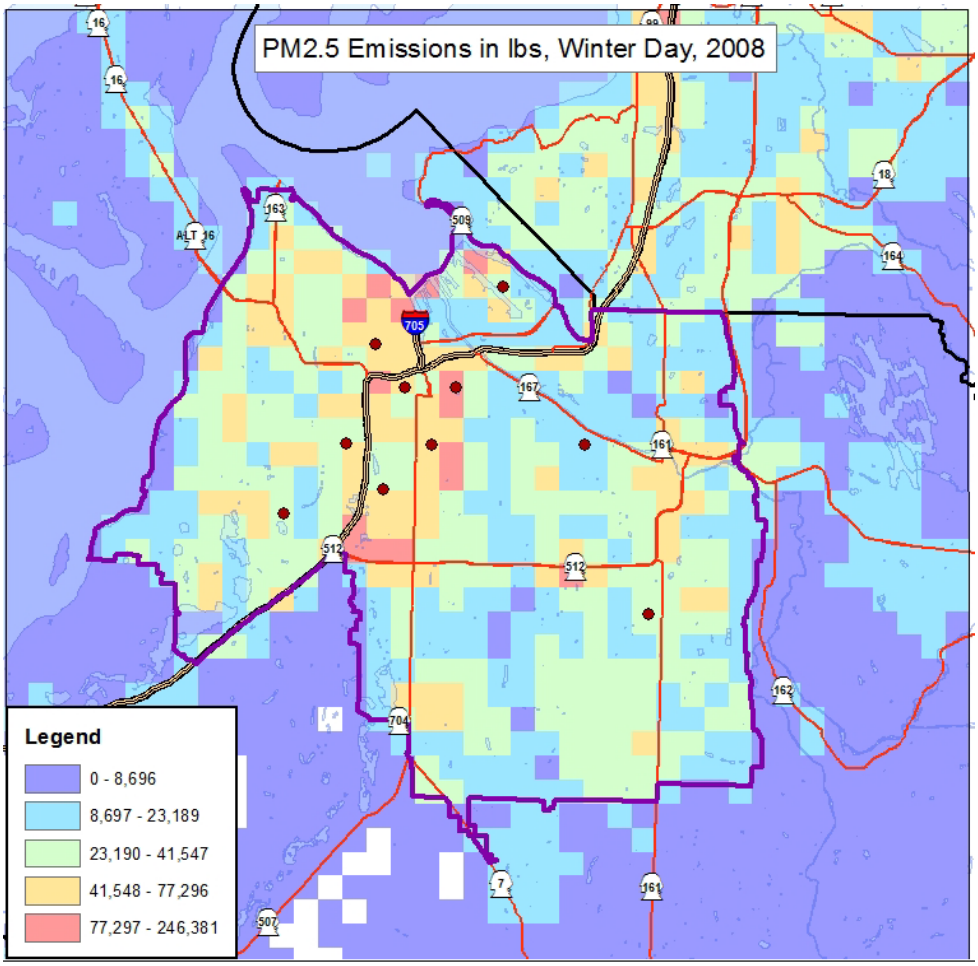


**Figure 3: Fine Particle Winter Day Emissions in Pounds, 2008**

| Table 4: 2008 Fine Particle Emissions (Pounds) | | | | | |
|---|---|---|---|---|---|
| | | Winter Weekday | | Annual | |
| Sector | Source | NAA | Pierce County | NAA | Pierce County |
| PT1 | MAJOR | 812 | 812 | 296,358 | 296,358 |
| PT2 | MINOR | 167 | 312 | 61,073 | 113,987 |
| NP | RWC-FP | 4,982 | 7,286 | 487,791 | 713,403 |
| NP | RWC-U | 12,630 | 14,596 | 1,236,646 | 1,429,087 |
| NP | RWC-C | 6,541 | 11,033 | 640,405 | 1,080,296 |
| NP | RWC-PL | 48 | 74 | 4,717 | 7,239 |
| NP | RWC-LG | 291 | 419 | 28,519 | 41,038 |
| NP | FUEL | 54 | 79 | 9,163 | 13,435 |
| NP | COOK | 727 | 1,190 | 227,533 | 372,428 |
| NP | DUST | 852 | 1,446 | 534,195 | 907,070 |
| NP | PAV | 1,284 | 1,835 | 437,143 | 624,896 |
| OR | ONRD | 3,041 | 4,071 | 822,879 | 1,176,306 |
| NR | COMM | 71 | 116 | 22,689 | 37,137 |
| NR | CNSTR | 787 | 1,185 | 301,734 | 454,555 |
| NR | IND | 52 | 84 | 21,868 | 35,794 |
| NR | LAWN | 169 | 254 | 91,090 | 137,225 |
| NR | RAIL | 1 | 2 | 201 | 513 |
| NR | RR | 55 | 113 | 20,020 | 41,277 |
| NR | PORT | 190 | 190 | 69,257 | 69,257 |
| NR | OCEAN | 171 | 268 | 62,305 | 97,642 |
| NR | HARB | 9 | 120 | 3,263 | 43,660 |
| NR | BOAT | 1 | 13 | 2,436 | 61,442 |
| | TOTAL | 32,933 | 45,500 | 5,381,285 | 7,754,046 |

| Table 5: 2008 $SO_2$ Emissions (Pounds) | | | | | |
|---|---|---|---|---|---|
| | | Winter Weekday | | Annual | |
| Sector | Source | NAA | Pierce County | NAA | Pierce County |
| PT1 | MAJOR | 3,597 | 3,597 | 1,312,887 | 1,312,887 |
| PT2 | MINOR | 0 | 44 | 25 | 16,173 |
| NP | RWC-FP | 84 | 123 | 8,268 | 12,092 |
| NP | RWC-U | 165 | 191 | 16,165 | 18,681 |
| NP | RWC-C | 132 | 223 | 12,937 | 21,824 |
| NP | RWC-PL | 5 | 8 | 493 | 757 |
| NP | FUEL | 796 | 1,167 | 134,649 | 197,426 |
| OR | ONRD | 422 | 560 | 154,184 | 220,406 |
| NR | COMM | 13 | 22 | 4,227 | 6,919 |
| NR | CNSTR | 216 | 325 | 82,719 | 124,615 |
| NR | IND | 16 | 26 | 6,684 | 10,941 |
| NR | LAWN | 5 | 8 | 5,253 | 7,913 |
| NR | RAIL | 0 | 0 | 31 | 79 |
| NR | RR | 140 | 292 | 51,092 | 106,635 |
| NR | PORT | 115 | 115 | 41,850 | 41,850 |
| NR | OCEAN | 3,061 | 4,814 | 1,117,148 | 1,757,009 |
| NR | HARB | 5 | 76 | 1,951 | 27,804 |
| NR | BOAT | 0 | 2 | 280 | 7,059 |
| | TOTAL | 8,772 | 11,591 | 2,950,844 | 3,891,069 |

| Table 6: 2008 $NO_X$ Emissions (Pounds) | | | | | |
|---|---|---|---|---|---|
| | | Winter Weekday | | Annual | |
| Sector | Source | NAA | Pierce County | NAA | Pierce County |
| PT1 | MAJOR | 4,995 | 4,995 | 1,823,163 | 1,823,163 |
| PT2 | MINOR | 375 | 1,022 | 136,961 | 372,975 |
| NP | RWC-FP | 549 | 803 | 53,740 | 78,595 |
| NP | RWC-U | 1,156 | 1,336 | 113,157 | 130,766 |
| NP | RWC-C | 730 | 1,232 | 71,480 | 120,578 |
| NP | RWC-PL | 60 | 92 | 5,858 | 8,989 |
| NP | RWC-LG | 79 | 113 | 7,716 | 11,103 |
| NP | FUEL | 3,703 | 5,429 | 626,640 | 918,798 |
| OR | ONRD | 69,074 | 93,032 | 24,077,212 | 34,418,392 |
| NR | COMM | 975 | 1,596 | 297,098 | 486,291 |
| NR | CNSTR | 9,363 | 14,105 | 3,586,390 | 5,402,815 |
| NR | IND | 1,268 | 2,076 | 518,105 | 848,036 |
| NR | LAWN | 471 | 710 | 458,656 | 690,955 |
| NR | RAIL | 6 | 15 | 1,683 | 4,293 |
| NR | RR | 1,834 | 3,735 | 669,427 | 1,363,322 |
| NR | PORT | 4,428 | 4,428 | 1,616,157 | 1,616,157 |
| NR | OCEAN | 2,611 | 3,915 | 953,084 | 1,429,135 |
| NR | HARB | 397 | 5,183 | 144,824 | 1,891,834 |
| NR | BOAT | 6 | 153 | 26,026 | 656,454 |
| | TOTAL | 102,079 | 143,969 | 35,187,376 | 52,272,654 |

| Table 7: 2008 VOC Emissions (Pounds) | | | |
|---|---|---|---|
| | | Pierce County | |
| Sector | Source | Winter Weekday | Annual |
| PT1 | MAJOR | 1,998 | 729,389 |
| PT2 | MINOR | 1,634 | 596,584 |
| NP | RWC-FP | 5,835 | 571,327 |
| NP | RWC-U | 25,280 | 2,475,217 |
| NP | RWC-C | 7,105 | 695,645 |
| NP | RWC-PL | 1 | 97 |
| NP | RWC-LG | 584 | 57,165 |
| NP | FUEL | 308 | 52,167 |
| NP | COOK | 182 | 56,817 |
| NP | GAS | 6,412 | 2,359,138 |
| NP | ARCH | 5,492 | 2,372,630 |
| NP | SOLV | 18,146 | 6,622,936 |
| OR | ONRD | 60,845 | 19,055,602 |
| NR | COMM | 1,794 | 583,223 |
| NR | CNSTR | 2,014 | 771,915 |
| NR | IND | 426 | 171,048 |
| NR | LAWN | 6,000 | 3,115,743 |
| NR | RAIL | 3 | 947 |
| NR | RR | 204 | 74,546 |
| NR | PORT | 280 | 102,280 |
| NR | OCEAN | 134 | 49,001 |
| NR | HARB | * | * |
| NR | BOAT | 1,316 | 3,728,310 |
| | TOTAL | 145,996 | 44,241,726 |

* Harbor craft county-level emissions are not readily available for VOC. May approximate as 13x Nonattainment Area values of 11 lb.

| Table 8: 2008 Ammonia Emissions (Pounds) | | | |
|---|---|---|---|
| | | Pierce County | |
| Sector | Source | Winter Weekday | Annual |
| PT1 | MAJOR | 197 | 72,000 |
| PT2 | MINOR | 0 | 28 |
| NP | RWC-FP | 556 | 54,412 |
| NP | RWC-U | 811 | 79,394 |
| NP | RWC-C | 502 | 49,104 |
| NP | RWC-PL | 7 | 710 |
| NP | FUEL | 1,080 | 182,730 |
| NP | FERT | 60 | 121,320 |
| NP | LIVE | 3,937 | 2,031,355 |
| OR | ONRD | 1,432 | 614,596 |
| | TOTAL | 8,582 | 3,205,649 |

# 3 INVENTORY DEVELOPMENT

## 3.1 General Information

Ecology developed inventories of emissions for base year 2008. The inventory made annual and typical fine particle ($PM_{2.5}$), Nitrogen Oxides ($NO_X$), Sulfur Dioxide ($SO_2$), Volatile Organic Compounds (VOC), and Ammonia ($NH_3$) winter season emissions estimates. It also defined typical emissions as average weekday and weekend emissions for the winter season. Section 1.2 provides justification for the season.

| Table 9: Inventories Developed | | |
|---|---|---|
| Geographic Area | Temporal Scale | Purpose |
| Pierce County | Annual and design day (wkday), median temperature profile | Starting point for allocating emissions to finer spatial resolutions, SIP requirements |
| Nonattainment Area | Annual and design day (wkday), median temperature profile | Attainment demonstration, motor vehicle emissions budget |
| State | Annual | SIP requirement. It is fulfilled by the 2008 NEI. |

We developed a list of sources using the 2008 NEI,[1] local knowledge, and categories as defined in the 2005 Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations.[2] The list of sources is in Appendix A. We used the guidance to select estimation methods and gathered information necessary to develop the base year.

*Temporal Allocation*

Unless noted, winter daily emissions were calculated from annual emissions using temporal allocation profiles. Winter weekday and weekend emissions for the three design day temperature profiles were prepared (see Section 1.2). For most of the source types, typical winter daily

emissions were used for all three temperature profiles. For residential wood combustion, emissions were calculated for each profile based on the specific temperatures. For onroad mobile sources, the emissions were calculated for each hour of each profile based on temperature. Methods for each category are described beginning in Section 3.2.

*Spatial Allocation*

$PM_{2.5}$, $NO_X$, and $SO_2$ emissions were spatially allocated to the Nonattainment Area. Because of their small role in fine particle concentrations in the Nonattainment Area, VOC and $NH_3$ emissions were not allocated to the Nonattainment Area. For sources without specific coordinates, spatial surrogates were used to approximate both the location and magnitude of the emissions. Many of the surrogates are the same as or similar to the surrogates used in the Pacific Northwest's air quality prediction model, AIRPACT. Surrogates were allocated to the Nonattainment Area using Geographic Information Systems (GIS) tools and scripts. Each emissions source was assigned to an appropriate surrogate. The Nonattainment Area and grid emissions are estimated as:

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

Where $E_{NAA}$ = emissions in the Nonattaiment Area, $E_{County}$ = emissions in county, $Surrogate_{NAA}$ = surrogate activity in the Nonattainment Area, and $Surrogate_{County}$ = surrogate activity in county.

*Fine Particle Speciation*

Fine Particles were speciated into five categories (nitrate, sulfate, elemental carbon, organic aerosol, and PM fines (i.e., unspeciated fine particles) using speciation profiles by SCC code available through the AIRPACT[3] modeling system and as direct output from EPA's Motor Vehicle Emission Simulator (MOVES) model.

*Demographics and Employment and Vehicle Miles Traveled*

Demographic, employment, and Vehicle Miles Traveled (VMT) data are used in emissions calculations for several source categories. PSRC provided estimated population, households, and employment for Pierce County, and an area approximating the Nonattainment Area using their forecast analysis zones (FAZs).[4] The Nonattainment Area VMT were derived from roadway link statistics.

**Table 10: 2008 Demographics, Employment, and VMT**

| Parameter | Pierce County | Pierce FAZs (NAA) |
|---|---|---|
| Population | 805,408 | 542,978 |
| Households | 300,225 | 209,609 |
| Total Employment | 332,804 | 234,676 |
| Construction Employment | 29,189 | 18,472 |
| Vehicle Miles Traveled | 15,690,815 | 11,799,857 |

*Inventory Tasks*

To estimate emissions, four basic tasks were completed for each source category. The four tasks were: (1) estimate the activity level, (2) adjust/allocate the activity level (or emissions) temporally and spatially, (3) determine emission factors (rates) per the activity, and (4) estimate emissions. The tasks are described below for each source category. The summary of emissions estimates may be found in Section 2.

## 3.2 Point Sources

Industrial, commercial, or institutional stationary sources which emit criteria and/or hazardous air pollutants (HAPs) are called point sources. Major point sources are those with the potential to emit 100 tons per year or more of any one criteria pollutant or a combination of criteria pollutants, and/or point sources with the potential to emit 10 tons per year or more of any single HAP, or 25 tons per year or more of a combination of HAPs (Section 112, CAA). Facilities with a major source potential-to-emit are included in Title V Air Operating Permit (AOP) programs unless a facility voluntarily adopts federally enforceable permit limits that reduce their potential-to-emit below the criteria and HAPs thresholds. Facilities that adopt these limits are called Synthetic Minor sources.

For nonattainment areas, 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. There are 9 Title V sources in Pierce County.

Simpson Tacoma Kraft (STK) is the only major point source in Ecology's jurisdiction. The eight other Title V sources in the county fall within the PSCAA's jurisdiction

To have a more thorough inventory, all sources registered with PSCAA were included. There are 33 registered sources in the county that are not Title V sources. These sources may also include emissions reported that are less than the required reporting limits.

PSCAA registers sources that emit at least:

1) 2.5 tons of any single HAP.
2) 6.25 tons of total HAPs.
3) 25 tons of carbon monoxide, nitrogen oxides, particulate matter, sulfur dioxides, or volatile organic compounds.

*Activity Level*

Individual facility throughputs and production rates determine the activity level for each facility.

*Spatial and Temporal Allocation*

Point sources are located by county, address, and coordinates. Throughput and emissions were assumed uniform throughout the year, and 25 percent of the annual total was assigned to each season.

*Emission Rates and Estimates*

Emissions estimates for each facility are calculated using a variety of emissions estimation methods: continuous emissions monitors, stack test data, mass balance, best professional judgment, manufacturer's specifications, speciation profiles, EPA emission factors (e.g., AP-42), and/or other state, manufacturer, or research group emission factors. Methods are selected considering permit conditions, data availability, and resource constraints.

For the 2008 base year inventory, Ecology used the 2008 annual emissions report to develop the point source inventory (Table 11). The fields that are null mean that the pollutant has not been emitted at the source. The fields that have a zero mean that the pollutant was emitted either in the past or presently, but in too small of a quantity to make it into the emissions inventory.

*Emissions Calculations*

For STK, Ecology used source tests from the facility to calculate the condensable PM for each unit.[5] The following calculation was used to estimate the condensable PM:

$$(CPM/FPM) * Ftpy = Ctpy$$

Where CPM (condensable PM) and FPM (Filterable PM) = known values given in the source test
Ctpy = Condensable tons per year
Ftpy = Filterable tons per year. Known value given in the annual EI

Ctpy + PM (each TSP, $PM_{2.5}$, $PM_{10}$) = total Condensable + Filterable PM in tpy.

STK did not submit a stack test for the Boiler #6 Stack, so Ecology used AP-42[6] to calculate the condensables for that unit.

**Table 11: 2008 Point Source EI (Pierce County Point Sources)**

| Plant Name | $PM_{2.5}$ | $SO_2$ | $NO_X$ | VOC | $NH_3$ | Within NAA | Title V (X) |
|---|---|---|---|---|---|---|---|
| American Reinforced Plastics Inc | | | | 3.6 | 0 | No | |
| Arclin Surfaces, LLC | | | | 31.4 | | Yes | X |
| Benchmark Custom Cabinets Inc | | | | | | Yes | |
| Boeing Commercial Airplane, Frederickson | 0 | 0 | 0 | 35.6 | 0 | Yes | X |
| Caraustar Mill Group Inc Tacoma Paperboard | 0 | 0 | 0 | | | Yes | |
| ConocoPhillips Company | | | | 31.6 | | Yes | |
| Delta Prefinishing Corp | | | | 20.5 | | Yes | |
| Feed Commodities LLC | 0 | 0 | 0 | 0 | | Yes | |
| Frederickson Power LP | 5.1 | 2.3 | 43 | 17.7 | | Yes | X |
| General Plastics Manufacturing Co | | | | 1.2 | | Yes | |

| Table 11: 2008 Point Source EI (Pierce County Point Sources) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Plant Name** | **$PM_{2.5}$** | **$SO_2$** | **$NO_X$** | **VOC** | **$NH_3$** | **Within NAA** | **Title V (X)** |
| Georgia-Pacific Gypsum LLC | 27 | 0 | 62 | 0 | | Yes | |
| Graymont Western US Inc | 36.1 | 9.6 | 57.2 | | | Yes | X |
| IDX - Seattle | | | | 0 | | Yes | |
| James Hardie Building Products Inc | | | | 0 | | Yes | |
| Jet Door LLC | | | | 0 | | Yes | |
| Lianga Pacific Inc | | | | 52.6 | 0 | Yes | |
| Milgard Manufacturing Inc | | | | 0 | | Yes | |
| Northwest Pipeline GP Sumner | 0 | 0 | 0 | 0 | | No | |
| Numatic Finishing | | | | 0 | | No | |
| Pacific Crest Industries Inc | | | | 73.3 | | No | |
| Pacific Northwest Baking Co | | | | 28.2 | | No | |
| Parker Paint Manufacturing Co Inc Professional Paint | | | | 2.3 | | Yes | |
| Ply Trim West Inc | | | | 0 | 0 | Yes | |
| Professional Coatings Inc | | | | 76.7 | | Yes | X |
| Puget Sound Energy, Frederickson | 1.1 | 3.7 | 18 | 0.2 | | Yes | X |
| Rainier Richlite Co | | | | 3.2 | | Yes | |
| Rainier Veneer Inc | 21.3 | 2.8 | 24.8 | 20.8 | | No | |
| Rainier Woodworking | | | | 0 | | Yes | |
| Shore Terminals LLC | | | | 0 | | Yes | |
| Simpson Lumber Company, LLC | 2.1 | 0 | 1.1 | 23.5 | | Yes | |
| Simpson Tacoma Kraft | *96.7 | 635 | 684 | 48 | 0 | Yes | X |
| Sonoco Products Co Paper Div | 0 | 0 | 0 | 0 | 0 | No | |
| Specialty Wood Manufacturing TRSW | | | | 0 | | Yes | |
| Sunnfjord Boat Inc | | | | 0 | | Yes | |
| Tacoma Export Marketing Co LLC TEMCO LLC | 0 | | | | | Yes | |
| Tacoma Fixture Co Inc | | | | 0 | | Yes | |
| Toray Composites America Inc | | | | 23.8 | | Yes | X |
| Tucci & Sons Inc McChord | 1.2 | 0 | 4.5 | 0 | | Yes | |
| Tucci & Sons Inc Taylor Way | 0.2 | 0 | 0.9 | 0 | | Yes | |
| US Air Force McChord Air Force Base | 0 | 0 | 37.2 | 0 | 0 | No | |
| US Army Fort Lewis DA Public Works | 5.1 | 5.3 | 56.1 | 37.6 | 0 | No | |
| US Oil & Refining Co | 9.2 | 5.9 | 109.3 | 131.3 | 36 | Yes | X |
| Westmark Products Inc | | | | 0 | | Yes | |
| * Figure includes condensable + filterable $PM_{2.5}$ - for calculation, see *Emission Calculations* | | | | | | | |

## 3.3 Nonpoint Sources

Nonpoint sources include a variety of sources such as residential wood combustion, minor stationary sources, and road dust. We typically estimate emissions by multiplying an activity level by an emission factor in mass per activity.

