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

August 18, 2008

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

The Honorable Christine Gregoire
Governor of the State of Washington
Post Office Box 40002
Olympia, Washington 98504-0002

Dear Governor Gregoire:

Thank you for your recommendations on the status of fine particle pollution throughout Washington. Fine-particle pollution represents one of the most significant barriers to clean air facing our nation today. Health studies link these tiny particles – about $1/30^{th}$ the diameter of a human hair – to serious human health problems including aggravated asthma, increased respiratory symptoms like coughing and difficult or painful breathing, chronic bronchitis, decreased lung function, and even premature death in people with heart and lung disease. Fine particle pollution can remain suspended in the air for long periods of time and create public health problems far away from emission sources. Reducing levels of fine-particle ($PM_{2.5}$) pollution is an important part of our nation's commitment to clean, healthy air.

We have reviewed the December 18, 2007 and March 13, 2008 letters from the Washington Department of Ecology, submitting Washington's recommendations on air quality designations for the 2006 24-Hour $PM_{2.5}$ standard. We have also reviewed the technical information submitted to support Washington's recommendations. We appreciate the effort your State has made to develop this supporting information.

This letter is to inform you that the U. S. Environmental Protection Agency intends to support all of Washington's recommended designations and boundaries with the exception of the State's recommendations for Yakima County and Clark County. For the Yakima County and Clark County areas, the State recommended that EPA designate these areas as "unclassifiable for the purpose of extending the deadline". EPA intends to designate Yakima County and Clark County as "attainment/unclassifiable," however, we do not intend to extend the deadline for $PM_{2.5}$ designations. EPA intends to support the State's boundary recommendation and designation of "nonattainment" for the Tacoma area. We intend to make final $PM_{2.5}$ decisions by December 18, 2006.

We have enclosed a detailed description of our analysis for areas in Washington State. Your Environmental Director will also receive a copy of this letter and the enclosure. Should you have additional information that you wish to be considered by EPA in this process, please provide it to us by October 20, 2008.

EPA has taken steps to reduce fine particle pollution both regionally and across the country. These actions include the Clean Diesel Program to dramatically reduce emissions from highway, nonroad and stationary diesel engines, and the Fine Particle Implementation rule, which defines requirements for states with levels of fine particle pollution that do not meet national air quality standards.

Please also be aware that in near future, EPA is planning to publish a notice in the Federal Register to solicit public comments on our intended designation decisions. As noted above, we intend to make final designation decisions for the 2006 24-Hour $PM_{2.5}$ standards by December 18, 2008. If you have any questions, please do not hesitate to contact me. We look forward to a continued dialogue with you as we work together to implement the $PM_{2.5}$ standards.

Sincerely,

Michelle Zelinski for

Elin D. Miller
Regional Administrator

Enclosure

cc: Mr. Jay Manning
Director, Washington Department
of Ecology

Mr. Stu Clark
Air Quality Program Manager
Washington Department of Ecology

Mr. Dennis McLarren
Executive Director Puget Sound
Clean Air Agency

Attachment 1

Washington
Area Designations For the
24-Hour Fine Particle National Ambient Air Quality Standard

The table below identifies the counties in the State of Washington that EPA intends to designate as not attaining the 2006 24-hour fine particle ($PM_{2.5}$) standard.[1] A county (or portion thereof) will be designated as nonattainment if it has an air quality monitor that is violating the standard or if the county is determined to be contributing to the violation of the standard.

Area	WA Recommended Nonattainment Counties	EPA's Intended Nonattainment Counties
Tacoma, Washington	Pierce (partial)	Pierce (partial)

EPA Technical Analysis for Tacoma (Pierce County), Washington

Discussion

Pursuant to section 107(d) of the Clean Air Act, EPA must designate as nonattainment those areas that violate the NAAQS and those areas that contribute to violations. This technical analysis for Tacoma identifies the nearby areas with monitors that violate the 24-hour $PM_{2.5}$ standard and evaluates the areas that potentially contribute to fine particle concentrations in the area. EPA has evaluated these areas based on the weight of evidence of the following nine factors recommended in EPA guidance and any other relevant information:

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

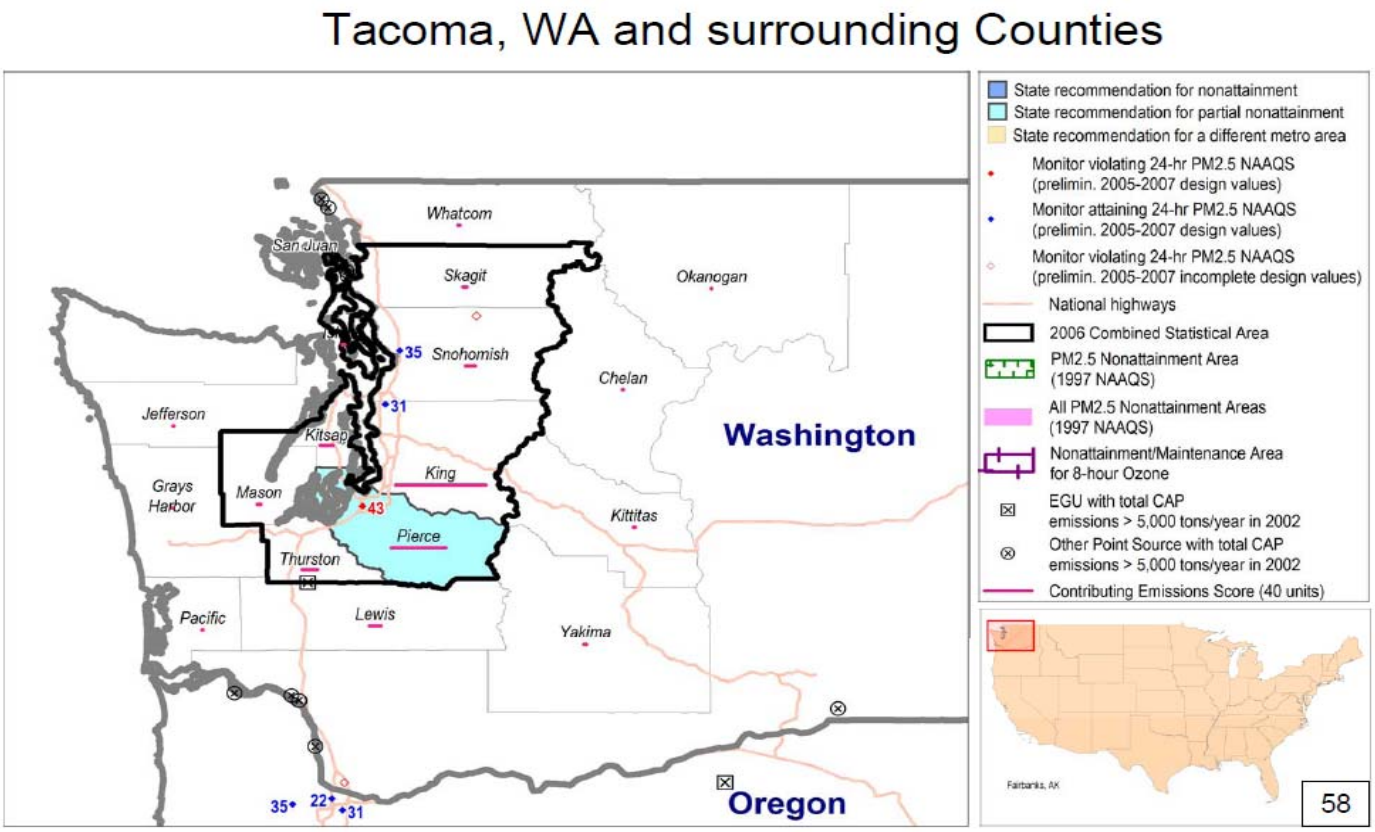
Background

Figure 1 is a map of the counties in the area and other relevant information such as the locations and design values of air quality monitors, the metropolitan area boundary, and counties recommended as nonattainment by the State. The violating monitor in the Pierce County area is

[1] EPA designated nonattainment areas for the 1997 fine particle standards in 2005. In 2006, the 24-hour PM2.5 standard was revised from 65 micrograms per cubic meter (average of 98th percentile values for 3 consecutive years) to 35 micrograms per cubic meter; the level of the annual standard for PM2.5 remained unchanged at 15 micrograms per cubic meter (average of annual averages for 3 consecutive years).