***Emissions = Activity level x Emission Factor***

Base year emissions estimation methods and data sources for each nonpoint source category are described in the sub-sections below.

### 3.3.1 Residential Wood Combustion

Residential wood combustion emissions were estimated using local survey data, EPA emission factors, local wood-burning device sales data, and local change-out program statistics.

*Activity Level –Base Year 2008*

Residential wood combustion activity was estimated using data from a residential wood combustion survey of 1,015 households conducted in the central Puget Sound area in 2007 (NRC2007).[7, 8] This survey is the most recent and comprehensive survey conducted in the area, and it solicited complete information to conduct an inventory. There have been other surveys about residential wood combustion, but they included fewer respondents, are older, or did not ask all the questions necessary to estimate the quantity of wood burned. PSCAA, Ecology, and the Hearth, Patio, and Barbeque Association reviewed the survey data and believed it to be reasonable.

The survey was used to determine the percentage of households using wood burning devices and the annual amount of wood burned per device for fireplaces, wood stoves, inserts, and pellet stoves. Wood stoves and inserts were further broken out into three categories: certified catalytic, certified non-catalytic, and non-certified.

The survey included seven geographic groups. Three of the groups were used in this inventory: Pierce County Urban Growth Area (UGA), Pierce County Non-Urban Growth Area (NUGA), and King County (KING). The Pierce County UGA survey responses were used to derive most of activity parameters for the Nonattainment Area. Parameters with low numbers of data points (e.g., fire logs burned in a certified insert) were estimated by combining geographic areas to get more data points. A few parameters were estimated using information available in EPA's residential wood combustion tool.[9]

The survey gathered information on the amount of pellets, manufactured fire logs, and cord wood burned. To calculate emissions using emission factors in pounds per ton (lb/ton) burned, the weight of the wood burned was estimated. The weight of a cord of wood varies with moisture content and species type. The most common species reported in the survey were fir, alder, and maple. PSCAA estimated the bone dry (zero percent moisture) weight of a cord to be 2189 pounds (lb). Pellets are sold in 40-lb sacks, and fire logs were estimated at 8 lb per log.

Annual emissions for each wood burning device were calculated according to the following equation:

T/yr = (HH) x (usage fraction) x (T burned/device-yr) x (pollutant lb/T) x (T/2000 lb)
Where HH = number of households in the geographic area

The numbers of households in each of the three geographic areas were estimated by the PSRC. The EPA data source is reference 9. All of the other parameter sources and values are described in the following tables.

| Table 12: Residential Wood Combustion Parameter Data Sources, Base Year 2008 | | | | |
|---|---|---|---|---|
| **Parameter** | **Fireplaces** | **Inserts** | **Woodstoves** | **Pellet Stoves** |
| **Pierce Nonattainment Area** | | | | |
| Own device (%) | UGA | UGA | UGA | UGA |
| Use device (%) | UGA | UGA+NUGA | UGA | UGA+NUGA+KING |
| Certified (% of devices used) | n/a | UGA+NUGA | UGA | n/a |
| Certified non-catalytic/catalytic split (%) | n/a | EPA | EPA | n/a |
| Cord wood burned | UGA | UGA+NUGA | UGA | n/a |
| Pellets burned | n/a | n/a | n/a | Entire survey |
| Fire logs burned | UGA | UGA+NUGA | UGA | n/a |
| **Pierce Attainment Area** | | | | |
| Own device (%) | NUGA | NUGA | NUGA | NUGA |
| Use device (%) | NUGA | NUGA | NUGA | UGA+NUGA+KING |
| Certified (% of devices used) | n/a | NUGA | NUGA | n/a |
| Certified non-catalytic/catalytic split (%) | n/a | EPA | EPA | n/a |
| Cord wood burned | NUGA | NUGA | NUGA | n/a |
| Pellets burned | n/a | n/a | n/a | Entire Survey |
| Fire logs burned | NUGA | NUGA | NUGA | n/a |

| Table 13: Residential Wood Combustion Parameter Values, Base Year 2008 | | | | |
|---|---|---|---|---|
| **Parameter** | **Fireplaces** | **Inserts** | **Woodstoves** | **Pellet Stoves** |
| **Pierce Nonattainment Area** | | | | |
| Own device (%) | 16 | 7 | 16 | 2 |
| Use device (%) | 10.8 | 4.8 | 14.7 | 1.1 |
| Certified (% of devices used) | n/a | 70 | 36 | n/a |
| Certified non-catalytic/catalytic split (%) | n/a | 75 / 25 | 75 / 25 | n/a |
| Cord wood burned (tons) | 1.0 | 1.8 | 1.9 | n/a |
| Pellets burned (tons) | n/a | n/a | n/a | 0.7 |
| Fire logs burned (tons) | 0.01 | 0.03 | 0.01 | n/a |
| **Pierce Attainment Area** | | | | |
| Own device (%) | 19 | 11 | 11 | 2 |
| Use device (%) | 10.0 | 9.3 | 8.0 | 1.1 |
| Certified (% of devices used) | n/a | 91 | 50 | n/a |
| Certified non-catalytic/catalytic split (%) | n/a | 75 / 25 | 75 / 25 | n/a |
| Cord wood burned (tons) | 0.9 | 2.0 | 1.1 | n/a |
| Pellets burned (tons) | n/a | n/a | n/a | 0.7 |
| Fire logs burned (tons) | 0.01 | 0.01 | 0.03 | n/a |
| **King County** | | | | |
| Own device (%) | 32 | 9 | 7 | 2 |
| Use device (%) | 17.3 | 5.9 | 5.9 | 1.2 |
| Certified (% of devices used) | n/a | 58 | 25 | n/a |
| Certified non-catalytic/catalytic split (%) | n/a | 75 / 25 | 75 / 25 | n/a |
| Cord wood burned (tons) | 1.2 | 1.4 | 1.2 | n/a |
| Pellets burned (tons) | n/a | n/a | n/a | 0.7 |
| Fire logs burned (tons) | 0.02 | 0.01 | 0.01 | n/a |

*Activity Level–Base Year Summary*

| Table 14: Number of Devices Used and Tons Burned | | | | |
|---|---|---|---|---|
| Parameter | Pierce NAA | | Pierce AA | |
| | Devices | Tons | Devices | Tons |
| Fireplace | 21,245 | 20,669 | 10,323 | 9,560 |
| Fireplace inserts; non-EPA certified | 2,786 | 5,102 | 876 | 1,770 |
| Fireplace inserts; EPA certified; non-catalytic | 4,983 | 9,124 | 6,569 | 13,273 |
| Fireplace inserts; EPA certified; catalytic | 1,661 | 3,041 | 2,190 | 4,424 |
| Wood stove; non-EPA certified | 18,436 | 35,312 | 4,129 | 4,519 |
| Wood stove; EPA certified, non-catalytic | 7,901 | 15,134 | 3,097 | 3,389 |
| Wood stove; EPA certified, catalytic | 2,634 | 5,045 | 1,032 | 1,130 |
| Pellet Stove | 2,103 | 1,542 | 1,124 | 824 |
| Residential Firelog Total: All Combustor Types | --- | 1,004 | --- | 441 |

*Emission Factors*

Emission factors were taken from version 7.1 of EPA's 2008 NEI Residential Wood Combustion Tool[9] (available for download at http://www.epa.gov/ttn/chief/net/2008inventory.html). Most of the factors in the tool are from AP-42, MARAMA, and Environment Canada.

| Table 15: Residential Wood Combustion Emission Factors in Lb/T | | | | | | |
|---|---|---|---|---|---|---|
| SCC | Device | $PM_{2.5}$ | $NO_X$ | $SO_2$ | VOC | $NH_3$ |
| 2104008100 | Fireplace | 23.6 | 2.6 | 0.4 | 18.9 | 1.8 |
| 2104008210 | Fireplace inserts; non-EPA certified | 30.6 | 2.8 | 0.4 | 53 | 1.7 |
| 2104008220 | Fireplace inserts; EPA certified; non-catalytic | 19.6 | 2.28 | 0.4 | 12 | 0.9 |
| 2104008230 | Fireplace inserts; EPA certified; catalytic | 20.4 | 2 | 0.4 | 15 | 0.9 |
| 2104008310 | Wood stove; non-EPA certified | 30.6 | 2.8 | 0.4 | 53 | 1.7 |
| 2104008320 | Wood stove; EPA certified, non-catalytic | 19.6 | 2.28 | 0.4 | 12 | 0.9 |
| 2104008330 | Wood stove; EPA certified, catalytic | 20.4 | 2 | 0.4 | 15 | 0.9 |
| 2104008400 | Pellet Stove | 3.06 | 3.8 | 0.32 | 0.041 | 0.3 |
| 2104009000 | Residential Firelog Total: All Combustor Types | 28.4 | 7.684 | 0 | 39.56 | 0 |

*Temporal Allocation*

Residential wood combustion emissions were calculated for the three design day temperature profiles using a temperature adjustment equation based on heating degree days with a base of 50 degrees (see Appendix A2). The temperature adjustment eliminates the need for a monthly activity adjustment since the temperature adjustment assumes activity is directly related to temperature. The calculated daily emissions were adjusted to weekday and weekend hourly activity using AIRPACT temporal allocation profile 407, which was calculated from the 2001 Washington State University woodstove survey.[10] The profile allocates 13.5 percent of activity to each weekday, and 16.1 percent to each weekend day.

*Spatial Allocation*

Activity and emissions were allocated to the Nonattainment Area as described above. Emissions were allocated to the modeling grids using a combination of the three survey area results and two surrogates: the number of total occupied housing units (by 2010 Census block), and the number of households where wood is the primary heat source (by 2000 Census block group). Had we allocated by the single surrogate of all occupied housing units, we may have overestimated emissions in densely populated areas. If we had allocated only by households with wood as the primary heat source, we would have missed entire areas since many Census block groups have no households with wood as their primary heat source.

For each of the three survey areas, emissions from devices identified as the primary heat source was allocated to households where wood is the primary heat source. Emissions from devices identified as a secondary or recreational heat source were allocated to total occupied housing units.

To use this method, first the fractions of emissions by device usage type (primary, secondary/recreational) were calculated. This was done at the whole survey level, since the sample sizes were too small for each survey area to produce reliable results for each device type (e.g., the amount of cord wood burned in certified catalytic inserts used for secondary heating).

Emissions Fractions Calculation

Each survey response was weighted according to its survey group. The group weighting factors were calculated as the number of households in the group divided by the sum of all the households in the survey area.

The weighted survey responses were summarized by major device (fireplace, insert, wood stove, pellet stove) and type of usage (primary, secondary, recreational). The device type summarization included whether the device was certified/not certified, and catalytic/non-catalytic for stoves and inserts.

Tons burned and emissions from wood stoves, inserts, and pellet stove results were combined into one category; fireplaces were a separate category. The percentage of tons burned and emissions were calculated for the three usage types: primary, secondary, recreational. For the wood stoves, inserts, and pellet stove category, 51 percent of the emissions were from primary usage, and the remaining 49 percent from secondary and recreational usage. For fireplaces, 17 percent of the emissions were from primary usage, and the remaining 83 percent from secondary and recreational usage. The results were nearly identical if using tons burned instead of emissions.

Final Spatial Allocation

The fractions calculated were multiplied by the emissions in each of the three survey areas to estimate the amount of emissions produced by primary, and secondary/recreational devices in each area. The emissions were allocated to the two spatial surrogates as described above.

### 3.3.2 Paved Road Dust

Paved road dust was estimated using vehicle miles traveled (VMT) activity from the Washington State Department of Transportation (WSDOT) and the emission factor equation in AP-42.

*Activity Level*

Average daily VMT (ADVMT) based on the national WSDOT's Highway Performance Monitoring System (HPMS) was obtained from the WSDOT. WSDOT makes estimates of county ADVMT by functional (roadway) classification from HPMS.[11] The HPMS classifications available in the WSDOT data were helpful in applying the AP-42 emission factor equation. Total Pierce County ADVMT was somewhat higher than the PSRC's travel demand model estimate. The travel demand model data was used to estimate onroad emissions. This is a small inconsistency in the inventory.

**Table 16: WSDOT 2008 ADVMT, Pierce County**

| Road Class | ADVMT |
|---|---|
| Rural Interstate | 328,822 |
| Rural PA Other | 0 |
| Rural Minor Art | 548,709 |
| Rural Major Col | 148,346 |
| Rural Minor Col | 33,014 |
| Rural Local | 103,912 |
| Urban Interstate | 3,218,994 |
| Urban PA F/E | 2,764,830 |
| Urban PA Other | 3,652,849 |
| Urban Minor Art | 3,306,077 |
| Urban Collector | 764,625 |
| Urban Local | 1,969,445 |
| **TOTAL** | **16,839,623** |

*Emission Factors and Temporal Allocation*

Monthly fine particle emission rates in grams per mile were calculated using equation 2 in EPA's AP42.[12, 13] Equation 2 estimates an emission rate for annual average conditions by incorporating a precipitation correction factor. Daily winter emissions were calculated assuming no rainfall, and therefore no precipitation adjustment.

$$E_{ext} = [\, k\,(sL)^{0.91} \times (W)^{1.02}\,]\,(1 - P/4N) \qquad \text{equation (2)}$$

where $E_{ext}$ is the emission factor in g/VMT
k = g/VMT particle size multiplier (0.25 for $PM_{2.5}$)
sL = silt loading in $g/m^2$
W = mean vehicle weight (tons)
P = number of days with at least 0.01 inches of precipitation in the given month
N = number of days in the given month

AP42 recommended values for average silt loading by average daily traffic (ADT) class were used. The HPMS facility types were classified into the ADT classes by dividing the number of statewide ADVMT by the roadway mileage. The classifications are shown in Table 17. Individual urban sampling areas are not shown in the table. However, with only minor exceptions, they each showed the same ADT classification as the urban average.

**Table 17: WSDOT Statewide Estimated Average Daily Traffic, 2008**

| Rural | Interstate | Prin Art | Min Art | Maj Coll | Min Coll | Local |
|---|---|---|---|---|---|---|
| Miles | 467 | 1,980 | 1,860 | 8,194 | 6,189 | 42,093 |
| ADVMT (in 1,000s) | 12,000 | 10,747 | 5,066 | 10,230 | 2,830 | 3,076 |
| Estimated ADT | 25,696 | 5,428 | 2,724 | 1,248 | 457 | 73 |
| ADT Class | > 10,000 limited access | 5,000 - 10,000 | 500 - 5,000 | 500 - 5,000 | < 500 | < 500 |
| Silt loading ($g/m^2$) | 0.015 | 0.06 | 0.2 | 0.2 | 0.6 | 0.6 |
| **Urban** | **Interstate** | **Free/Expr** | **Prin Art** | **Min Art** | **Collector** | **Local** |
| Miles | 297 | 375 | 1,319 | 2,599 | 2,379 | 15,774 |
| ADVMT (in 1,000s) | 29,184 | 14,029 | 23,712 | 20,361 | 8,801 | 11,874 |
| Estimated ADT | 98,263 | 37,411 | 17,977 | 7,834 | 3,699 | 753 |
| ADT Class | > 10,000 limited access | > 10,000 limited access | > 10,000 | 5,000 - 10,000 | 500 - 5,000 | 500 - 5,000 |
| Silt loading ($g/m^2$) | 0.015 | 0.015 | 0.03 | 0.06 | 0.2 | 0.2 |

Mean vehicle weight by road class was calculated from a Federal Highway Administration report of in-use operating weights and VMT by vehicle type and road class.[14]

**Table 18: Mean Vehicle Weight in Tons**

| Road Class | Vehicle Weight (Tons) | Road Class | Vehicle Weight (Tons) |
|---|---|---|---|
| Urban Interstate | 3.27 | Rural Interstate | 5.71 |
| Urban PA F/E | 2.56 | Rural Minor Art | 3.16 |
| Urban PA Other | 2.51 | Rural Major Col | 2.74 |
| Urban Minor Art | 2.26 | Rural Minor Col | 2.62 |
| Urban Collector | 2.18 | Rural Local | 2.49 |
| Urban Local | 2.14 | | |

Days per month of precipitation greater than 0.01 inches in 2008 were obtained for SeaTac.

**Table 19: Days with Greater Than 0.01 Inches of Precipitation**

| Month | Days | Month | Days | Month | Days |
|---|---|---|---|---|---|
| 01 | 20 | 05 | 12 | 09 | 6 |
| 02 | 13 | 06 | 7 | 10 | 15 |
| 03 | 20 | 07 | 3 | 11 | 23 |
| 04 | 19 | 08 | 11 | 12 | 21 |

Monthly and day-of-week ADVMT adjustments were provided by WSDOT.[15] Weekday adjustments are the average of Monday-Friday adjustments. Weekend adjustments are average Saturday/Sunday adjustments.

| Table 20: WSDOT Monthly Adjustment Factors, 2008 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Road Type** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| Rural Interstate | 0.77 | 0.85 | 0.93 | 1.00 | 1.03 | 1.12 | 1.22 | 1.24 | 1.10 | 1.03 | 0.89 | 0.83 |
| Other Rural Arterial | 0.77 | 0.86 | 0.90 | 0.95 | 1.04 | 1.12 | 1.25 | 1.26 | 1.11 | 1.03 | 0.84 | 0.79 |
| Other Rural | 0.72 | 0.77 | 0.82 | 0.87 | 1.05 | 1.23 | 1.42 | 1.36 | 1.20 | 1.01 | 0.84 | 0.71 |
| Urban Interstate | 0.92 | 0.97 | 0.99 | 1.01 | 1.06 | 0.99 | 0.98 | 0.98 | 0.99 | 0.95 | 0.91 | 0.91 |
| Other Urban Arterial | 0.92 | 0.95 | 0.98 | 1.01 | 1.06 | 1.07 | 1.06 | 1.07 | 1.03 | 1.00 | 0.93 | 0.93 |

| Table 21: WSDOT Day-of-Week Adjustment Factors, 2008 | | |
|---|---|---|
| **Road Type** | **Weekday** | **Weekend** |
| Rural Interstate | 98.578 | 103.52 |
| Other Rural Arterial | 100.584 | 98.225 |
| Other Rural | 97.956 | 105.565 |
| Urban Interstate | 105.658 | 85.855 |
| Other Urban Interstate | 107.052 | 82.29 |

Monthly emissions were calculated using the equation below. Annual emissions were calculated by summing all months. Daily emissions were calculated using the equation below with the daily emission factor E (no precipitation), the January monthly adjustment, and with D = 1.

V x T x D x E x (lb/454 g) x (T/2000 lbs) - monthly emissions
where V = ADVMT
T = monthly VMT adjustment factor
D = number of days in month, and
E = emission factor in g/VMT

*Spatial Allocation*

Emissions were allocated to the Nonattainment Area and modeling grid using a surrogate as described in Section 3.1. Each inventory year's PSRC's link-level VMT were the surrogates. The VMT was allocated to the Nonattainment Area and modeling grid using GIS methods. PSRC's VMT is described more fully in Section 3.5.

### 3.3.3 Minor Stationary Sources

PSCAA inventoried minor stationary sources. Sources are required to report emissions from any criteria pollutant that equals or exceeds 25 tons per year.[16] All reported emissions of $PM_{2.5}$, $NO_X$, $SO_2$, $NH_3$, and VOCs are included in this inventory (see Table 11).

### 3.3.4 Other Nonpoint Sources

Many nonpoint categories were estimated by EPA for the 2008 NEI. Neither PSCAA nor Ecology had local data on these sources. For the categories listed below, the EPA estimates[17] were used in the inventory without changes.

- Residential Distillate Oil Combustion

- Residential Natural Gas Combustion
- Construction Dust
- Commercial Charbroiling
- Gas Cans
- Gas Stations, Stage 1 and Underground Tank Breathing
- Non-Industrial Commercial and Consumer Solvents
- Architectural Surface Coating
- Livestock
- Fertilizer

*Temporal Allocation*

Annual emissions were adjusted to winter (January) weekday and weekend hourly activity using AIRPACT temporal allocation profiles for month and day of week. Several of the profiles came from EPA emissions modeling files.[18] The descriptions and category assignments are shown in the tables below.

**Table 22: Temporal Profiles, Month and Day Type**

| Profile | Description | Source |
|---|---|---|
| **Month** | | |
| 262 | Win=25.0%, Spr=25.0%, Sum=25.0%, Fal=25.0% (uniform) | EPA |
| 485 | Win=57.0%, Spr=22.5%, Sum=1.5%, Fal=19.2% | EPA |
| 996 | Win=3.7%, Spr=31.4%, Sum=28.1%, Fal=36.7% | EPA |
| 1500 | Win=17.7%, Spr=25.5%, Sum=34.3%, Fal=22.6% | EPA from Gilliland NH3 profile |
| 4002 | Win=21.1%, Spr=25.1%, Sum=30.6%, Fal=23.1% | Architectural Coating 1996 Quarterly Business review revenue |
| 4015 | Win=20.7%, Spr=24.3%, Sum=30.6%, Fal=24.0% | EPA NONROAD2008 model for Construction Equipment (SEASON.DAT) |
| 4016 | Win=23.3%, Spr=25.6%, Sum=26.5%, Fal=24.6% | 2008 WSDOT[15] |
| **Day** | | |
| 6 | Weekdays=16.7%, Weekends=8.3% | EPA |
| 7 | Weekdays=14.3%, Weekends=14.3% (uniform) | EPA |
| 407 | Weekdays=13.5%, Weekends=16.1% | 2001 WSU Survey[10] |
| 409 | Weekdays = 14.1%, Weekends = 14.7% | 2008 WSDOT[15] |

**Table 23: Temporal Allocation, Month and Day Type**

| Category | Month | Day Type |
|---|---|---|
| Residential Distillate Oil and Natural Gas | 485 | 407 |
| Construction Dust – Commercial/Industrial | 4015 | 6 |
| Construction Dust – Roads | 4015 | 6 |
| Commercial Charbroiling | 262 | 6 |
| Gas Cans – Spillage, Refilling | 4016 | 409 |
| Gas Cans – Permeation, Evaporation | 262 | 7 |
| Gas Stations | 262 | 7 |
| Non-Ind. Comm/Cons Solvents | 262 | 7 |
| Architectural Surface Coating | 4002 | 7 |
| Livestock | 1500 | 7 |
| Fertilizer | 996 | 7 |

*Temporal Allocation – Additional Adjustments for Construction Dust*

A further adjustment was made to construction dust to account for higher soil moisture values in the winter. The NEI dust equations contains a multiplier of 24/PE where PE is the 30-year average precipitation-evaporation value from Thornthwaite's PE Index. Fine particle concentrations in the Nonattainment Area greater than or equal to 25 µg/m$^3$ from 2001–2010 occurred during October–February with few exceptions. A variation of Thornwaite's precipitation-evaporation equation (below) was used to calculate PE by month using 10 years of temperature and precipitation data[19] from the Tacoma Narrows meteorological station. The calculated monthly PE values for October–February were normalized to produce a 12-month PE value representative of the winter (i.e., the high fine particle values). The normal annual PE was divided by the winter PE to produce a moisture adjustment factor (60 percent).

*Precipitation-Evaporation Equation*

$$PE = \sum^{12} 115\,[P/T-10]^{10/9}$$

where P is average monthly precipitation (inches) with 0.5 being the minimum value
T is average monthly temperature (degrees F) with 28.4 ° F being the minimum value used in the calculation.

**Table 24: Tacoma Narrows Temperature (°F) and Precipitation (Inches), 1999–2008**

| Parameter | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature | 41.8 | 43 | 45.7 | 49.7 | 55.1 | 60.3 | 64.8 | 64.8 | 59.9 | 52.7 | 45.5 | 41.5 | 52.1 |
| Precipitation | 7.16 | 3.64 | 4.11 | 2.48 | 1.84 | 1.49 | 0.54 | 1.02 | 1.09 | 3.5 | 6.92 | 5.98 | 39.76 |

The calculated 60 percent adjustment was reasonable when compared to other information:

- PSCAA regulations specify no visible emissions.
- Emissions Inventory Improvement Program estimation method applies 50 percent control to PM nonattainment areas.
- Western Regional Air Partnership and AP42 attribute 10 to 74 percent control efficiency for watering depending on schedule and operation.

*Spatial Allocation*

Sources emitting $PM_{2.5}$, $SO_2$, or $NO_X$ were spatially allocated to the Nonattainment Area. Sources emitting only VOC or $NH_3$ were not allocated. Emissions were allocated to the Nonattainment Area using surrogates as described in Section 3.1. Each inventory year's PSRC's link-level VMT were the surrogates. The VMT was allocated to the Nonattainment Area using GIS methods. PSRC's VMT is described more fully in Section 3.5.

**Table 25: Spatial Allocations for Other Nonpoint Sources**

| Category | Surrogate | Source |
|---|---|---|
| Residential Distillate Oil and Natural Gas | Occupied Housing Units | 2010 Census block |
| Construction Dust – Commercial/Industrial | Land Use: commercial/industrial/transportation | Tax Parcels, 2008 |
| Construction Dust – Roads | Road miles | PSRC, 2008 |
| Commercial Charbroiling | Land Use: commercial/industrial/transportation | Tax Parcels, 2008 |

## 3.4 Nonroad Mobile Sources

Nonroad mobile sources include all off-road vehicles and equipment. Locomotives and marine vessels are included in the nonroad category.

### 3.4.1 Nonroad Mobile Sources, Except Locomotives, Marine, and Port of Tacoma Sources

The Nonroad Mobile category includes emissions estimates from gasoline, diesel, compressed natural gas (CNG), and liquefied petroleum gas (LPG) fueled equipment. Emissions were estimated using EPA's NONROAD2005 model.[20] Equipment types are compiled into six categories:

1) Lawn and Garden Equipment
2) Railroad Maintenance Equipment
3) Recreational Marine Vessels
4) Construction and Mining Equipment
5) Commercial Equipment
6) Industrial Equipment

*Temporal Allocation and Emission Rates*

Emissions were generated for the four seasons using the seasonal temporal option in the NONROAD2005 model for 2008 base year and 2014 projection year. The month of January, both weekday and weekend, was also chosen to represent a typical winter day scenario for each year as well (see Table 26). NONROAD2005 requires user input of seasonal meteorological and fuel parameters. The required fuel parameters are gasoline RVP and oxygen content; sulfur contents of gasoline; diesel (land and marine); CNG; LPG; and presence of stage II vapor recovery requirements.

**Table 26: 2008 Nonroad Model Parameters**

| Fuel RVP | $O_2$ Wt. % | Gas Sulfur % | Diesel Sulfur % | Marine Diesel Sulfur % | CNG/ LPG Sulfur % | Min Temp (°F) | Max Temp (°F) | Avg. Temp (°F) | EtOH blend mkt % | EtOH Vol % | Yr. | Period | Mo. | Season | Type | Week Day/End |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 3.5 | 0.0045 | 0.0351 | 0.0435 | 0.003 | 26 | 47 | 36 | 100 | 10 | 08 | Monthly | Jan | | Typical Day | Day |
| 14 | 0 | 0.0045 | 0.0351 | 0.0435 | 0.003 | 26 | 47 | 36 | 0 | 0 | 08 | Monthly | Jan | | Typical Day | Day |
| 14 | 3.5 | 0.0045 | 0.0351 | 0.0435 | 0.003 | 26 | 47 | 36 | 100 | 10 | 08 | Monthly | Jan | | Typical Day | End |
| 14 | 0 | 0.0045 | 0.0351 | 0.0435 | 0.003 | 26 | 47 | 36 | 0 | 0 | 08 | Monthly | Jan | | Typical Day | End |
| 14 | 3.5 | 0.0045 | 0.0351 | 0.0435 | 0.003 | 34 | 46 | 42 | 100 | 10 | 08 | Seasonal | | Win | Period Total | Day |
| 14 | 0 | 0.0045 | 0.0351 | 0.0435 | 0.003 | 34 | 46 | 42 | 0 | 0 | 08 | Seasonal | | Win | Period Total | Day |
| 12 | 3.5 | 0.0045 | 0.0351 | 0.0435 | 0.003 | 41 | 58 | 52 | 100 | 10 | 08 | Seasonal | | Spg | Period Total | Day |
| 12 | 0 | 0.0045 | 0.0351 | 0.0435 | 0.003 | 41 | 58 | 52 | 0 | 0 | 08 | Seasonal | | Spg | Period Total | Day |

| Table 26: 2008 Nonroad Model Parameters | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fuel RVP | $O_2$ Wt. % | Gas Sulfur % | Diesel Sulfur % | Marine Diesel Sulfur % | CNG/ LPG Sulfur % | Min Temp (°F) | Max Temp (°F) | Avg. Temp (°F) | EtOH blend mkt % | EtOH Vol % | Yr. | Period | Mo. | Season | Type | Week Day/End |
| 10 | 3.5 | 0.0045 | 0.0351 | 0.0435 | 0.003 | 53 | 74 | 67 | 100 | 10 | 08 | Seasonal | | Sum | Period Total | Day |
| 9 | 0 | 0.0045 | 0.0351 | 0.0435 | 0.003 | 53 | 74 | 67 | 0 | 0 | 08 | Seasonal | | Sum | Period Total | Day |
| 10 | 3.5 | 0.0045 | 0.0351 | 0.0435 | 0.003 | 46 | 62 | 57 | 100 | 10 | 08 | Seasonal | | Fall | Period Total | Day |
| 9 | 0 | 0.0045 | 0.0351 | 0.0435 | 0.003 | 46 | 62 | 57 | 0 | 0 | 08 | Seasonal | | Fall | Period Total | Day |

*Activity Level and Spatial Allocation*

The NONROAD model contains data on statewide equipment types and usage. The model utilizes spatial surrogates appropriate for each equipment type to disaggregate state activity levels to individual counties. The default surrogates were used for all equipment types except recreational marine vessels. The default spatial surrogate for recreational marine is water surface area. This method can overestimate recreational boat usage in certain counties due to the large areas of open water in a county's jurisdiction. A new allocation based on Pierce County boat registrations was substituted for the default. Registrations for 2008 were provided by the Washington Department of Licensing (Table 28).[21]

Emissions were allocated to the Nonattainment Area and modeling grids based on spatial surrogates.

| Table 27: Spatial Allocations for Nonroad Sources | | |
|---|---|---|
| Category | Surrogate | Source |
| Recreational Marine Vessels | Land Use: open water | MRLC* |
| Railroad Maintenance Equipment | Active Railroad Track | WSDOT GIS files |
| Commercial Equipment | Land Use: commercial/industrial/transportation | Tax Parcels, 2008 |
| Construction and Mining Equipment | Land Use: residential/commercial/industrial/transportation | MRLC* |
| Industrial Equipment | Land Use: commercial/industrial/transportation | Tax Parcels, 2008 |
| Lawn and Garden Equipment | Land Use: residential/commercial/industrial/transportation | MRLC* |
| * Multi-resolution Land Characteristics[22] | | |

| Table 28: County Boat Registrations, 2008 | |
|---|---|
| County | Registrations |
| Pierce | 27896 |

### 3.4.2 Locomotives

Emissions from Class I line haul and switch yard locomotives were estimated using EPA guidance and other information.[23] Two Class I railroads operate in Washington: Burlington Northern Santa Fe Railway (BNSF) and Union Pacific Railroad (UPRR). 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.[24,25]

*Activity Level*

Activity level is measured in gallons of diesel consumed by locomotives. BNSF, UPRR, and Amtrak provided county fuel use for line haul and switch yard locomotives for 2008.[26,27,28]

*Temporal and Spatial Adjustments*

The activity information was obtained by county; therefore, no spatial adjustments were necessary at the county level. Emissions were allocated to the Nonattainment Area using active railroad track GIS data from WSDOT as the spatial surrogate.

Locomotives were assumed to operate uniformly year-round per EPA guidance.[29]

*Emission Rates*

BNSF, UPRR, and AMTRAK provided emissions estimates for 2008.

**Table 29: 2008 Emissions Estimates—Locomotives**

| County | Type | Pollutant | Emissions 2008 |
|---|---|---|---|
| PIERCE | Line Haul | $NO_X$ | 514.5 |
| PIERCE | Line Haul | $PM_{2.5}$ | 17.1 |
| PIERCE | Line Haul | $SO_2$ | 44.9 |
| PIERCE | Line Haul | VOC | 30.0 |
| PIERCE | Passenger | $NO_X$ | 56.1 |
| PIERCE | Passenger | $PM_{2.5}$ | 1.3 |
| PIERCE | Passenger | $SO_2$ | 0.8 |
| PIERCE | Passenger | VOC | 2.6 |
| PIERCE | Yard | $NO_X$ | 111.0 |
| PIERCE | Yard | $PM_{2.5}$ | 3.3 |
| PIERCE | Yard | $SO_2$ | 7.6 |
| PIERCE | Yard | VOC | 6.7 |

### 3.4.3 Marine and Port of Tacoma Sources

Five types of marine and port sources were inventoried: ocean-going vessels, harbor vessels, cargo handling equipment, on-road heavy-duty vehicles, and port rail operations. Pleasure craft

were also inventoried, but in Section 3.4.1. The 2005 inventory prepared for the Puget Sound Maritime Air Quality Forum by Starcrest Consulting Group, LLC (2005 PSEI) was the starting point for the inventories.[30] The inventory is a bottom-up, activity-based emissions inventory. It is unprecedented in scope and detail for the Puget Sound area.

*Emissions Calculations*

For all sources except ferries, emissions were calculated by projecting the 2005 PSEI to each of the evaluation years. Emissions for pollutant "P" were calculated:

$E_{year} = E_{2005} \times A \times F$ Where E = Emissions,
A = Activity adjustment factor
F = Fuel/engine adjustment factor for pollutant

The activity and fuel/engine adjustment factors are described in the *Activity Level* and *Emission Factors* sections below. There were some errors in the 2005 PSEI for ferry boat emissions. Fuel estimates and emission factors were available for ferries, so emissions were calculated directly.

*Activity Level*

Activity level and emission rates are described in the 2005 PSEI report. The report addressed $PM_{10}$, $PM_{2.5}$, $NO_X$, $SO_2$, Carbon Monoxide (CO), and VOC. The emissions were projected to 2008 using local information and federal regulatory programs. Activity was projected using one of four activity surrogates for each type of ship or port equipment: Port of Tacoma Twenty-ft Equivalent Units (TEUs),[31, 32] Alaska Fishing Permits,[33, 34] or Ferry Boat Fuel Use for the Pt. Defiance-Tahlequah run.[35] Most of the surrogate assignments were recommended by Ron Stuart of the Port of Tacoma.

**Table 30: Ship and Port Activity Data, Growth Factors**

| Activity Measure | 2005 to 2008 |
|---|---|
| Twenty-ft Equivalent Units (TEUs) | 0.90 |
| Alaska Fishing Permits | 0.94 |
| Ferry Fuel Use–Pt. Defiance-Tahlequah | 1.20 |

**Table 31: Ship and Port Activity Data**

| Activity Measure | 2005 | 2008 |
|---|---|---|
| Twenty-ft Equivalent Units (TEUs) | 2,066,446 | 1,861,358 |
| Alaska Fishing Permits | 31,000 | 29,000 |
| Ferry Fuel Use–Pt. Defiance-Tahlequah | 172,156 | 205,957 |

**Table 32: Ship and Port Activity Projection Surrogates**

| Marine or Port Source | Surrogate, 2005 to 2008 |
|---|---|
| Ocean-going Vessels | TEUs |
| Harbor Craft–Ferry | n/a |

| Table 32: Ship and Port Activity Projection Surrogates | |
|---|---|
| **Marine or Port Source** | **Surrogate, 2005 to 2008** |
| Harbor Craft–Tugs and Workboats | TEUs |
| Harbor Craft–Fishing Boats | Fishing Permits |
| Harbor Craft–Excursion | Assume same as 2005 |
| Harbor Craft–Government | Assume same as 2005 |
| Cargo Handling Equipment | TEUs |
| Port Heavy Duty Vehicles | TEUs |
| Port Rail | TEUs |

*Emission Factors*

Ocean-going Vessels–Transit & Maneuvering

Emission rates for 2008 were assumed to be the same as emission rates in 2005; therefore, no adjustments for emission factors were made.

Ocean-going Vessels–Hotelling

Some ships switch to a low sulfur fuel (less than or equal to 500 parts per million (ppm)) or use shore power at the Port of Tacoma. Based on NW Ports Clean Air Strategy 2010 Implementation Report and information from PSCAA and the Port of Tacoma, it was assumed that 50 percent of hotelling uses the same fuel as maneuvering and transit; 35 percent low sulfur (less than or equal to500 ppm), 15 percent shore power.[36]

Harbor Craft–Except Ferry Boats

EPA's NONROAD2008 model was run for 2005 and the evaluation years for diesel-powered boats. Emissions factors for harbor vessels were calculated and expressed as grams per hour using the NONROAD model output. The ratio of the evaluation year to 2005 emission factors was calculated. The ratios were used as emission factor adjustments. The fuel sulfur content for 2005 was the PSEI value of 3100 ppm (p. 89, Section 1.12.1). For 2008, the NONROAD value of 435 ppm was used.

| Table 33: Harbor Craft Emission Rate Adjustment Factors | |
|---|---|
| **Pollutant** | **2008** |
| $PM_{2.5}$ | 0.64 |
| $SO_2$ | 0.140 |
| $NO_X$ | 1.00 |
| VOC | 1.00 |

Cargo Handling Equipment

In the 2005 PSEI (Section 5.6.1, p. 316), several factors were applied to equipment at the Port of Tacoma:

- All diesel-powered equipment used either ultra-low sulfur diesel (15 ppm) or highway diesel.
- Sixty diesel oxidation catalysts were retrofit on 30 straddle carriers.
- Sixty-four yard tractors used fuel-efficient onroad engines.

The 2005 PSEI assumed onroad diesel sulfur content was 310 ppm.

Port Heavy Duty Vehicles

The 2005 PSEI used the MOBILE model to estimate emission factors for heavy duty vehicles. MOBILE has been replaced with MOVES. Because all the specific activity data used in the 2005 PSEI inventory was not readily available, recalculation would have been a major exercise. The emissions from heavy duty vehicles were a small part of the Port inventory; therefore, no adjustments were made.

Port Rail

Emission rates for 2008 were assumed to be the same as emission rates in 2005; therefore, no adjustments for emission factors were made.

*Activity Level and Emission Factors for Ferry Boats*

There are two ferry routes in the modeling domain: Pt. Defiance–Tahlequah Vashon (operated by the state) and Steilacoom-Ketron-Anderson Island (locally operated). Fuel use and sulfur content for the Pt. Defiance–Tahlequah Vashon route were obtained from Washington State Ferries.[35] The Steilacoom-Ketron-Anderson Island (Anderson Island) route is about the same length as the Pt. Defiance route. In 2011, there were 20 round trips per day for Pt. Defiance and approximately 14 for Anderson Island. Therefore, Anderson Island fuel use was estimated at 14/20 (0.7) of the Pt. Defiance amount (likely overestimation because of smaller boat size).

Ferry emissions were calculated using NONROAD emission factors expressed in grams per gallon using 15 ppm sulfur (S) fuel. The Pt. Defiance ferry used 15 ppm fuel beginning in 2007; biodiesel (B5) began in 2009. Factors for B5 were not available, so factors for 15 ppm S fuel were used. The same factors were used for the Anderson Island ferry.