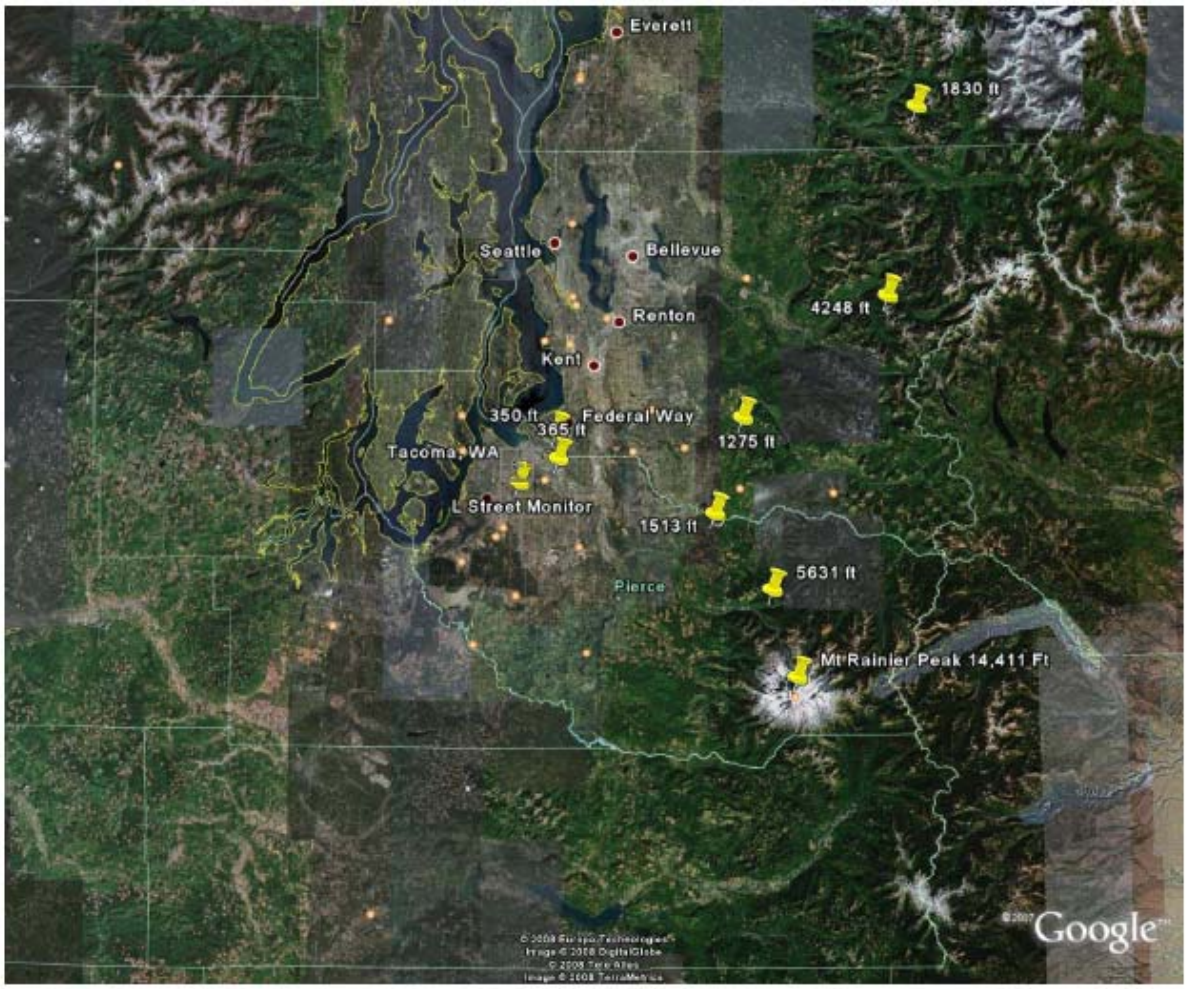
located at 7802 South L Street (South L Street monitor) in a suburban area of Tacoma, Washington Pierce County. The City of Tacoma is a major urban center in the Southern Puget Sound Region. Situated on Commencement Bay, an inlet of Puget Sound, Tacoma lies at the foot of Mt. Rainier in the Puyallup River valley, bordered by mountains. Commencement Bay serves the Port of Tacoma, a major center of international trade. The Port handled more than $36.33 billion in annual trade and nearly 2 million TEUs (Twenty-foot Equivalent container Units) in 2007. Tacoma is situated in the Seattle-Tacoma-Olympia Consolidated Statistical Area, a highly urbanized area along the Interstate 5 corridor. To the east of Interstate 5, along the eastern portion of Pierce, King, Snohomish, and Thurston Counties the Cascade mountains rise to over 14,000 feet ft in elevation at Mt Rainier in Pierce County. Tacoma is about 36 miles south from the city of Seattle, the largest city in Washington State and 30 miles north of the City of Olympia, the Capitol of Washington State. See Figure 2. The Puyallup Indian Reservation is located in the Tacoma Area, about five miles northeast of the violating monitor. See Figure 3.