**Table 34: Ferry Boat Fuel Use**

| Year | Ship Data Source | HP | Gallons | | |
|---|---|---|---|---|---|
| | | | Pt. Defiance | Anderson | Total |
| 2005 | Rhododendron | 2170 | 172,156 | 120,509 | 292,665 |
| 2008 | Rhododendron | 2170 | 205,957 | 144,170 | 350,127 |

| Table 35: Ferry Boat Emission Factors | |
|---|---|
| **Pollutant** | **2008** |
| $PM_{2.5}$ | 2.18 |
| $SO_2$ | 0.09 |
| $NO_X$ | 130.73 |
| VOC | 4.45 |

*Temporal and Spatial Allocation*

Emissions were assumed to occur uniformly throughout the year.

County-level estimates were available in the 2005 PSEI for all source types except individual harbor craft types. Port of Tacoma, PSCAA, and Ecology staff assigned emissions to the Nonattainment Area based on the geographic area of operation for each source type. The Pierce County estimates for individual harbor craft types include a small portion of King County, which results in a small overestimation. The estimates were made early in the inventory process when modeling was contemplated. The modeling domain had included a small portion of King County. Harbor craft county-level emissions are not readily available for VOC. Pierce County, VOC was estimated at approximately 13 times the Nonattainment Area values (this is the approximate ratio for other pollutants).

*Double-Counting*

There is potential for double-counting in this category since it overlaps with other nonroad sources. The three sources are briefly discussed below.

Cargo handling equipment: This equipment is counted as industrial equipment in the NONROAD model, but the county allocations are based on manufacturing employment, which is not counted as port activity (Section 3.4.1). Therefore, emissions were not subtracted from the NONROAD model totals.

Port of Tacoma Rail: Three companies have rail operations in or near the Port of Tacoma: BNSF, UPRR, and Tacoma Rail. Emissions from BNSF and UPRR were counted under the locomotive category (Section 3.4.2). The 2005 PSEI did not contain sufficient detail to determine whether any emissions from BNSF or UPRR may have been double counted in this section. If there was double-counting within the Port of Tacoma, it was likely small.

Light and Heavy-Duty Vehicles: Heavy-duty vehicle activity within port boundaries is a very small fraction of overall vehicle activity; therefore, the small amount of double-counting that will occur was considered acceptable.

## 3.5 Onroad Mobile Sources

Onroad mobile source emissions come from exhaust, evaporation, and brake and tire wear. Vehicle refueling was also calculated in the onroad category. EPA's MOVES model was used

with local and default data to calculate emissions. MOVES may be run to produce emissions (Inventory model) or emission factors (Rates mode). MOVES was run in both the Rates and Inventory modes to calculate winter day emissions, and in the simpler Inventory mode to calculate annual emissions. The MOVES Technical Guidance for SIP inventories and the MOVES User's Guide were used in developing the local parameters.[37, 38]

Because activity level, temporal allocation, and spatial allocation are integral parts of the MOVES modeling process, they will be discussed below in the context of the MOVES model.

*MOVES Modeling*

MOVES input parameters were similar (though not identical) for both the annual Inventory mode run and the winter day Inventory and Rates mode runs. All of the parameters are used directly in Inventory mode; however, in Rates mode, several are treated as placeholders and essentially ignored. The actual values of these parameters are input during post-processing of the MOVES output. This allows the ability to use more specific input data. Tables outlining the inputs and data sources are shown below and are followed by a discussion of the MOVES panel options and parameters for the annual and winter day runs.

Panel Options

- Scale
- Time Spans
- Geographic Bounds
- Vehicles
- Road Types
- Pollutants and Processes
- Datasets - Low Emission Vehicle Program
- Strategies - Bus Fuel
- Output

Parameters

- Vehicle Populations
- Vehicle Miles Traveled (VMT)
- Temporal Allocation
- I/M Program
- Low Emission Vehicle Program (LEV)
- Fuel Parameters
- Temperatures and Humidity
- Road Type Distribution
- Vehicle Age Distribution
- Speeds
- Stage II Vapor Recovery

**Table 36: Base Year 2008 MOVES Inputs and Data Sources**

| Parameter | Data Source |
|---|---|
| Vehicle Populations | Local (DOL, OSPI, FTA) |
| Vehicle Miles Traveled (VMT) | Local (PSRC) with EPA default tailoring |
| Temporal Allocation | Local (WSDOT, PSRC) with EPA default tailoring |
| I/M Program | Local (Ecology) |
| Fuel Parameters | Local (Fuel Survey, Regulations) and Default |
| Temperatures | Local (Design Day Profiles) |
| Road Type Distribution | Local (PSRC) with EPA default tailoring |
| Vehicle Age Distribution | Local (DOL, OSPI, FTA) |
| Speeds | Local (PSRC) |
| Stage II Vapor Recovery | Local (Ecology) and Default |

*Annual Emissions*

Panel Options

Annual emissions were run for Pierce County for each evaluation year. MOVES was run in Inventory mode at the county scale by hour for one weekday and one weekend day for each of January, April, July, and October. All vehicle types, road types, and emissions processes producing the target pollutants were included. Pierce County Transit's buses run almost exclusively on CNG. This was defined in the Strategies panel item. Emissions were output by day type, fuel type, vehicle type, and emissions process.

Parameters

The model parameters used in the annual inventory are available in Appendix A3

Post-Processing

Annual emissions were calculated according to the equations below.

$$E_{Annual} = (365/4) \times \sum \{[E_{Weekday} \times (5/7)] + [E_{Weekend} \times (2/7)]\}$$

Where E = emissions and the summation $\sum$ is over the four months run, each representing a season: Jan = winter, Apr = spring, Jul = summer, Oct = fall.

Emissions were estimated for the Nonattainment Area by multiplying Pierce County emissions by the fraction of Pierce County PSRC link VMT that was in the Nonattainment Area. This was done for each evaluation year. The link VMT is discussed under the winter day inventory below.

*Winter Day Emissions*

Panel Options

Winter day emission rates were run for Pierce County. MOVES was run in Rates mode at the county scale by hour for one weekday and one weekend day in January for each of the three design day temperature profiles. Weekday and weekend Inventory runs were made for Pierce County using the median design day temperature profile in order to obtain output vehicle counts and VMT, and data supporting calculation of winter weekend emissions. All vehicle types, road types, and emissions processes producing the target pollutants were included. Pierce County Transit's buses run almost exclusively on CNG. This was defined in the Strategies panel item. Emissions were output by hour, fuel type, road type, and emissions process. Optional outputs of VMT and vehicle populations were chosen.

Parameters

With the exception of hourly temperatures, all of the parameters for the winter day runs were the same as the annual runs. The Inventory mode runs for Pierce County were run with the median design day temperature profile. One Pierce County Rates mode run was made for each of the

three design day temperature profiles. As noted above, several of the parameters are treated as placeholders in MOVES, and were essentially ignored. These parameters were: VMT, month and day VMT adjustments, vehicle counts, and speeds.

Road type distribution and hourly VMT adjustments are used both actual input data and as placeholders. As actual data, the road type distribution allots vehicle types to road types by hour. The road type distribution is a placeholder with respect to the fraction of VMT assigned to each road type. For hourly adjustments, they are used as actual data to distribute vehicle operation throughout the day. This affects the some output emissions rates due to the relationship with hourly temperature. The hourly adjustments are used as placeholders with respect to the amount of VMT allocated to each hour.

The placeholder parameters were replaced by link-specific data during post-processing of the MOVES output. All of these parameters are briefly discussed below, with more detail provided in the post-processing section.

**Vehicle Miles Traveled, and Month, Day, and Hour VMT Adjustments**

PSRC provided average weekday daily VMT (ADVMT) for the year. The VMT was provided by link, road type, and speed for five different time periods throughout the day. Each link was identified by a “To” and “From” node, and coordinates were provided for each node. This allowed for accurate spatial allocation to the Nonattainment Area. While this introduced some inconsistency in the VMT between the annual and daily emissions calculations, it was not great.

PSRC's VMT represents an average annual weekday. It was adjusted to winter weekday by multiplying by a January adjustment factor (0.919) calculated:

$Jan_{Adjustment} = Jan_{Fraction}/AvgMonth_{Fraction}$

Where $Jan_{Fraction}$ = WSDOT January fraction = 0.077, and

$AvgMonth_{Fraction}$ = Average monthly fraction = 1/12 = 0.083

Winter VMT was assigned to each hour of the day by dividing the five time period VMT totals by the number of hours in each period and assigning the amount to each of the hours in the period. The periods were AM (6am-9am), MD (9am-3pm), PM (3pm-6pm), EV (6pm-10pm), and NT (10pm-6am).

Weekend VMT follows a different hourly pattern than weekday VMT. Weekday VMT has morning and afternoon commute peaks, while weekend VMT has a single extended peak during the mid-day. PSRC does not model weekend VMT patterns. Weekend adjustment factors were calculated by dividing the emissions from the weekend Pierce County Inventory run by the weekday emissions. Calculation of weekend emissions is described more fully in the post-processing section.

**Vehicle Counts**

Vehicle counts were the same as used in the annual inventory, and were obtained from the design day Inventory mode run.

**Road Type Distribution and Speeds**

The PSRC roadway links were classified by road type and speed for each time period. Each link's period VMT was matched to emission rates for the appropriate road type and speed.

Post-Processing

The Rates mode produces emission factors in gram per mile and grams per vehicle. The output required extensive post-processing with the PSRC VMT data to calculate emissions for each geographic area. The post-process is detailed in Appendix A3.

# 4 QUALITY ASSURANCE AND QUALITY CONTROL

In order to provide data of sufficient quality for maintenance planning needs, the inventory process included quality assurance (QA) and quality control (QC) procedures. The procedures addressed data quality objectives of accuracy, completeness, comparability, and representativeness. Ecology used the following target goals for each objective:

- *Accuracy:* The inventory calculated and documented all estimates using acceptable methods. Individual source requirements and availability of data and resources affected estimation method selection.
- *Completeness:* Ecology addressed completeness by ensuring that the inventory included all applicable source categories, and verified that the inventory contained all the information required to estimate emissions.
- *Representativeness:* We calculated actual annual and peak fine particle season daily emissions for the 2008 evaluation year. The inventory calculations used local data wherever possible.
- *Comparability:* Ecology compared data by source category to both the prior 2005 base year inventory done by Ecology and PSCAA's 2005 Inventory. We corrected or justified any discrepancies greater than 20 percent, involving sources that made up greater than five percent of either the 2005 or the 2008 annual inventories.

For the comparability comparison, sources that were inventoried in all three inventories were compared. The sources shaded in the table below had discrepancies greater than 20 percent involving sources that made up greater than five percent of either the 2005 or the 2008 annual inventories.

For onroad, the SIP Revision Emissions Inventory used the MOVES model with local data. The 2005 inventories used the older MOBILE model. Fleet turnover and the change in models affected the estimates. For wood stoves, the SIP Revision Emission Inventory used a 2007 survey focused on the Nonattainment Area and greater Puget Sound area. 2005 inventories relied on older surveys with fewer respondents.

| Table 37: Base Year 2008 MOVES Inputs and Data Sources | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Category | 2005 EIs | | | | 2008 | | Discrepancy | |
| | PSCAA | % | ECY | % | SIP EI | % | SIP/PSCAA | SIP/ECY |
| Onroad Mobile | 501 | 25.4 | 294 | 10.0 | 588 | 19.9 | 1.174 | 0.781 |
| Nonroad Model Sources | 414 | 21.0 | 434 | 14.7 | 398 | 13.4 | 0.961 | 0.640 |
| Marine, except Recreational | 89 | 4.5 | 89 | 3.0 | 105 | 3.6 | 1.183 | 0.787 |
| Locomotives | 27 | 1.4 | 26 | 0.9 | 21 | 0.7 | 0.764 | 0.509 |
| Residential Wood Combustion | 679 | 34.5 | 1,884 | 64.1 | 1,636 | 55.3 | 2.409 | 1.603 |
| Point Sources | 181 | 9.2 | 177 | 6.0 | 205 | 6.9 | 1.134 | 0.754 |
| Residential Fuel Use | 78 | 4.0 | 36 | 1.2 | 7 | 0.2 | 0.086 | 0.057 |
| **Total All sources** | **1,969** | **100.0** | **2,941** | **100.0** | **2,959** | **100.0** | | |

## 4.1 Quality Control Procedures

Ecology performed calculations as appropriate for the given estimation method. QC checks were an integral part of calculations. We performed calculations electronically wherever possible to minimize errors. We made hand calculations to verify electronic calculation equations. This final inventory report fully documents those calculations. During the development of the report we made comparisons to the 2005 inventory to catch any potential errors.

## 4.2 Quality Assurance Procedures

Several EI staff were involved in calculating the inventories. EI staff performed the reality/peer review and sample calculation checks on one another's work. We used several quality assurance checks to address the data quality objectives:

- Reality/peer review checks
- Sample calculations
- Sensitivity analysis (emissions ranking)
- Range checks (see Comparability objective)

## Appendix A1: $PM_{2.5}$, $NO_X$, and $SO_2$ Source Categories

Ecology developed a list of fine particle emissions source categories as described in Section 3. The table below lists each category and Pierce County emissions from the 2008 National Emissions Inventory, version 1 general purpose release.

**Table 38: 2008 National Emissions Inventory (version 1.5 General Purpose Release)***

| Sector | Category | Tons/Yr | | | | | Percent Total | | | | | Use NEI Estimations for EI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $PM_{2.5}$ | $SO_2$ | $NO_X$ | VOC | $NH_3$ | $PM_{2.5}$ | $SO_2$ | $NO_X$ | VOC | $NH_3$ | |
| NP | CommercialCooking | 186 | | | 28 | | 5% | 0% | 0% | 0% | 0% | X |
| NP | Cnstr_IndComInst | 292 | | | | | 7% | 0% | 0% | 0% | 0% | X |
| NP | Cnstr_Res | 15 | | | | | 0% | 0% | 0% | 0% | 0% | |
| NP | Cnstr_Road | 161 | | | | | 4% | 0% | 0% | 0% | 0% | X |
| NP | PavedRoads | 120 | | | | | 3% | 0% | 0% | 0% | 0% | |
| NP | UnpavedRoads | 37 | | | | | 1% | 0% | 0% | 0% | 0% | |
| NP | Fertilizer | 0 | | | | 61 | 0% | 0% | 0% | 0% | 3% | X |
| NP | ResFuel_Coal | 0 | 0 | 0 | 0 | 0 | 0% | 0% | 0% | 0% | 0% | |
| NP | ResFuel_DO | 5 | 96 | 41 | 2 | 2 | 0% | 4% | 0% | 0% | 0% | X |
| NP | ResFuel_Kerosene | 0 | 2 | 1 | 0 | 0 | 0% | 0% | 0% | 0% | 0% | |
| NP | ResFuel_LPG | 0 | 0 | 31 | 1 | 0 | 0% | 0% | 0% | 0% | 0% | |
| NP | ResFuel_NatGas | 2 | 3 | 419 | 25 | 89 | 0% | 0% | 2% | 0% | 5% | X |
| NP | ResFuel_Wood | 1,839 | 30 | 197 | 2,395 | 104 | 47% | 1% | 1% | 10% | 5% | |
| NP | Livestock | 0 | | | | 1,016 | 0% | 0% | 0% | 0% | 53% | X |
| NP | CMV | 359 | 1,458 | 7,970 | 235 | 3 | 9% | 60% | 29% | 1% | 0% | |
| NP | Locomotives | 24 | 8 | 784 | 38 | 0 | 1% | 0% | 3% | 0% | 0% | |
| NP | Managed_Burns | 1 | | 0 | 1 | | 0% | 0% | 0% | 0% | 0% | |
| NP | OpenBurning | 0 | 0 | 0 | 0 | | 0% | 0% | 0% | 0% | 0% | |
| NP | GasCans | 0 | | | 501 | | 0% | 0% | 0% | 2% | 0% | X |
| NP | GasStations | 0 | | | 679 | | 0% | 0% | 0% | 3% | 0% | X |
| NP | GasStations_Stg2 | 0 | | | 152 | | 0% | 0% | 0% | 1% | 0% | |
| NP | PetrolStoreTransp | 0 | | | 109 | | 0% | 0% | 0% | 0% | 0% | |
| NP | Asphalt | 0 | | | 235 | | 0% | 0% | 0% | 1% | 0% | |
| NP | DryClean | 0 | | | 208 | | 0% | 0% | 0% | 1% | 0% | |
| NP | SolvConsCom | 0 | | | 3,311 | | 0% | 0% | 0% | 13% | 0% | X |
| NP | Surf_Arch | 0 | | | 1,186 | | 0% | 0% | 0% | 5% | 0% | X |
| NP | Surf_Traffic | 0 | | | 56 | | 0% | 0% | 0% | 0% | 0% | |
| NP | Wastewater | 0 | | | 15 | 3 | 0% | 0% | 0% | 0% | 0% | |
| NR | NRModel | 377 | 82 | 4,142 | 4,643 | 5 | 10% | 3% | 15% | 19% | 0% | |
| ON | Onroad | 225 | 100 | 12,791 | 10,818 | 611 | 6% | 4% | 47% | 43% | 32% | |
| P | Airports | 2 | 2 | 9 | 14 | | 0% | 0% | 0% | 0% | 0% | |
| P | Point | 266 | 657 | 912 | 365 | 36 | 7% | 27% | 3% | 1% | 2% | |
| | | **3,911** | **2,437** | **27,296** | **25,016** | **1,929** | **100%** | **100%** | **100%** | **100%** | **100%** | |

Full EI

County, Design Day only

*The highlighted categories are the ones Ecology included in the EI. The peach colored rows are included in all the various inventories: county/Nonattainment Area/modeling domain for annual and design day. The green colored rows are the categories we are only doing design day county-level inventories.

Several categories were identified in the guidance as potentially having medium or high significance, but were not inventoried in the 2008 NEI. Some of the categories are captured in-part in the Minor Point Source category. Others are only small contributors to the total winter Nonattainment Area emissions. They will not be included in the inventory.

| **Table 39: Sources in the Nonattainment Area That will not be Inventoried Because Their Wintertime Emissions are Expected to be Insignificant** | |
|---|---|
| Fuel Combustion—Industrial, Commercial, Institutional | Partly captured in Minor Point Sources |
| Agricultural Tiling | Expected to be Insignificant |
| Grain Elevators | Expected to be Insignificant |
| Mining and Quarrying | Expected to be Insignificant, partly captured in Minor Point Sources |
| Other Combustion | |
| Wildfires | Expected to be Insignificant |
| Cigarette Smoke | Expected to be Insignificant |
| Charcoal Grilling–Residential | Expected to be Insignificant |
| Firefighting Training | Expected to be Insignificant |
| Aircraft/Rocket Engine Firing and Testing | Expected to be Insignificant |
| Structure Fires | Expected to be Insignificant |
| Motor Vehicle Fires | Expected to be Insignificant |
| Open Fire | Expected to be Insignificant |
| Cremation, Human and Animal | Expected to be Insignificant |

## Appendix A2: Residential Wood Combustion Temperature Adjustment

We calculated residential wood combustion emissions for the three temperature profiles calculated for the design day (see IPP). The calculation is similar to the residential wood combustion temperature adjustment system used in the AIRPACT air quality forecasting model. Briefly, analysis of several fine particle and meteorological monitoring sites throughout the region showed a strong linear relationship between ambient temperature and ambient fine particulate concentrations at temperatures below 50 degrees Fahrenheit.[39] This relationship was used to develop the temperature adjustment system. The adjustment system involves normalizing emissions to heating degree days (based on 50 degrees = $HDD_{50}$), and then multiplying the normalized value by the heating degree days for the design day. A more detailed description follows.

### 1) Calculate baseline-heating degree-days ($HDD_{50}$)

Calculate annual heating degree days ($HDD_{50}$) for wood stove survey period Sept. 2006–Aug. 2007. This is the sum of the heating degree days for each day of the year. Daily min-max temperatures from the Tacoma - South L-Street meteorological site were used.

*Annual* $HDD_{50} = \sum_{I=1}^{365} 50 - Tavg_i$, *days).*

*= 1299*

*where Tavg = the daily average temperature (sum over all 365*

*If Tavg > 50, set the value of Tavg = 50.*

### 2) Calculate emissions as tons per $HDD_{50}$

Calculate annual county emissions (tons/yr). Divide the annual emissions by the annual $HDD_{50}$ calculated in step (1). The result is emissions expressed as tons per $HDD_{50}$. This can be viewed as emissions normalized to heating degree days.

*Tons/*$HDD_{50}$ *= (Tons/yr) /* $HDD_{50}$*/yr)*

### 3) Calculate the design day $HDD_{50}$

The design day heating degree days are calculated as (50 – average temperature for the day). The average temperatures used in the calculation is the average of the maximum and minimum temperatures for the three design day temperature profiles.

*Design Day* $HDD_{50}$ *= 50 –average temperature for the design day*

$HDD_{50}$ *for 25th percentile profile = 50 – (43 + 32)/2 = 9*

$HDD_{50}$ *for 50th percentile profile = 50 – (46 + 27)/2 = 14*

$HDD_{50}$ *for 75th percentile profile = 50 – (40 + 23)/2 = 18*

### 4) Calculate the design day emissions

Multiply the emissions in Tons/$HDD_{50}$ by the design day $HDD_{50}$ calculated in step (3). These are the final daily emissions.

*Tons/day = Tons/*$HDD_{50}$ *x* $HDD_{50}$

# Appendix A3: MOVES Parameters and Post-Processing

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# 1 MOVES INPUT PARAMETERS

Motor Vehicle Emission Simulator (MOVES) input parameters suitable for modeling average daily emissions for nonattainment/maintenance plan areas are presented here. Input parameters were developed that are characteristic of local conditions for each county and month. Some of the parameters presented here require local data. For others, EPA recommends that local data be used, especially when constructing mobile source inventories for State Implementation Plan (SIP) or conformity purposes. Inputs have been developed for modeling base year 2008.

## 1.1 VMT Average Speed

MOVES Table: avgSpeedDistribution

Used the MOVES default.

## 1.2 Vehicle Miles Traveled Statistics

MOVES Tables: HPMSVtypeYear, roadTypeDistribution, roadType

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. VMT data and crosswalks between Highway Performance Monitoring System (HPMS) and MOVES classifications are shown in tables below.

### 1.2.1 County Vehicle Miles Traveled

MOVES Table: HPMSVtypeYear

The national Department of Transportation's Highway Performance Monitoring System (HPMS) VMT data as obtained from the Washington State Department of Transportation (WSDOT) was used for the annual inventory.[1] HPMS is a system of traffic counts collected over several urban and rural sampling areas. WSDOT makes estimates of county VMT by roadway (functional) classification.

In MOVES, VMT must be allocated by MOVES road type and HPMS vehicle type. To allocate the VMT by HPMS vehicle type, WSDOT's travel activity by vehicle type and road class was examined. The data were not suitable for allocating VMT by vehicle type. This was due to uncertainty in assigning similar vehicle types (e.g., cars vs. light trucks, light trucks vs. smaller single-unit trucks). In lieu of the WSDOT data, a default 2008 MOVES run for the nation was conducted to determine the national distribution of VMT by vehicle and road type. This distribution was used to allocate the fraction of county VMT for each road type to the HPMS vehicle types (Table 1-1). It is noted that EPA developed the national travel fractions assuming that vehicles in the same HPMS class have the same road type distribution. County VMT estimates by HPMS vehicle class (b) were calculated:

(1) a = VMT x TF, for each combination of county, HPMS road type (Table 1-2) and HPMS vehicle class (Table 1-5). VMT is from Table 1-2. TF is the travel fraction from Table 1-1.
(2) b = ∑(a), by county and HPMS vehicle class.

### 1.2.2 Road and Vehicle Type Travel Distribution

MOVES Table: roadTypeDistribution

The MOVES roadTypeDistribution file contains VMT fractions by MOVES vehicle and road type. Though the vehicle breakout uses the MOVES vehicle classes, it is achieved by assuming all MOVES vehicle types included in a single HPMS class have the same road distribution (inherent assumption in the national travel fractions). The distribution fractions (d) were calculated for each MOVES vehicle type and MOVES road type as follows:

(1) a = VMT x TF, for each combination of HPMS road type (Table 1-2), MOVES road type (Table 1-4), and MOVES vehicle class (Table 1-5). VMT is from Table 1-2. TF is the travel fraction from Table 1-1.
(2) b = ∑(a), by MOVES road type and vehicle class.
(3) c = ∑(a), by vehicle class.
(3) d = b/c

### 1.2.3 Restricted Road Ramp Fraction

MOVES Table: roadType

To model restricted- access roads (e.g., freeways), vehicle hours traveled are split between the ramps and the roadway. The MOVES ramp fraction default is eight percent. It is recommended to use the default unless local data exists to replace the default. Since local data was not available, the default was used.

### 1.2.4 WSDOT VMT Information and MOVES-HPMS Classifications

**Table 1-1: National Travel Activity by MOVES Vehicle and Road Class**

| HPMS Veh Class | MOVES Veh Class | Rural | | Urban | |
|---|---|---|---|---|---|
| | | Restricted | Unrestricted | Restricted | Unrestricted |
| Motorcycles | Motorcycle | 0.0054 | 0.0054 | 0.0054 | 0.0046 |
| Passenger Cars | Passenger Car | 0.4642 | 0.5259 | 0.5536 | 0.5718 |
| Other 2 axle-4 tire | Passenger Trk | 0.2389 | 0.2820 | 0.2722 | 0.2825 |
| Other 2 axle-4 tire | Light Commercial Trk | 0.0798 | 0.0942 | 0.0909 | 0.0944 |
| Buses | Intercity Bus | 0.0012 | 0.0015 | 0.0006 | 0.0006 |
| Buses | Transit Bus | 0.0004 | 0.0005 | 0.0002 | 0.0002 |
| Buses | School Bus | 0.0013 | 0.0017 | 0.0007 | 0.0007 |
| Single Unit Trucks | Refuse Truck | 0.0008 | 0.0009 | 0.0006 | 0.0006 |
| Single Unit Trucks | Single Unit Short-haul Trk | 0.0266 | 0.0300 | 0.0188 | 0.0180 |
| Single Unit Trucks | Single Unit Long-haul Trk | 0.0034 | 0.0039 | 0.0024 | 0.0023 |
| Single Unit Trucks | Motor Home | 0.0016 | 0.0018 | 0.0011 | 0.0011 |

| Table 1-1: National Travel Activity by MOVES Vehicle and Road Class | | | | | |
|---|---|---|---|---|---|
| HPMS Veh Class | MOVES Veh Class | Rural | | Urban | |
| | | Restricted | Unrestricted | Restricted | Unrestricted |
| Combination Trucks | Cmb Short-haul Trk | 0.0746 | 0.0221 | 0.0226 | 0.0098 |
| Combination Trucks | Cmb Long-haul Trk | 0.1018 | 0.0302 | 0.0309 | 0.0134 |

| Table 1-2: Pierce County WSDOT ADVMT in Thousands by HPMS Road Type, 2008 | | | | | |
|---|---|---|---|---|---|
| Rural | | | | | |
| Interst | Prin Art | Min Art | Maj Col | Min Col | Local |
| 329 | 0 | 549 | 148 | 33 | 104 |
| Urban | | | | | |
| Interst | Free/Expr | Prin Art | Min Art | Col | Local |
| 3,219 | 2,765 | 3,653 | 3,306 | 765 | 1,969 |

| Table 1-3: HPMS and MOVES Road Classifications | | |
|---|---|---|
| HPMS Road Type | WSDOT Road Type (temporal) | MOVES Road Type |
| Rural Interstate | Rural Interstate | Rural Restricted Access |
| Rural Principal Arterial Other | Rural Arterial | Rural Unrestricted Access |
| Rural Minor Arterial | Rural Arterial | Rural Unrestricted Access |
| Rural Major Collector | Rural Other | Rural Unrestricted Access |
| Rural Minor Collector | Rural Other | Rural Unrestricted Access |
| Rural Local | Rural Other | Rural Unrestricted Access |
| Urban Interstate | Urban Interstate | Urban Restricted Access |
| Urban Principal Arterial Freeway/Expressway | Urban Arterial | Urban Restricted Access |
| Urban Principal Arterial Other | Urban Arterial | Urban Unrestricted Access |
| Urban Minor Arterial | Urban Arterial | Urban Unrestricted Access |
| Urban Collector | Urban Arterial | Urban Unrestricted Access |
| Urban Local | Urban Arterial | Urban Unrestricted Access |

| Table 1-4: HPMS and MOVES Vehicle Classifications | |
|---|---|
| **MOVES Vehicle Type** | **HPMS & MOVES Vehicle Class** |
| Motorcycle | Motorcycles |
| Passenger Car | Passenger Cars |
| Passenger Truck | Other 2 axle-4 tire vehicles |
| Light Commercial Truck | Other 2 axle-4 tire vehicles |
| Intercity Bus | Buses |
| Transit Bus | Buses |
| School Bus | Buses |
| Refuse Truck | Single Unit Trucks |
| Single Unit Short-haul Truck | Single Unit Trucks |
| Single Unit Long-haul Truck | Single Unit Trucks |
| Motor Home | Single Unit Trucks |
| Combination Short-haul Truck | Combination Trucks |
| Combination Long-haul Truck | Combination Trucks |

## 1.3 VMT Temporal Adjustments

MOVES Tables: monthVMTFraction, dayVMTFraction, hourVMTFraction

VMT is not temporally uniform. WSDOT provided adjustment factors for month, day-of-week, and hour (weekday and weekend).[2] The adjustment factors were based on traffic counter data, and were calculated for five road classes. MOVES temporal files were developed using the WSDOT temporal adjustments with WSDOT VMT and road and vehicle travel estimates described in Section 1.2.

It is again noted that EPA developed the national travel fractions assuming that vehicles in the same HPMS class have the same road type distribution. Therefore, all MOVES vehicle types included in a single HPMS vehicle class have the same temporal adjustments. In the MOVES default database, all vehicle types are assumed to have the same temporal distributions. The same assumption will be made for Washington, since the state has no information to develop temporal distributions by vehicle type.

The MOVES day-of-week and hourly adjustment files contain adjustment factors by MOVES vehicle and road type. One set of adjustments were developed for the state. Because the adjustments are specific to road type, the factors can be applied to Pierce County based on the individual mix of road types within the county. The MOVES monthly adjustment file contains estimates by MOVES vehicle type, but not by road type. Without road type, county variation could not be obtained through linkage with the county mix of road types. Therefore, the monthly adjustments were constructed for Pierce County specifically.

### 1.3.1 Monthly Adjustments

MOVES Table: monthVMTFraction

The monthly adjustments (d) were calculated for leap years and non-leap years for each month. The same distribution is used for all vehicle types; this is consistent with the MOVES default. The *Other Rural Arterial* category is used to represent MOVES class *Rural Unrestricted*. *Off-network* fractions were calculated as the average of the fractions for *Urban Restricted* and *Urban Unrestricted*.

*Non-Leap Year*

(1) a = ∑VMT, for Pierce County and MOVES road type (Table 1-4). VMT is from Table 1-2.
(2) b = ∑(a), for Pierce County
(3) c = a/b, which are VMT fractions by county and MOVES vehicle class.
(4) m = WSDOT VMT fractions by month and MOVES road type. The fractions were calculated from the data in Table 1-6 such that the fractions sum to 1 for the year.
(5) d = ∑(c x m), by month

*Leap Year*

Leap year factors were calculated by multiplying the WSDOT February monthly adjustments by 29 days/28 days, (2) summing all monthly adjustments by vehicle type (using the new adjustment for Feb.), and (3) normalizing all the monthly factors by dividing them by the summed monthly adjustments.

**Table 1-5: WSDOT VMT Monthly Adjustment Factors**

| WSDOT Road Type | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rural Interstate | 0.77 | 0.85 | 0.93 | 1 | 1.03 | 1.12 | 1.22 | 1.24 | 1.1 | 1.03 | 0.89 | 0.83 |
| Other Rural Arterial | 0.77 | 0.86 | 0.9 | 0.95 | 1.04 | 1.12 | 1.25 | 1.26 | 1.11 | 1.03 | 0.84 | 0.79 |
| Other Rural | 0.72 | 0.77 | 0.82 | 0.87 | 1.05 | 1.23 | 1.42 | 1.36 | 1.2 | 1.01 | 0.84 | 0.71 |
| Urban Interstate | 0.92 | 0.97 | 0.99 | 1.01 | 1.06 | 0.99 | 0.98 | 0.98 | 0.99 | 0.95 | 0.91 | 0.91 |
| Other Urban Arterial | 0.92 | 0.95 | 0.98 | 1.01 | 1.06 | 1.07 | 1.06 | 1.07 | 1.03 | 1 | 0.93 | 0.93 |

### 1.3.2 Day of Week Adjustments

MOVES Table: dayVMTFraction

The day-of-week adjustments (d) were calculated for each day type (weekday, weekend) and MOVES road type. The same distribution is used for all months and vehicle types; this is consistent with the MOVES default. The *Other Rural Arterial* category is used to represent MOVES class *Rural Unrestricted*. *Off-network* fractions were calculated as the average of the fractions for *Urban Restricted* and *Urban Unrestricted*.

(1) a = ∑ Mon to Fri adjust. factors (Table 1-7) for each MOVES road type (Table 1-4).

(2) b = ∑ Sat and Sun adjust. factors (Table 1-7) for each MOVES road type (Table 1-4).

(3) c = a+b, by MOVES road type.

(4) $d_{weekday}$ = a/c, $d_{weekend}$ = b/c

| Table 1-6: WSDOT VMT Day of Week Adjustment Factors (x 100) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Road Type** | **Sunday** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| Rural Interstate | 107.38 | 93.76 | 88.1 | 89.95 | 98.22 | 122.86 | 99.66 |
| Other Rural Arterial | 96.32 | 95.22 | 94.32 | 95.17 | 100.48 | 117.73 | 100.13 |
| Other Rural | 100.33 | 93.64 | 92.97 | 94.06 | 98.66 | 110.45 | 110.8 |
| Urban Interstate | 79.69 | 101.01 | 103.03 | 104.91 | 106.65 | 112.69 | 92.02 |
| Other Urban Interstate | 75.33 | 102.5 | 104.86 | 106.51 | 107.92 | 113.47 | 89.25 |

### 1.3.3 Hourly Adjustments

MOVES Table: hourVMTFraction

The hourly adjustments (b) were calculated for each day type (weekday, weekend), hour, and MOVES road type. The same distribution is used for all vehicle types; this is consistent with the MOVES default. The *Other Rural Arterial* category is used to represent MOVES class *Rural Unrestricted*. *Off-network* fractions were calculated as the average of the fractions for *Urban Restricted* and *Urban Unrestricted*.

(1) a = ∑ Hourly factors (Table 1-8) for each MOVES road type (Table 1-4) and day type (weekday/weekend)

(2) $b_{weekday}$ = Hour j/a, where j = 1 through 24, and daytype = weekday

(3) $b_{weekend}$ = Hour j/a, where j = 1 through 24, and daytype = weekend

| Table 1-7: WSDOT VMT Hourly Fractions (x 100) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Hour | Rural | | | | | | Urban | | | |
| | Interstate | | Arterial | | Other | | Interstate | | Other | |
| | Wkday | Wkend | Wkday | Wkend | Wkday | Wkend | Wkday | Wkend | Wkday | Wkend |
| 1 | 1 | 1.2 | 0.6 | 1 | 0.6 | 1 | 0.8 | 1.6 | 0.6 | 1.6 |
| 2 | 0.8 | 0.8 | 0.4 | 0.6 | 0.4 | 0.8 | 0.6 | 1 | 0.4 | 1 |
| 3 | 0.6 | 0.6 | 0.4 | 0.4 | 0.4 | 0.6 | 0.4 | 0.8 | 0.4 | 0.8 |
| 4 | 0.8 | 0.6 | 0.6 | 0.4 | 0.6 | 0.4 | 0.6 | 0.6 | 0.4 | 0.6 |
| 5 | 1.2 | 0.6 | 1 | 0.6 | 1.4 | 0.6 | 1.2 | 0.6 | 1.2 | 0.6 |
| 6 | 2.4 | 1 | 2.2 | 1 | 2.6 | 1 | 3.2 | 1 | 2.8 | 1.2 |
| 7 | 3.6 | 1.6 | 3.8 | 1.6 | 4.2 | 1.4 | 5.2 | 1.8 | 5.2 | 1.8 |
| 8 | 4.6 | 2.6 | 5.2 | 2.6 | 5.6 | 2.4 | 6.6 | 2.6 | 6.6 | 2.6 |
| 9 | 4.8 | 3.8 | 5.2 | 4 | 5.2 | 3.8 | 6 | 3.8 | 5.8 | 3.8 |
| 10 | 5.4 | 5.2 | 5.8 | 5.6 | 5 | 5.2 | 5.2 | 5 | 5.4 | 5 |
| 11 | 6 | 6.4 | 6.2 | 7 | 5.4 | 6.6 | 5.2 | 6 | 5.2 | 6.2 |
| 12 | 6.4 | 7.2 | 6.6 | 7.8 | 5.8 | 7.6 | 5.2 | 6.8 | 5.4 | 7 |
| 13 | 6.6 | 7.6 | 7 | 8.4 | 6.2 | 8.4 | 5.6 | 7.2 | 5.8 | 7.6 |
| 14 | 6.8 | 7.8 | 7 | 8.4 | 6.6 | 8.6 | 5.8 | 7.4 | 6 | 7.6 |
| 15 | 7.2 | 8 | 7.6 | 8.4 | 7 | 8.6 | 6.4 | 7.4 | 6.6 | 7.6 |
| 16 | 7.6 | 8 | 8.2 | 8.4 | 8 | 8.6 | 7 | 7.4 | 7.4 | 7.4 |
| 17 | 7.6 | 7.8 | 8.2 | 8 | 8.4 | 8.2 | 7.4 | 7.4 | 7.8 | 7.4 |
| 18 | 7.2 | 7.2 | 7.4 | 7 | 8.2 | 7.2 | 7.4 | 7 | 7.4 | 7 |
| 19 | 5.6 | 6.2 | 5.4 | 5.8 | 6.2 | 5.8 | 5.8 | 6.2 | 5.8 | 6.2 |
| 20 | 4.4 | 5 | 3.8 | 4.6 | 4.4 | 4.6 | 4.2 | 5.2 | 4.2 | 5 |
| 21 | 3.6 | 4 | 3 | 3.4 | 3.4 | 3.4 | 3.4 | 4.4 | 3.4 | 4.2 |
| 22 | 2.8 | 3 | 2.2 | 2.6 | 2.6 | 2.6 | 3 | 3.8 | 2.8 | 3.6 |
| 23 | 2 | 2.2 | 1.6 | 1.8 | 1.6 | 1.8 | 2.2 | 3 | 2 | 2.8 |
| 24 | 1.4 | 1.4 | 1 | 1.2 | 1 | 1.2 | 1.4 | 2 | 1.4 | 1.8 |

## 1.4 Fleet Characteristics

MOVES Tables: sourceTypeAgeDistribution, sourceTypeYear, SCCVtypeDistribution

Washington has a substantially older fleet than the national average. This has a significant effect on emissions. Local data sources were supplemented with some national default information to calculate the number of vehicles by type and age, and the age distribution as of December 31. The data sources and calculations are described below.

The Washington State Department of Licensing (DOL) registers non-governmental vehicles annually. Registrations for calendar year 2008 were obtained from DOL.[3] Because DOL does not register public transit and school buses each year, alternate sources of information were obtained.

Transit and Intercity bus data came from Federal Transit Administration (FTA) Annual Report data for 2008.[4] EPA classified all FTA buses as Transit when they developed the default database. They used Federal Highway Administration (FHWA) bus information to develop the Intercity estimates. EPA believed this estimate should be improved. The overall split was 62 percent/38 percent Intercity/Transit. For Washington, the FTA data appears to include both

Intercity and Transit (though could not find definition of these terms). For the Washington fleet, the FTA counts were supplemented with private bus counts from DOL (identified as Stages). Though the end use (school or other transit) of the DOL buses cannot be determined by any easy means, they are only a small portion of the buses (~300). The default 62 percent/38 percent Intercity/Transit split was applied to the total.

For public school buses, the Washington State Office of the Superintendent of Public Instruction (OSPI) supplied data for 2008.[5] Private school buses were counted in the DOL data. Total school buses were the sum of the DOL and OSPI data.

### 1.4.1 Age Distribution

MOVES Table: sourceTypeAgeDistribution

The DOL, FTA, and OSPI registration data was used to calculate the number of vehicles in the state by model year for several vehicle classes. The registration classes matched to the MOVES vehicle types as shown in Table 1-9.

Four of the registration classes had to be split in order to match the MOVES vehicle types: light duty trucks, non-refuse single unit trucks, combination trucks, and transit/intercity buses. To make the splits, the fractions in Table A.1 of the MOVES Technical Guidance were used.[6] The fractions were multiplied by the number of Washington registrations in the registration class to estimate the number of Washington registrations in the MOVES vehicle type.

**Table 1-8: DOL and MOVES Vehicle Classifications**

| MOVES Vehicle Type | WA Registration Vehicle Class |
|---|---|
| Motorcycle | Motorcycle |
| Passenger Car | Passenger Car |
| Passenger Truck | Trucks up to 19,500 lbs gvwt |
| Light Commercial Truck | Trucks up to 19,500 lbs gvwt |
| Intercity Bus | Transit/Intercity Bus |
| Transit Bus | Transit/Intercity Bus |
| School Bus | School Bus |
| Refuse Truck | Refuse Truck |
| Single Unit Short-haul Truck | Single Unit Trucks > 19,500 lbs gvwt |
| Single Unit Long-haul Truck | Single Unit Trucks > 19,500 lbs gvwt |
| Motor Home | Motor Home |
| Combination Short-haul Truck | Combination Trucks |
| Combination Long-haul Truck | Combination Trucks |

### 1.4.2 Vehicle Counts

MOVES Table: sourceTypeYear

Vehicle counts and MOVES vehicle type for 2008 were calculated according to the MOVES Technical Guidance.[6] Vehicle counts were calculated as described in Section 1.4.

An adjustment was made for short and long haul single and combination trucks. County registrations may not be a good indicator of trucking activity in an individual county. For these trucks, the state total registrations were apportioned to Pierce County based on county-to-state truck VMT calculated in Section 1.2.1.

**Table 1-9: Vehicle Counts**

| MOVES Vehicle Type | Pierce |
|---|---|
| Motorcycle | 22,835 |
| Passenger Car | 279,200 |
| Passenger Truck | 246,062 |
| Light Commercial Truck | 80,118 |
| Intercity Bus | 289 |
| Transit Bus | 177 |
| School Bus | 1,202 |
| Refuse Truck | 236 |
| Single Unit Short-haul Truck | 3,768 |
| Single Unit Long-haul Truck | 262 |
| Motor Home | 7,307 |
| Combination Short-haul Truck | 1,776 |
| Combination Long-haul Truck | 1,530 |
| TOTAL VEHICLES | 644,762 |

## 1.5 Vehicle Inspection and Maintenance Program

MOVES Table: IMCoverage

A Vehicle Inspection and Maintenance (I/M) program is operated in the Puget Sound region.[7] Both gasoline and diesel vehicles are tested, but MOVES only models I/M benefits for gasoline vehicles. The remainder of this section addresses the I/M program for gasoline vehicles.

In MOVES, the I/M program is defined for each county and evaluation year. The required parameters are test frequency, pollutant, test type, first and last model year tested, fuel type, vehicle type, emissions process, and compliance factor. They are described in more detail below.

The test frequency is biennial. The pollutant and emissions processes tested are exhaust hydrocarbons and carbon monoxide, and evaporative hydrocarbons.

The program includes multiple test types. From 2008 to June 30, 2012, vehicles required to test are given a gas cap check, and either a 2500/idle test, acceleration simulation mode (ASM) test, or on-board diagnostic (OBD) test. The vehicle type and model year determine the test type given. Beginning July 1, 2012, Ecology is proposing to simplify the I/M tests by eliminating the gas cap check and ASM tests. The I/M program will be ended no later than December 31, 2019, and may be ended in 2017.

A summary of the test types, model years tested, and vehicle (duty) types are shown in the table below. To simplify data requirements, the current I/M program is defined from calendar year 2008 to 2012. The future program is defined as covering calendar year 2013 to 2019.

**Table 1-10: I/M Program Test Types and Applicable Model Years and Vehicle Duty Class**

| ID | Test Type | Veh Duty | 2008-2012 | | 2013-2019 | |
|---|---|---|---|---|---|---|
| | | | First MY | Last MY | First MY | Last MY |
| 1 | ASM 2525 Phase-in Cutpoints | Light | First MY | 1995 | | |
| 2 | Two-mode, 2500 RPM/Idle Test | Light | | | First MY | 1995 |
| 3 | Exhaust OBD Check | Light | 1996 | Last MY | 1996 | 2008 |
| 4 | Two-mode, 2500 RPM/Idle Test | Heavy | First MY | Last MY | First MY | 2008 |
| 5 | Evaporative Gas Cap Check | Heavy | First MY | 1999 | | |
| 6 | Evaporative System OBD Check | Light | 1996 | Last MY | 1996 | 2008 |
| 7 | Evaporative Gas Cap Check | Light | First MY | 1995 | | |

Note: First and last model year (MY) for each year of evaluation are defined in WACs 173-422 and 173-422A.

The final parameter is the compliance factor. The compliance factor is the product of the compliance rate and (100 - waiver rate)/100. The compliance rate is the percentage of vehicles required to test that either pass the test or receive a waiver. A compliance factor was calculated for each geographic area based on 2007 testing and licensing data.[8] The waiver rate is the percentage of vehicles that fail an initial test and do not pass a retest, but do receive waiver. Waiver rates were calculated for each test type and geographic area based on 2007–2008 testing data.[9] The compliance rates, waiver rates, and compliance factors are shown in Table 1-12.

**Table 1-11: Compliance Rate, Waiver Rate, and Compliance Factor**

| ID | Test Type | Veh Duty | Area | Waiver Rate | Compliance Rate | Compliance Factor |
|---|---|---|---|---|---|---|
| 1 | ASM 2525 Phase-in Cutpoints | Light | Puget Sound | 20.5 | 94.5 | 75.1 |
| 2 | Two-mode, 2500 RPM/Idle Test | Light | Puget Sound | 19.7 | 94.5 | 75.9 |
| 3 | Exhaust OBD Check | Light | Puget Sound | 27.9 | 94.5 | 68.1 |
| 4 | Two-mode, 2500 RPM/Idle Test | Heavy | Puget Sound | 13.6 | 94.5 | 81.6 |
| 5 | Evaporative Gas Cap Check | Heavy | Puget Sound | 0 | 94.5 | 94.5 |
| 6 | Evaporative System OBD Check | Light | Puget Sound | 27.9 | 94.5 | 68.1 |
| 7 | Evaporative Gas Cap Check | Light | Puget Sound | 0 | 94.5 | 94.5 |

## 1.6 California Low-Emission Vehicle (LEV II) Program

MOVES Table: mylevs.emissionRateByAge

The MOVES model uses federal emissions standards by default. Because several states adopted California Low-Emission Vehicle (LEV) standards in place of the federal standards, EPA provided files and instructions for modeling LEV standards.[10]

LEV standards affect cars and light duty trucks, Sports Utility Vehicles (SUVs) and vans. The California LEV input database provides a set of alternate hydrocarbon (HC), carbon monoxide (CO), and nitrogen oxides ($NO_X$) start and running emission rates based on EPA and California Air Resources Board (CARB) analysis of the LEV programs. The input database provides rates from model year 1994 until model year 2050, including both the LEV I and LEV II California standards. These rates replace the rates in the default database for these particular pollutants and model years. EPA provided tools to modify the files to reflect the model years affected by the LEV standards in the area of interest.

Washington adopted California LEV II standards beginning with 2009 model year vehicles. The EPA tools were used to create a supplementary emissionRateByAge table where the first model year subject to LEV II standards is 2009. The LEV standards are given by fuel type, engine type, vehicle type, model year, pollutant, emission mode, age group, and vehicle operating mode. The vehicle operating mode describes what the vehicle is doing (accelerating, braking, cruising, idling), vehicle specific power (VSP – an energy measure in kilowatts per tonne), and speed. There are individual 31 operating modes in the LEV table.

There are over 65,000 standards records in the supplementary file, but the LEV standards as fractions of the federal standards are fairly constant for the three major classes of operating modes shown in Table 1-13.

**Table 1-12: LEV Standards as Fractions of Federal Standards, Approximate**

| Pollutant | Running Emissions speed < 25 or speed ≥ 25 and VSP < 18 | | Running Emissions speed ≥ 25 and VSP ≥ 18 | | Start Emissions | |
|---|---|---|---|---|---|---|
| | Car | Light Truck | Car | Light Truck | Car | Light Truck |
| HC | 0.78 | 0.76 | 1.01 | 0.99 | 0.75 | 0.77 |
| CO | 0.67 | 0.64 | 1.00 | 0.99 | 0.76 | 0.76 |
| NOx | 1.02 | 0.79 | 1.01 | 0.99 | 1.01 | 0.92 |

EPA also included files and a procedure to model the effects of California's Zero-Emission Vehicle (ZEV) requirements on evaporative emissions. Washington did not adopt the ZEV standards, so these should not be used.

## 1.7 Meteorological Parameters

MOVES Table: zoneMonthHour

Emissions are affected by temperature and humidity. These parameters are required by month and hour to estimate emission rates. EPA contracted with Air Improvement Resources, Inc. (AIR) to develop MOVES default average temperature and humidity data for each month and hour. AIR developed the parameters using data from the National Climatic Data Center, National Weather Service and its Cooperative Observation branch, and the Federal Aviation Administration.[11]

The defaults were examined. They appeared reasonable and were used for calculating the annual inventory.

## 1.8 Fuel Parameters

MOVES Tables: fuelFormulation, fuelSupply, AVFT Strategy file

The gasoline fuel parameters are Reid vapor pressure (RVP); sulfur content; oxygenate types, volume, and market share; aromatic, olefin, and benzene content; and the volume percentage of gasoline evaporated at 200 and 300 degrees Fahrenheit. For diesel, only sulfur content is required. Gasoline fuel parameters were determined using a combination of legal specifications, MOVES defaults, and fuel survey information.

Fuel survey information came from Northrop-Grumman. They sample summer and winter gasoline in several major urban areas. The surveys provide information for all the parameters except the market share of oxygenates. Sampling data were obtained for the summer of 2007, and the winter of 2006–2007 for three urban areas: Portland, Seattle, and Spokane.[12] The samples were grouped by area and oxygenate level (zero percent or 10 percent). The survey did not include volumetric data necessary to calculate weighted averages of the parameters; therefore, the survey data could not be used directly to develop MOVES fuel properties.

The MOVES defaults came from the National Mobile Inventory Model (NMIM) County Database (NCD), which has actual data for years up to 2005; and the Energy Information Administration's Annual Energy Outlook 2007, which projected fuel usage for 2012. Counties were allocated to one of four groups: (1) King, Pierce, and Snohomish, (2) Spokane, (3) Other Western Washington, (4) Other Eastern Washington.

The default data county groupings separating King/Pierce/Snohomish from the rest of western Washington were likely based on past conditions. Pierce/King/Snohomish Counties were once part of a voluntary low Reid Vapor Pressure (RVP) agreement, but this condition no longer existed in 2008. A comparison of the MOVES defaults with the Northrup-Grumman data showed the Seattle survey data (representing King/Pierce/Snohomish) agreed better with the Other Western Washington group (excluding RVP). Without volumetric survey data, selecting the best default was partly subjective.

The MOVES Technical Guidance[6] recommended using model defaults for all fuel properties except RVP and oxygenated fuel market share, unless survey data was available and included volumetric data to weigh the sample results. Since the Northrup-Grumman data did not include volumes, the guidance recommendation was followed, though Pierce County was regrouped according to the best-fit with survey data ranges as described in the paragraph above (see Section 1.8.4).

Additional information is provided for some of the parameters below.

### 1.8.1 Reid Vapor Pressure (RVP)

RVP varies by year, geographic area, and time of year. The most recent RVP requirements were set in 1992.[13] The summertime (May–Sept.) RVP limit for Washington is 9.0 pounds per square inch (psi). When using a 10 percent ethanol blend, the RVP limit is allowed to increase by 1 psi, so ethanol fuels' RVP was increased 1 psi. (The MOVES model defaults did not increase RVP by the waiver amount).

The default MOVES winter RVPs were unchanged. Instructions for the NMIM County Database specify how to calculate RVP for each month based on the summer and winter RVPs.[14] December, January, and February are all given the winter value. May through October are given the summer value. March, April, and November are set according to the equation:

SummerRVP + [(WinterRVP – SummerRVP) * 0.57]

### 1.8.2 Oxygenated Fuels

Federal regulations require increasing amounts of ethanol be used nationally. Most commonly, ethanol fuels are a blend of 10 percent ethanol and 90 percent gasoline (abbreviated as E10). The actual Northrup-Grumman survey values ranged from 8.2 to 10.9 percent ethanol. All fuels in this range will be modeled as E10.

In 2008 Washington saw a rise in E10 use from approximately 46.5 percent in the early part of the year to near 100 percent by the year's end.[15] E10 fuel is expected to stay at 100 percent for 2009 and future years.

### 1.8.3 Fuel Sulfur Content

#### 1.8.3.1 Gasoline

Federal Tier 2 regulations require refiners to meet an average gasoline sulfur content of 30 parts per million (ppm). The Northrup-Grumman fuel survey data showed sulfur contents ranging from 11 ppm to 55 ppm. In MOVES, sulfur values below 30 ppm are treated as 30 ppm.[16, 17] MOVES assigned sulfur values ranging from 42 to 45 ppm for 2008, the limit average of 30 ppm for years 2009 through 2011, and near 27 ppm for 2012. The MOVES defaults were used.

#### 1.8.3.2 Diesel

Sulfur content is the only parameter for diesel fuel. Under the federal 2007 Heavy-Duty Highway Rule, most diesel fuel was required to meet a 15 ppm sulfur limit on September 1, 2006. There are credits, phase-ins, and hardship provisions that result in a full phase-in on December 1, 2010.[18] The MOVES model sulfur content defaults are used. The default is 43 ppm from January 2008 through May 2010, and 11 ppm from June 2010 forward.

### 1.8.4 Final Gasoline Parameters

The default MOVES fuel parameters for Western and Eastern Washington were used as templates to create fuel profiles. The RVPs were changed as necessary to reflect the summertime legal limits and interpolated spring/fall values, and the oxygenated fuel waiver. Oxygenated fuels were modeled as E10. The market shares were changed to reflect actual ethanol usage.

**Table 1-13: Western Washington Gasoline Parameters, 2008**

| Month | Market Share | Ethanol | RVP | Sulfur | Aromatic | Olefin | Benzene | E200 | E300 |
|---|---|---|---|---|---|---|---|---|---|
| | % | % | psi | ppm | % | % | % | % | % |
| Jan-Feb | 53.5 | 0 | 14.2 | 45.1 | 28.6 | 8.2 | 1.45 | 49 | 87 |
| Mar | 53.5 | 0 | 12.0 | 45.1 | 28.6 | 8.2 | 1.61 | 50 | 87 |
| Apr | 33.7 | 0 | 12.0 | 45.1 | 28.6 | 8.2 | 1.61 | 50 | 87 |
| May-Oct | 33.7 | 0 | 9.0 | 45.1 | 28.6 | 8.2 | 1.83 | 50 | 87 |
| Nov | 3.0 | 0 | 12.0 | 45.1 | 28.6 | 8.2 | 1.61 | 50 | 87 |
| Dec | 3.0 | 0 | 14.2 | 45.1 | 28.6 | 8.2 | 1.45 | 49 | 87 |
| Jan-Feb | 46.5 | 10 | 14.2 | 45.1 | 28.6 | 8.2 | 1.45 | 49 | 87 |
| Mar | 46.5 | 10 | 12.4 | 45.1 | 28.6 | 8.2 | 1.61 | 50 | 87 |
| Apr | 66.3 | 10 | 12.4 | 45.1 | 28.6 | 8.2 | 1.61 | 50 | 87 |
| May-Oct | 66.3 | 10 | 10.0 | 45.1 | 28.6 | 8.2 | 1.83 | 50 | 87 |
| Nov | 97.0 | 10 | 12.4 | 45.1 | 28.6 | 8.2 | 1.61 | 50 | 87 |
| Dec | 97.0 | 10 | 14.2 | 45.1 | 28.6 | 8.2 | 1.45 | 49 | 87 |

| Table 1-14: Western Washington Gasoline Parameters, 2009-2019 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Month | Market Share | Ethanol | RVP | Sulfur | Aromatic | Olefin | Benzene | E200 | E300 |
| | | % | % | psi | ppm | % | % | % | % | % |
| 2009 | Jan,Feb,Dec | 100 | 10 | 14.4 | 30.0 | 27.8 | 8.2 | 1.40 | 50 | 88 |
| 2009 | Mar,Apr,Nov | 100 | 10 | 12.5 | 30.0 | 27.7 | 8.2 | 1.61 | 51 | 88 |
| 2009 | May-Oct | 100 | 10 | 10.0 | 30.0 | 27.7 | 8.2 | 1.90 | 51 | 88 |
| 2010 | Jan,Feb,Dec | 100 | 10 | 14.5 | 30.0 | 26.9 | 8.2 | 1.12 | 51 | 89 |
| 2010 | Mar,Apr,Nov | 100 | 10 | 12.6 | 30.0 | 26.9 | 8.2 | 1.29 | 52 | 89 |
| 2010 | May-Oct | 100 | 10 | 10.0 | 30.0 | 26.8 | 8.2 | 1.52 | 53 | 90 |
| 2011 | Jan,Feb,Dec | 100 | 10 | 14.7 | 30.0 | 26.0 | 8.2 | 0.64 | 52 | 90 |
| 2011 | Mar,Apr,Nov | 100 | 10 | 12.7 | 30.0 | 26.0 | 8.2 | 0.65 | 53 | 90 |
| 2011 | May-Oct | 100 | 10 | 10.0 | 30.0 | 25.9 | 8.2 | 0.65 | 54 | 91 |
| 2012 | Jan,Feb,Dec | 100 | 10 | 14.8 | 28.0 | 25.2 | 8.2 | 0.64 | 53 | 91 |
| 2012 | Mar,Apr,Nov | 100 | 10 | 12.7 | 27.4 | 25.1 | 8.2 | 0.65 | 54 | 92 |
| 2012 | May-Oct | 100 | 10 | 10.0 | 26.5 | 25.0 | 8.2 | 0.65 | 55 | 92 |

### 1.8.5 Transit and Intercity Bus Fuel

MOVES Alternate Fuels and Vehicle Technology file

Pierce County Transit's buses run almost exclusively on Compressed Natural Gas (CNG). The fuel was defined as 100 percent CNG via the MOVES Strategy panel for Alternate Fuels and Vehicle Technologies (AFVT).

## 1.9 Stage II Vapor Recovery

MOVES Table: countyYear

A stage II vapor recovery program began in 1992 in Pierce County.[19] Gasoline stations dispensing more than 600,000 gallons per year were required to install stage II controls.

MOVES models stage II programs by county using the percent efficiency of the controls on vapor displacement and spills. Recent program data has not been collected to calculate the efficiencies. AP42 and MOBILE documents gave some guidance on a total efficiency as follows: When information on the amount of gasoline dispensed is available by control category, i.e., with stage II control and without stage II control, the efficiencies may be set to 90 percent, which is the expected efficiency of the stage II system.[20] This is the preferred method. When information on the amount of gasoline dispensed with and without stage II control is not known, the efficiencies may both be set to 86 percent,[21] which is a combined estimate of the efficiency of the stage II system, the amount of gasoline dispensed through stage II controls, and the effect of enforcement programs.[22]

MOVES used Washington's old calculation of 86 percent as the MOVES default vapor displacement efficiency for Washington counties using stage II. MOVES default spillage efficiency is 50 percent for all counties in the nation using stage II. The MOVES defaults were used.

# 2 WINTER DAY INVENTORY POST-PROCESSING

Post-processing MOVES and VMT data to calculate winter day emissions for each geographic area consisted of nine steps. Each step is described below.

1) Assign each link to the MOVES Road Type.
2) Apportion each link's VMT to one or two MOVES speed bins.
3) Split VMT into the individual 24 hours.
4) Split VMT by fuel type (gas, diesel, CNG).
5) Calculate link population.
6) Generate emission factors using the MOVES model for the three design day temperature profiles.
7) Calculate weekday link emissions.
8) Estimate weekend link emissions.
9) Allocate the link emissions to Pierce County and the Nonattainment Area.

PSRC provided VMT by link for five time periods (AM, MD, PM, EV, NT).[23]

- Node coordinates
- Length
- Facility type
- Functional class (for most links)
- Nonattainment area flag
- Congested speed
- VMT

## 2.1 Step 1 – Assign each link to the MOVES Road Type

**Table 2-1: PSRC and MOVES Road Types**

| PSRC Facility Type | MOVES Road Type |
|---|---|
| Urban Arterial | Urban Unrestricted |
| Rural Arterial | Rural Unrestricted |
| Freeways or Expressways with any Urban Functional Class | Urban Restricted |
| Freeways or Expressways with any Rural Functional Class | Rural Restricted |
| Freeways or Expressways with no Functional Class | Urban Restricted |
| Centroid Connectors *see assignment logic below* | Rural Unrestricted |
| Centroid Connectors *see assignment logic below* | Urban Unrestricted |

Centroid Connectors represent travel from one zone to another and were predominantly assigned a functional class of *5*. Class 5 is not identified as either rural or urban. Centroid connector links were classified by querying all links with the same i-node coordinate as the given centroid connector. If any i-node coordinate was classified as an urban arterial, then the centroid connector was classified as urban unrestricted. If no i-node coordinate was classified as urban,

but one or more was classified as a rural arterial, then the centroid connector was classified as rural unrestricted. If there were no other links with the same i-node, or the i-nodes could not be classified, then the centroid connector was classified as urban unrestricted.

## 2.2 Step 2 – Apportion each link's VMT to one or two MOVES speed bins

The calculation is described in the MOVES Technical Guidance for SIPs.[6] The calculation assigns a portion of the link VMT to the speed bins with midpoints that lie below and above the link speed as shown in the example below. (Note in the guidance, the midpoint of speed bin 1 is 2.5 mph, and the midpoint of speed bin 16 is 75 mph for the purposes of the calculations.)

EXAMPLE
*Given:* Link speed = 17 mph with 50 VMT.
This speed falls between the midpoints of bins 4 and 5:
Bin 4 midpoint = 15, Bin 5 midpoint = 20

*Calculation:*
Fraction of VMT in bin 4: 1-[(17-15)/(20-15)] = 0.6; VMT in bin 4 = 50 x 0.6 = 30
Fraction of VMT in bin 5: 1-[(20-17)/(20-15)] = 0.4; VMT in bin 5 = 50 x 0.4 = 20

NOTE: This process creates records for each speed bin, resulting in two records for each link that fell in between two speed bins. As an alternate, additional fields could have been added to each link: binA, binA VMT, binB, binB VMT.

## 2.3 Step 3 – Split VMT into the individual 24 hours

MOVES emission rates are specific to each hour. To match emission rates to VMT, VMT was assigned to each hour. Each PSRC time period was split into its individual hours by dividing the VMT by the number of hours in each period. For example, the AM peak runs from 6 to 9, so the VMT in this period was divided by 3 and assigned to each hour 6, 7, and 8.

NOTE: An alternate way of handling the hourly variation would be to adjust the emission factors to match the PSRC time periods: *Average* the MOVES rateperdistance emission factors, and *add* the rateperprofile and ratepervehicle emission factors for each time period.

## 2.4 Step 4 – Split VMT by fuel type (gas, diesel, CNG)

MOVES was used to make the fuel split. It was run in Inventory mode, with Distance Traveled and Population output checked in the Activity box of the General Output panel (population will be used in the next step). Fuel Type and Road Type were checked in the Output Emissions panel. The other MOVES settings and inputs were the same as for the actual emission factor runs. These will be described later in this document. The activity output from the MOVES run was used to calculate the fraction of VMT for each fuel type by county, day type (weekday, weekend), hour, and road type. These fractions were multiplied by the link VMT to assign to each fuel type.

NOTE: This step is not necessary if emissions by fuel type are not necessary.

## 2.5 Step 5 – Calculate link population

Vehicle populations are needed since part of the emission factors are output in grams pervehicle (e.g., start emissions, some evaporative emissions). We are lacking a good spatial data for these processes, so they are allocated to links based on the amount of VMT. Vehicle populations are constant for each hour, meaning the entire vehicle population is used in each hour's emissions calculation.

Link VMT from the previous step was disaggregated by hour, speed bin, and fuel type. This resulted in multiple records for each link. Other link characteristics were nonattainment area flag, day type, and road type. The population output from the MOVES Inventory mode run used in the previous step gave population by fuel type. VMT was summed by day type, hour, and fuel type. Each link record's VMT was divided by this sum to calculate the fraction of population to assign to each link record. The fraction was multiplied by the population by fuel type.

NOTE: This step was the most confusing of the steps. Care must be taken to check results and make sure the sum of all link population by hour is the total vehicle population.

## 2.6 Step 6 – Generate emission factors using the MOVES model for the three design day temperature profiles

MOVES was run at the County Scale in Emission Rate (factor) mode according to the MOVES Technical Guidance for SIPs. The panel and County Data Manager settings and input files are described in a separate document. Emissions factors are output in three files: rateperdistance (grams per mile), rateperprofile (grams per vehicle), and ratepervehicle (grams per vehicle).

Emission factors in the rateperdistance file can be output by year, month, day type, hour, pollutant, process, vehicle type or source classification code (SCC), fuel type, model type, road type, and speed bin. Panel settings determine how aggregated they can be. For this project, they were output by year, month, day type, hour, pollutant, process, fuel type, road type, and speed bin. They were summed to eliminate process type since it was not needed for this project.

Emission factors in the rateperprofile file can be output by temperature profile, year, day type, hour, pollutant, process, vehicle type or SCC, and fuel type. Panel settings determine how aggregated they can be. For this project, they were output by year, day type, hour, pollutant, process, and fuel type. They were summed to eliminate process type since it was not needed for this project.

Emission factors in the ratepervehicle file can be output by year, month, day type, hour, pollutant, process, vehicle type or SCC, and fuel type. Panel settings determine how aggregated they can be. For this project, they were output by year, day type, hour, pollutant, process, and fuel type. They were summed to eliminate process type since it was not needed for this project.

Emission factors from the rateperprofile and rateperdistance files were summed since both are multiplied by vehicle population.

NOTE: Process will be needed if speciated HC is needed, e.g., in an ozone modeling inventory.

NOTE: The MOVES manual has tips for running emission factors to lessen run time and output. The methods normally result in having to design a somewhat more complex post-process. For this project, none of the time-saving tips were used. Run time was about eight hours per each of the three design day temperature profiles.

## 2.7 Step 7 – Calculate weekday link emissions

The link record VMT in Step 4 and population in Step 5 were multiplied by the emission factors in Step 6. Rateperdistance factors were matched to VMT by year, month, day type, hour, pollutant, process, fuel type, road type, and speed bin. The sum of the rateperprocess and ratepervehicle factors were matched to population by year, day type, hour, pollutant, process, and fuel type. The link record emissions were summed by link, day, hour, and fuel.

## 2.8 Step 8 – Estimate weekend link emissions

Weekend emissions were calculated using the Pierce County Inventory run (Step 4) to get the ratio of weekend to weekday emissions. The ratios were multiplied by the weekday link emissions to estimate weekend emissions.

## 2.9 Step 9 – Allocate the link emissions to the County and Nonattainment Area

The link emissions were summed by county and Nonattainment Area using the link county and Nonattainment Area flags.

## 2.10 Step 10 – Quality Assurance

County emissions in pounds per day (ppd) calculated in Step 9 were compared to the January weekday county emissions output from the MOVES Inventory mode run done in Step 4. Results were similar as shown in the tables below. Possible sources of the differences are: (1) average January temperature profile vs. the design day temperature profile, and (2) average speed distribution vs. link speeds.

**Table 2-2: Comparison of Inventory and Rates Mode Emissions**

| Pollutant | Rates ppd | Inventory ppd | Rates/ Inventory Ratio |
|---|---|---|---|
| $NH_3$ | 1,636 | 1,432 | 0.88 |
| $NO_X$ | 97,154 | 93,032 | 0.96 |
| $PM_{2.5}$ | 3,875 | 4,071 | 1.05 |
| SO2 | 594 | 560 | 0.94 |
| VOC | 59,521 | 60,845 | 1.02 |

## APPENDIX A3 ENDNOTES

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| **%** | percent |
| **µg/m$^3$** | micrograms per cubic meter |
| **ADT** | average daily traffic |
| **ADVMT** | average daily vehicle miles traveled |
| **AFVT** | alternate fuels and vehicle technologies |
| **AIR** | Air Improvement Resources, Inc |
| **AIRQUEST** | Northwest International Air Quality Environmental Science and Technology Consortium |
| **AIRPACT** | Air Information Report for Public Access and Community Tracking |
| **Anderson Island** | Steilacoom-Ketron-Anderson Island ferry route |
| **AOP** | air operating permit |
| **AP-42** | EPA document ID for *Compilation of Air Pollutant Emission* Factors publication |
| **ARCH** | architectural coatings |
| **Art** | arterial |
| **ASM** | acceleration simulation mode |
| **Avg** | average |
| **B5** | fuel blend of five percent biodiesel and 95 percent petroleum diesel |
| **BNSF** | Burlington Northern Santa Fe Railway |
| **BOAT** | marine–pleasure craft |
| **CAA** | Clean Air Act |
| **CARB** | California Air Resources Board |
| **CNG** | compressed natural gas |
| **CNSTR** | nonroad–construction |
| **CO** | carbon monoxide |
| **Col** | collector |
| **Comm** | commercial |
| **COMM** | nonroad–commercial |
| **Cons** | consumer |
| **COOK** | commercial cooking |
| **CPM** | condensable PM |
| **Ctpy** | condensable tons per year |
| **Device-yr** | device year |

| | |
|---|---|
| **DOL** | Washington State Department of Licensing |
| **DUST** | dust–construction |
| **E10** | ethanol fuel blend of 10 percent ethanol and 90 percent gasoline |
| **E200** | The percent of fuel evaporated at 200 degrees Fahrenheit |
| **E300** | The percent of fuel evaporated at 300 degree Fahrenheit |
| **Ecology** | Washington State Department of Ecology |
| **Ecy** | Washington State Department of Ecology |
| **EI** | emissions inventory |
| **EPA** | United State Environmental Protection Agency |
| **EtOH** | ethanol |
| **EV** | evening hours 6pm–10pm |
| **Fal** | fall |
| **FAZs** | forecast analysis zones |
| **F/E** | freeways and expressways |
| **FERT** | fertilizer application |
| **FHWA** | Federal Highway Administration |
| **FPM** | filterable PM |
| **FRM** | Federal Reference Method |
| **Ft** | foot/feet |
| **FTA** | Federal Transit Administration |
| **Ftpy** | filterable tons per year |
| **FUEL** | residential fuel, except wood |
| **GAS** | gas stations and gas cans |
| **GIS** | geographic information systems |
| **$g/m^2$** | grams per meter squared |
| **g/VMT** | grams per vehicle mile traveled |
| **HAPs** | hazardous air pollutants |
| **HARB** | marine–harbor craft |
| **HC** | hydrocarbon |
| **$HDD_{50}$** | annual heating degree days |
| **HH** | number of households in the geographic area |
| **HPMS** | Highway Performance Monitoring System |
| **I/M** | Vehicle Inspection and Maintenance Program |
| **IND** | nonroad–industrial |
| **IPP** | Inventory preparation plan |

| | |
|---|---|
| **KING** | King County |
| **LAWN** | nonroad–lawn and garden |
| **Lb** | pound(s) |
| **Lb/ton** | pounds per ton |
| **LEV** | low emission vehicle program |
| **LEV II** | California low-emission vehicle program |
| **LIVE** | livestock waste |
| **Lpg** | liquefied petroleum gas |
| **Major** | major point sources |
| **Max** | maximum |
| **MD** | midday hours 9am to 3pm |
| **Min** | minimum |
| **Minor** | minor point sources |
| **Mkt** | market |
| **MLRC** | multi resolution land characteristics |
| **Mo** | month |
| **MOBILE** | vehicle emission factor model |
| **MOVES** | Motor Vehicle Emission Simulator model |
| **MY** | model year |
| **n/a** | not applicable |
| **NAA** | Tacoma-Pierce County Nonattainment Area |
| **NAAQS** | National Ambient Air Quality Standards |
| **NCD** | National Mobile Inventory Model County database |
| **NEI** | National Emissions Inventory |
| **$NH_3$** | ammonia |
| **NMIM** | National Mobile Inventory Model |
| **Nonattainment Area** | Tacoma-Pierce County Nonattainment Area |
| **Non-ind** | non-industrial |
| **$NO_X$** | nitrogen oxides |
| **NP** | nonpoint sources |
| **NR** | nonroad sources |
| **NRC** | National Research Council |
| **NT** | night hours 10pm-6am |
| **NUGA** | Pierce County non-urban growth area |
| **$O_2$** | oxygen |

| | |
|---|---|
| **OBD** | on-board diagnostic test |
| **OCEAN** | marine–ocean-going vessels |
| **ODEQ** | Oregon Department of Environmental Quality |
| **ONRD** | onroad |
| **OR** | onroad sources |
| **OSPI** | Washington State Office of the Superintendent of Public Instruction |
| **PA** | principal arterial |
| **PAV** | dust-paved roads |
| **PE** | precipitation-evaporation |
| **PM** | particulate matter |
| **PM fines** | unspeciated fine particles |
| **$PM_{10}$** | particles that are less than 10 micrograms in diameter |
| **$PM_{2.5}$** | particles that are less than 2.5 micrograms in diameter |
| **PORT** | Port of Tacoma, non-marine |
| **Ppd** | pounds per day |
| **PPM** | parts per million |
| **PSCAA** | Puget Sound Clean Air Agency |
| **PSEI** | Puget Sound Maritime Emissions Inventory |
| **PSI** | pounds per square inch |
| **PSRC** | Puget Sound Regional Council |
| **PT** | point sources |
| **PT1** | major point sources |
| **PT2** | minor point sources |
| **Pt. Defiance** | Point Defiance–Tahlequah ferry route |
| **QA** | quality assurance |
| **QC** | quality control |
| **RAIL** | nonroad–railroad equipment |
| **RR** | locomotives |
| **RVP** | reid vapor pressure |
| **RWC-C** | residential fuel, wood—certified stoves & inserts |
| **RWC-FP** | residential fuel, wood—fireplaces |
| **RWC-LG** | residential fuel, wood—firelogs |
| **RWC-PL** | residential fuel, wood—pellet stoves |
| **RWC-U** | residential fuel, wood—uncertified stoves & inserts |
| **S** | sulfur |

| | |
|---|---|
| **SCC** | source classification code |
| **SIP** | State Implementation Plan |
| **$SO_2$** | sulfur dioxide |
| **SOLV** | consumer & commercial solvents |
| **Spr** | spring |
| **STK** | Simpson Tacoma Kraft |
| **SUV** | sports utility vehicles |

**Tacoma-Pierce County Nonattainment Area –** Most of the greater Tacoma and the surrounding communities within Pierce County's urban growth area west of State Route 167. EPA designated this area nonattainment for the 2006 24-hour fine particle national ambient air quality standard in 2009

**Tacoma–South L Street –** The monitoring site in the Nonattainment Area with a monitor that uses the FRM. EPA uses data from the FRM monitor at Tacoma – South L Street to determine compliance with the federal health based fine particle standards.

| | |
|---|---|
| **TEUs** | twenty foot equivalent units |
| **Title V** | Title V (five) air operating permits |
| **tpy** | tons per year |
| **TSP** | total suspended particles |
| **Week Day/End** | weekday or weekend |
| **Win** | winter |
| **Wkdy** | weekday |
| **WSDOT** | Washington State Department of Transportation |
| **UGA** | Pierce County urban growth area |
| **UPRR** | Union Pacific Railroad |
| **VMT** | vehicle miles traveled |
| **VOC** | volatile organic compounds |
| **Vol** | volume |
| **VSP** | vehicle specific power |
| **Yr** | year(s) |
| **ZEV** | zero-emission vehicle |

## APPENDIX A ENDNOTES

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# Appendix B. SIP Strengthening Rules

Puget Sound Clean Air Agency's Regulation 1-13–Solid Fuel Burning Device Standards

## AMENDATORY SECTION

### REGULATION I, SECTION 13.01 POLICY AND PURPOSE

The Board of Directors of the Puget Sound Clean Air Agency (Board) declares it to be the public policy of the Agency to control and reduce air pollution caused by ((~~woodstove emissions~~)) solid fuel burning devices such as wood stoves, pellet stoves, and fireplaces. It is the Agency's policy to ((~~reduce woodstove emissions by encouraging the continued efforts to~~)) educate the public about the health effects of ((~~woodstove~~)) wood stove emissions ((~~, other~~)) and cleaner heating alternatives ((~~, and~~)). It is the ((~~desirability~~)) intent of ((~~achieving better emission performance and heating efficiency from woodstoves pursuant to the emissions performance standards as adopted by the Department of Ecology~~)) this regulation to secure and maintain levels of air quality that protect human health and to comply with the requirements of the state and federal Clean Air Acts. ((~~It is further the policy of the Board to encourage the replacement of uncertified woodstoves with cleaner sources of heat.~~))

The Board encourages cities, towns and counties within its jurisdiction to ((~~adopt woodsmoke control programs including~~)) enhance((~~d~~)) public education ((~~and abatement ordinances~~)) and assist in the enforcement of this Regulation during declared air quality episodes and periods of impaired air quality. ((~~Nothing in this Regulation shall be construed to impair the right of any city, town or county to adopt and enforce woodsmoke abatement ordinances.~~))

## REPEALER

### REGULATION I, SECTION 13.02 GENERAL CONDITIONS FOR SOLID FUEL BURNING DEVICES

## NEW SECTION

### REGULATION I, SECTION 13.02 DEFINITIONS

When used herein:

(a) ADEQUATE SOURCE OF HEAT means a heating system designed to maintain seventy degrees Fahrenheit at a point three feet above the floor in each normally inhabited room. If any part of the heating system has been disconnected, damaged, or is otherwise nonfunctional, the Agency shall base

the assessment of the adequacy of the design on the system's capability prior to the disconnection, damage, improper maintenance ((~~failure to maintain~~)), malfunction, or occurrence that rendered the system nonfunctional.

(b) AGENCY means the Puget Sound Clean Air Agency.

(c) CERTIFIED WOOD STOVE means a wood stove that:

(1) has been determined by Ecology to meet Washington emission performance standards, pursuant to RCW 70.94.457 and WAC 173-433-100; or

(2) has been certified and labeled in accordance with procedures and criteria specified in "40 C.F.R. 60 Subpart AAA - Standards of Performance for Residential Wood Heaters" as amended through July 1, 1990; or

(3) meets the "Oregon Department of Environmental Quality Phase 2" emissions standards contained in Subsections (2) and (3) of Section 340-21-115, and is certified in accordance with "Oregon Administrative Rules, Chapter 340, Division 21 - Woodstove Certification" dated November 1984.

(d) COAL-ONLY HEATER means an enclosed, coal burning appliance capable of and intended for residential space heating, domestic water heating, or indoor cooking and has all of the following characteristics:

(1) An opening for emptying ash which is located near the bottom or the side of the appliance;

(2) A system which admits air primarily up and through the fuel bed;

(3) A grate or other similar device for shaking or disturbing the fuel bed or power driven mechanical stoker; and

(4) The model is listed by a nationally recognized safety testing laboratory for use of coal only, except for coal ignition purposes.

(e) ECOLOGY means the Washington State Department of Ecology.

(f) EPA means the United States Environmental Protection Agency.

(g) FINE PARTICULATE or PM2.5 means particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.

(h) FIREPLACE means any permanently installed masonry fireplace or any factory-built metal solid fuel burning device designed to be used with an open combustion chamber and without features to control the air to fuel ratio.

(i) NONAFFECTED PELLET STOVE means a pellet stove that has an air-to-fuel ratio equal to or greater than 35.0 to 1.0 when tested by an accredited laboratory in accordance with methods and procedures specified by the EPA in "40 CFR 60 Appendix A, Test Method 28A - Measurement of Air to Fuel Ratio and Minimum Achievable Burn Rates for Wood-Fired Appliances" as amended through July 1, 1990.

(j) NONATTAINMENT AREA means a geographical area designated by EPA at 40 C.F.R. Part 81 as exceeding a National Ambient Air Quality Standard for a given criteria pollutant. An area is nonattainment only for the pollutants for which the area has been designated nonattainment.

(k) PM10 means particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers.

(l) PROPERLY SEASONED FUEL WOOD means untreated wood or untreated lumber with moisture content of 20% or less, wet basis, or 25% or less, dry basis.

(m) SOLID FUEL BURNING DEVICE or SOLID FUEL HEATING DEVICE means a device that burns wood, coal, or any other nongaseous or nonliquid fuels, and includes any device burning any solid fuel which has a heat input less than one million British thermal units per hour. This includes, but is not limited to, devices used for aesthetic or space-heating purposes in a private residence or commercial establishment.

(n) SUBSTANTIALLY REMODELED means any alteration or restoration of a building exceeding sixty percent of the appraised value of such building within a twelve-month period.

(o) TACOMA, WASHINGTON FINE PARTICULATE NONATTAINMENT AREA means the area of Pierce County that is designated by EPA as not meeting the 2006 federal 24-hr fine particulate National Ambient Air Quality Standard and described in 40 CFR 81.348. This area is also known as the Tacoma, Pierce County Nonattainment Area.

(p) TREATED WOOD means wood or lumber of any species that has been chemically impregnated, painted, or similarly modified to prevent weathering and deterioration.

(q) WOOD STOVE or WOOD HEATER means an enclosed solid fuel burning device capable of and intended for residential space heating and domestic

water heating that meets the following criteria contained in "40 CFR 60 Subpart AAA - Standards of Performance for Residential Wood Heaters" as amended through July 1, 1990:

(1) An air-to-fuel ratio in the combustion chamber averaging less than 35.0, as determined by EPA Reference Method 28A;

(2) A useable firebox volume of less than twenty cubic feet;

(3) A minimum burn rate less than 5 kg/hr as determined by EPA Reference Method 28; and

(4) A maximum weight of 800 kg, excluding fixtures and devices that are normally sold separately, such as flue pipe, chimney, and masonry components not integral to the appliance.

Any combination of parts, typically consisting of but not limited to: doors, legs, flue pipe collars, brackets, bolts and other hardware, when manufactured for the purpose of being assembled, with or without additional owner supplied parts, into a woodstove, is considered a woodstove.

**REPEALER**

**REGULATION I, SECTION 13.03 CONTINGENCY PLAN**

**NEW SECTION**

**REGULATION I, SECTION 13.03 OPACITY STANDARDS**

(a) A person shall not cause or allow emission of a smoke plume from any solid fuel burning device to exceed an average of twenty percent opacity for six consecutive minutes in any one-hour period.

(b) Test method and procedures. Methods and procedures specified by the EPA in “40 CFR 60 Appendix A reference method 9 –Visual Determinations of the Opacity of Emissions from Stationary Sources" as amended through July 1, 1990, shall be used to determine compliance with subsection (a) of this section.

(c) Enforcement. Smoke visible from a chimney, flue or exhaust duct in excess of the opacity standard shall constitute prima facie evidence of unlawful operation of a solid fuel burning device. This presumption may be refuted by demonstration that the smoke was not caused by a solid fuel burning device. The provisions of this section shall not apply during the starting of a new fire for a period not to exceed twenty minutes in any four-hour period.

**NEW SECTION**

**REGULATION I, SECTION 13.04 ALLOWED AND PROHIBITED FUEL TYPES**

(a) A person shall cause or allow only the following materials to be burned in a solid fuel burning device:

(1) Properly seasoned fuel wood; or

(2) An amount of paper necessary for starting a fire; or

(3) Wood pellets; or

(4) Biomass fire logs intended for burning in a wood stove or fireplace; or

(5) Coal with sulfur content less than 1.0% by weight burned in a coal-only heater.

(b) All other materials are prohibited from being burned in a solid fuel burning device, including, but not limited to: garbage; pallets; treated lumber; fencing; treated wood; plastic and plastic products; rubber products; animal carcasses; asphaltic products; waste petroleum products; paints and chemicals; paper (other than an amount necessary to start a fire); or any substance that emits dense smoke or obnoxious odors.

**NEW SECTION**

**REGULATION I, SECTION 13.05 RESTRICTIONS ON OPERATION OF SOLID FUEL BURNING DEVICES**

(a) No person in a residence or commercial establishment shall operate a solid fuel burning device under any of the following conditions:

(1) Whenever the Agency has declared the first stage of impaired air quality for a geographical area in accordance with RCW 70.94.473(1)(b)(i) or (ii) unless an exemption for the residence or commercial building has been obtained from the Agency pursuant to subsection (d) of this section or the solid fuel burning device is one of the following:

(A) A nonaffected pellet stove; or

(B) A wood stove certified and labeled by the EPA under "40 CFR 60 Subpart AAA - Standards of Performance for Residential Wood Heaters" as amended through July 1, 1990; or

(C) A wood stove meeting the "Oregon Department of Environmental Quality Phase 2" emission standards contained in Subsections (2) and (3) of Section 340-21-115, and certified in accordance with

"Oregon Administrative Rules, Chapter 340, Division 21 – Woodstove Certification" dated November 1984; or

(D) A solid fuel burning device approved by Ecology as meeting the standards in RCW 70.94.457(1)(a)-(b).

(2) Whenever the Agency has declared the second stage of impaired air quality for a geographical area in accordance with RCW 70.94.473(1)(c)(i), (ii), or (iii) unless an exemption for the residence or commercial building has been obtained from the Agency pursuant to subsection (d) of this section.

(b) Whenever a first stage of impaired air quality is declared under subsection (a)(1):

(1) New solid fuel shall be withheld from any solid fuel burning device already in operation for the duration of the first stage of impaired air quality if that device is restricted from operating under subsection (a)(1) of this section during the first stage of impaired air quality;

(2) Smoke visible from a chimney, flue, or exhaust duct after three hours has elapsed from the declaration of a first stage of impaired air quality shall constitute prima facie evidence of unlawful operation of a solid fuel burning device if that solid fuel burning device is restricted from operating during a first stage of impaired air quality. This presumption may be refuted by demonstration that the smoke was not caused by a solid fuel burning device.

(c) Whenever a second stage of impaired air quality is declared under subsection (a)(2):

(1) New solid fuel shall be withheld from any solid fuel burning device already in operation for the duration of the second stage of impaired air quality if that device is restricted from operating under subsection (a)(2) of this section during the second stage of impaired air quality.

(2) Smoke visible from a chimney, flue, or exhaust duct after three hours has elapsed from the declaration of a second stage of impaired air quality shall constitute prima facie evidence of unlawful operation of a solid fuel burning device if that solid fuel burning device is restricted from operating during a second stage of impaired air quality. This presumption may be refuted by demonstration that the smoke was not caused by a solid fuel burning device.

(d) Any person desiring an exemption from the Agency for the purposes of subsections (a)(1) or (2) of this section shall apply to the Agency using procedures specified by the Agency.

(1) The following are eligible for exemption:

(A) A residence or commercial building that has no adequate source of heat other than a solid fuel burning device and the building was neither constructed nor substantially remodeled after July 1, 1992.

(B) A residence or commercial building that has no adequate source of heat other than a solid fuel heating device and the building:

i. was constructed or substantially remodeled after July 1, 1992; and

ii. is outside an urban growth area, as defined in RCW 36.70A; and

iii. is outside an area designated by EPA as a PM2.5 or PM10 particulate nonattainment area.

(2) Exemptions shall be valid for a period determined by the Agency. Exemptions may be renewed using procedures specified by the Agency, provided the applicant meets the applicable requirements at the time of exemption renewal. Exemptions may be revoked if the Agency determines the residence or commercial building for which the exemption was approved no longer qualifies for an exemption.

**<u>NEW SECTION</u>**

**REGULATION I, SECTION 13.06 EMISSION PERFORMANCE STANDARDS**

(a) Solid fuel burning devices. A person shall not advertise to sell, offer to sell, sell, bargain, exchange, give away, or install a solid fuel burning device unless it meets both subsections (1) and (2):

(1) It has been certified and labeled in accordance with procedures and criteria specified in "40 CFR 60 Subpart AAA - Standards of Performance for Residential Wood Heaters" as amended through July 1, 1990; and

(2) It meets the following particulate air contaminant emission standards and the test methodology of EPA in effect on January 1, 1991, or an equivalent standard under any test methodology adopted by EPA subsequent to such date:

(A) Two and one-half grams per hour for catalytic woodstoves; and

(B) Four and one-half grams per hour for all other solid fuel burning devices.

(3) For purposes of subsection (a)(2) of this section, "equivalent" shall mean the emissions limits specified in subsection (a)(2) multiplied by a statistically reliable conversion factor determined by Ecology that relates the emission test results from the methodology established by the EPA prior to May 15, 1991, to the test results from the methodology subsequently adopted by EPA.

(b) Fireplaces. A person shall not advertise to sell, offer to sell, sell, bargain, exchange, give away, or install a factory-built fireplace unless it meets the 1990 EPA standards for wood stoves or an equivalent standard that may be established by the state building code council by rule.

(c) Subsection (a) of this section shall not apply to fireplaces, including factory-built fireplaces and masonry fireplaces.

**<u>NEW SECTION</u>**

**REGULATION I, SECTION 13.07 PROHIBITIONS ON WOOD STOVES THAT ARE NOT CERTIFIED WOOD STOVES**

(a) Subsections (a)(1) – (a)(4) of this section shall be effective January 1, 2015 and apply only to PM2.5 nonattainment areas or areas where required by EPA.

(1) Any person who owns or is responsible for a wood stove that is both (a) not a certified wood stove and (b) is located in the Tacoma, Washington fine particulate nonattainment area must remove and dispose of it or render it permanently inoperable by September 30, 2015.

(2) Any person who owns or is responsible for a coal-only heater located in the Tacoma, Washington fine particulate nonattainment area must remove and dispose of it or render it permanently inoperable by September 30, 2015.

(3) Subsection (a)(1) of section does not apply to:

(A) A person in a residence or commercial establishment that does not have an adequate source of heat without burning wood; or

(B) A person with a shop or garage that is detached from the main residence or commercial establishment that does not have an adequate source of heat in the detached shop or garage without burning wood.

(4) The owner or person responsible for removing or rendering permanently inoperable a wood stove under subsection (a)(1) of this section or a coal-only heater under subsection (a)(2) of this section must provide

documentation of the removal and disposal or rendering permanently inoperable to the Agency using the Agency's procedures within 30 days of the removal or rendering permanently inoperable.

(b) PM10. Subsection (b) of this section is established for the sole purpose of a contingency measure for PM10 nonattainment and maintenance areas. If the EPA makes written findings that: (1) an area has failed to attain or maintain the National Ambient Air Quality Standard for PM10, and (2) in consultation with Ecology and the Agency, finds that the emissions from solid fuel burning devices are a contributing factor to such failure to attain or maintain the standard, the use of wood stoves not meeting the standards set forth in RCW 70.94.457 shall be prohibited within the area determined by the Agency to have contributed to the violation. This provision shall take effect one year after such a determination.

# Appendix C. Best Practices for Environmental Justice in the Tacoma-Pierce County Nonattainment Area

## 1. Introduction and Background

"Best Practices for Environmental Justice" provides an outline of Ecology's plan to integrate environmental justice into the Tacoma-Pierce County Nonattainment Area. EPA defines Environmental justice as *the fair treatment and meaningful involvement of all people . . . with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.*

**Priority communities include:**

- Low-income households–(an example of a possible definition of low income includes 150% of the federal poverty line)
- Vulnerable populations
  - Communities of Color
  - Children
  - Elderly
  - People with low levels of mobility
  - Those with underlying health conditions
- Limited English Proficient (LEP) based on 2010 census data
  - LEP communities with a high level of illiteracy in their native language
- Puyallup Tribe of Indians
- People whose primary source of heat is wood

## 2. Environmental Justice Goals for the SIP

- Reduce health risks from fine particle pollution in priority communities
- Consider social and environmental effects on priority communities when determining how to reduce fine particle pollution
- Build meaningful public participation in the SIP development and decision making processes. Design a communication strategy that informs and engages priority communities
- Direct resources and incentives to priority communities

## 3. Ecology Resources

Project Lead: Richelle Perez

Air Quality Program Leadership Team Sponsor: Julie Oliver

Senior Environmental Planner: Doug Schneider

Outreach Environmental Planner: Margo Thompson

As needed:

Ecology Environmental Justice Committee: Millie Piazza, Frank Van Haren, technical experts, i.e., GIS, toxicologists, demographers

In-house Translation: Spanish, Chinese, Vietnamese, & Korean

## 4. Partners and Stakeholders

### A. Partners

- Washington State Department of Ecology
- Puget Sound Clean Air Agency
- U.S. Environmental Protection Agency (EPA)

  Region 10: Jeff Hunt

  EPA Environmental Justice Program: Rochelle Labiosa
- City/County governments
- Environmental Justice and Public Health Advocacy Organizations
- Public Health Organizations (hospitals, other)
- Puyallup Tribe of Indians

### B. Stakeholders

- Business
  - Hearth, Patio, and Barbeque Association
  - Chambers of Commerce/Tacoma-Pierce County Economic Development Board
  - Other business associations and local businesses
- Community and Non-Profit Organizations
- Religious and Faith based Organizations
- Rental Associations/Landlords
- Realtor Associations
- Housing and Neighborhood Associations

    - Neighborhood councils
    - Homeowners associations
    - Other community and neighborhood associations
  - Local Utilities

**C. Resources**

- Other states with fine particle nonattainment areas
- Office of Financial Management

**5. Action Plan**

**A. Demographic Analysis**

- Assess socio-economic data to determine priority areas
- Determine if we need to consider any communities outside of the Nonattainment Area. Are there populations that work or recreate in the Nonattainment Area but do not live there?

B. **Evaluate Social and Environmental Effects of Control Strategies**

Collaboratively work with agencies, interest groups, and affected communities to evaluate the effects of control strategies and mitigation options. Work with community groups and member to do the following:

- Identify disproportionately high and adverse effects (environmental, economic, health, social effects) of control strategies on priority communities
    - What are the current social, environmental, health and economics effects on communities–Baseline or "Do Nothing" Scenario?
    - Do SIP control measures impose undue hardships on priority communities?
    - Is it justified to develop control measures that go significantly beyond what is required, so that the priority community receives an added margin of health benefits?
- Identify mitigation options
    - Identify and distribute incentive funding with a focus on priority communities
    - If assistance levels are not adequate, consider possible exemptions and associated effects
- Work with others to consider changes to control strategies that prevent or mitigate adverse environmental, social, health or economic effects

**C. Identify and Prioritize Resources**

- Identify resources and any limitations/restrictions on particular resources
  - Identify what resources already exist in the community
  - Seek out additional resources
  - Explore opportunities to leverage additional resources or package resources of different types and from different sources
    - Funding related to improvements in health
    - Weatherization
    - Incentives at local, state, and federal levels
- Decide if legislation is necessary
- Determine how to distribute, prioritize, and direct funds and assistance in line with community values

**D. Plan for Public Outreach & Education**

- Consider type and level of community involvement
  - Will the SIP development involve a formal stakeholder process? If not, what level of community involvement do you need to plan for?
- Develop a Communication Plan
- Build meaningful involvement
  - Use and update Ecology's Environmental Justice checklist when planning outreach activities
  - Ensure that the priority communities understand the problems, solutions, and are part of the discussion
  - Hold "fact-gathering" public meetings in the priority communities
  - Plan meetings in areas/at time accessible to the community
  - Build partnerships with community groups on air quality issues to address community concerns and issues
- Plan for Limited English Proficiency (LEP) Audiences
  - Decide on languages for translation/interpretation
  - Translate crucial public documents, notices, etc
  - Identify when interpretation needs to be provided (i.e., public meetings, community educational talks) and in what media (i.e., radio, print, public meeting or presentation)
  - When possibly, field test documents

- Evaluate existing resources to disseminate messages/materials
  - School programs
  - Faith-based communities
  - Neighborhood organizations

## 6. Next Steps

- Track lessons learned and develop tools for ensuring environmental justice best practices in the development of future SIPs.

Developed by the Interagency State Implementation Plan Environmental Justice Work Group

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Kathy Ross - Tacoma-Pierce County Health Department
Gail Sandlin – AQP, Ecology
Doug Schneider – Senior SIP Planner, AQP, Ecology
Alexandria Teague – Pierce County
Margo Thompson –SIP Outreach Planner, AQP, Ecology
Frank Van Haren – Environmental Justice Committee Member, AQP, Ecology

# Appendix D. Environmental Justice Questionnaire

Ecology developed Appendix D to help Ecology and PSCAA track the actions taken in the Nonattainment Area to address environmental justice. It will:

- Track challenges the agencies and their partners faced in addressing environmental justice.
- Recommend actions the agencies would like to incorporate into their efforts, if given additional resources.

Ecology will work collaboratively with PSCAA to complete the questionnaire.

**How did the agencies address environmental justice concerns for the priority communities identified in the sections below?**

**Low-income households**

Examples include the following:

- The eligibility level for low income used in assistance programs
- Incentive levels for uncertified wood stove removal and replacement programs
- Heating options available to households replacing an uncertified wood stove
- Partnerships with other organizations that provide related assistance such as for weatherization or covering heating expenses
- Options for responding to a notice of violation during a burn ban

**People whose primary source of heat is wood**

Examples include the following:

- Heating options available to households replacing an uncertified wood stove
- Options for responding to a notice of violation during a burn ban
- Outreach and program recruitment strategies targeted at this community
- Partnerships developed to provide assistance for alternative heat sources during burn bans

**Limited English Proficient (LEP) communities**

Examples include the following:

- Demographic analysis at the neighborhood level
- Translation and interpretation services available in various languages
- Outreach and program recruitment strategies focused on this community.

**Households that Rent**

Examples include the following:

- Outreach and program recruitment strategies focused on landlords
- Outreach and program recruitment strategies focused on tenants
- Options for responding to a notice of violation during a burn ban

**Vulnerable populations including the following:**

- Communities of Color
- Children
- Elderly
- People with low levels of mobility
- Those with underlying health conditions

Examples include outreach and program recruitment strategies targeted at these communities.

**Puyallup Tribe of Indians**

**Are there other ways your agency addressed environmental justice concerns that the comments above do not cover?**

**Is there anything else your agency would like to share?**

# Appendix E. PSCAA's Board Resolution No. 1238

## Approval of Tacoma-Pierce County Fine Particle Nonattainment Recommendations for Emission Reduction Strategies

http://www.pscleanair.org/announce/hearings/documents/0212_RES1238.pdf

# Appendix F. Substitute House Bill 2326 Chapter 219, Laws of 2012

## An Act relating to protecting air quality that is impacted by high emitting solid fuel burning devices; amending RCW 70.94.473 and 70.94.477; adding a new section to chapter 70.94 RCW; and providing an expiration date.

http://apps.leg.wa.gov/documents/billdocs/2011-12/Pdf/Bills/Session%20Laws/House/2326-S.SL.pdf

# Appendix G. Response to Comments

Appendix G has the following five major sections: (1) this overview, (2) Ecology's response to comments, (3) copies of written comments, (4) transcript of the October 16, 2012, hearing, and (5) public involvement notices for the public comment period and public hearing on the State Implementation Plan (SIP) revision for the Tacoma-Pierce County Nonattainment Area. Some of the elements of this appendix come from the public comment period and public hearing. This includes Sections 1–4 and some of the items in Section 5. They will only appear in the final SIP revision and submittal.

Two of the major requirements of any SIP revision are a public comment period and public hearing on the proposed SIP revision.

In the final SIP revision, the second section of this appendix will contain a summary of the comments received during the public comment period and public hearing on the proposed SIP revision along with Ecology's response. Ecology will accept comments from September 10 through October 18, 2012. In cases where we receive a number of comments on the same subject, we may provide representative examples.

In the final SIP revision, the third section of this appendix will contain copies of the written comments received including e-mails.

In the final SIP revision, the fourth section of this appendix will contain the transcript from the public hearing on the proposed Tacoma-Pierce County Nonattainment Area SIP revision. Ecology will hold the hearing in Tacoma, Washington, on October 17, 2012.

In the final SIP revision, the fifth section of this appendix will contain copies of materials related to public involvement notices for the public comment period and public hearing. This includes:

- Affidavits of publication of the Notice for Opportunity for Public Comment in newspapers
- Ecology News Release on the public comment period and public hearing
- Certification of Hearing

# Appendix H. Additional Resources

Ecology's Tacoma-Pierce County Nonattainment Area Website
http://www.ecy.wa.gov/programs/air/sips/designations/pm_tacoma.htm

Clean Air Pierce County – Puget Sound Clean Air Agency's (PSCAA) Website for the Tacoma-Pierce County Nonattainment Area
http://www.cleanairpiercecounty.org/

Tacoma-Pierce County Clean Air Task Force – Report and Recommendations to Puget Sound Clean Air Agency
http://www.cleanairpiercecounty.org/taskforce/CleanAirTaskForceReport_FullReport.pdf

Clean Air Performance Commitment (CAPC) Memorandum of Understanding
http://www1.pscleanair.org/announce/hearings/documents/100420MOUfinal.pdf

## Rules and Statutes

Chapter 36.70A RCW (Revised Code of Washington) Growth management – planning by selected counties and cities
http://apps.leg.wa.gov/RCW/default.aspx?cite=36.70A&full=true

RCW 70.94.457 Solid fuel burning devices – Emission performance standards
http://apps.leg.wa.gov/RCW/default.aspx?cite=70.94.457

(Washington Administrative Code) WAC 173-433-100 – Solid fuel burning devices
https://fortress.wa.gov/ecy/publications/publications/wac173433.pdf

## Additional Technical Information

Summary Technical Report in Support of $PM^{2.5}$ Clean Air Performance Commitment (CAPC) Process for Tacoma Washington
http://www1.pscleanair.org/programs/community/nonattainment/fineparticulatematter/tacomapierce/Tacoma%20PM2.5%20CAPC%20Tech%20Report%20-%20Oct%2014%202010.pdf

Sources of Fine Particles in the Wapato Hills-Puyallup River Valley $PM_{2.5}$ Nonattainment Area
http://www.ecy.wa.gov/pubs/1002009.pdf

2008 National Emissions Inventory
http://www.epa.gov/ttnchie1/net/2008inventory.html