Figure 1



Counties labeled in bold reflect NAAs under 1997 NAAQS

Figure 2 Southern Puget Sound area topography



On December 18, 2007, the State of Washington (the State) recommended that the monitor located at 7802 South L Street in Tacoma, Pierce County, WA be designated as "nonattainment" for the monitor based on air quality data from 2004-2006.[2] [3] The State of Washington (the State) also recommended that monitors located in Vancouver, Clark County, WA and Yakima, Yakima County, WA be designated as "unclassifiable" for the purpose of extending the deadline based on missing years of air quality data for the period 2004-2006.[4]

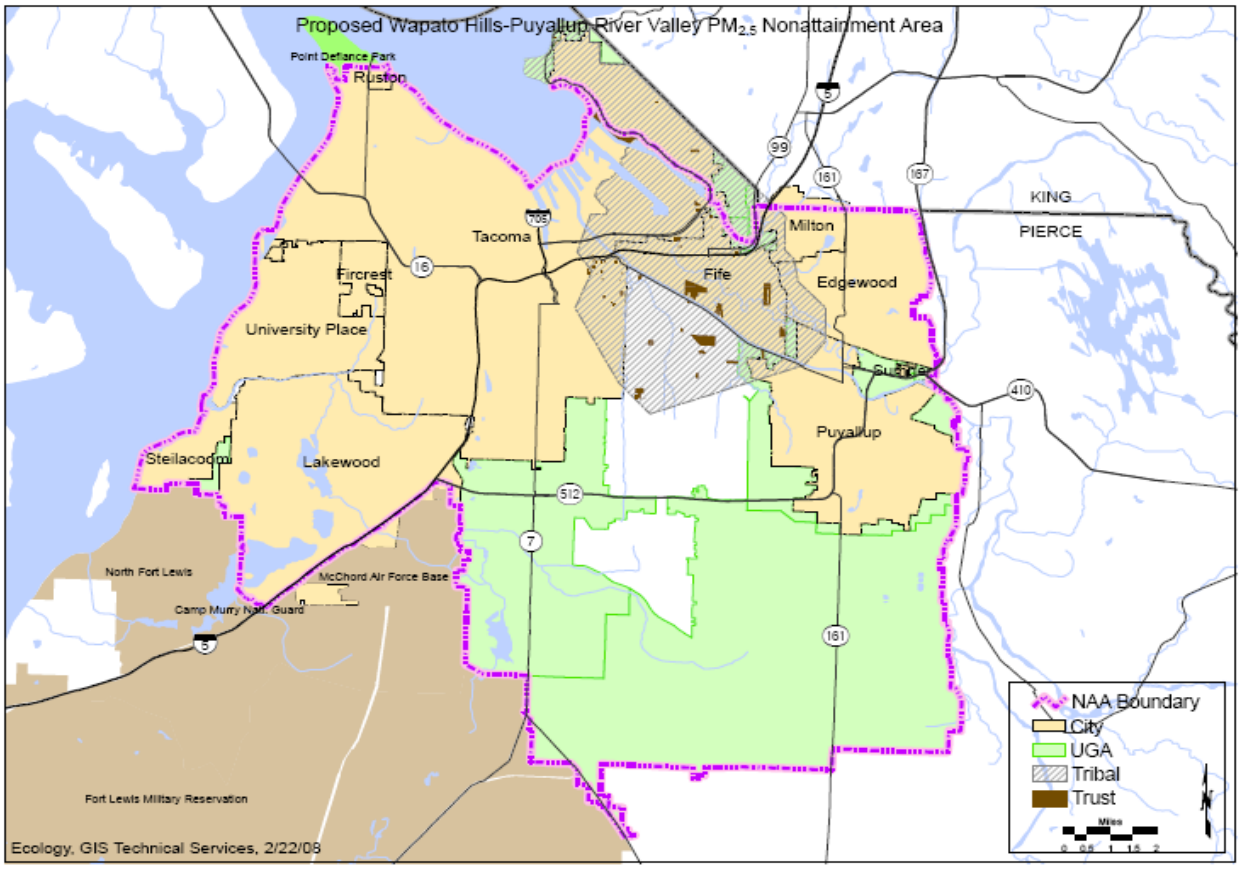
The December 18, 2007 letter did not include a boundary recommendation for the nonattainment area or a nine factors analysis. The letter indicated that the State was still completing its evaluation of an appropriate area for the recommended "nonattainment" designation for the South L Street monitor. The December 17th letter addressed tribal lands in the vicinity of the violating monitor, and indicated that the State's recommendation did not apply

[2] See December 18, 2007 letter from Jay Manning, Director of the Washington Department of Ecology to Elin Miller, Regional Administrator EPA Region 10.
[3] The 7802 L Street monitor is within the jurisdiction of the Puget Sound Clean Air Agency (PSCAA), which manages air quality programs for areas in King County, Pierce County, Snohomish County and Kitsap County.
[4] These data are from Federal Reference Method (FRM) and Federal Equivalent Method (FEM) monitors located in the State.

to trust lands within the Puyallup Indian Reservation under the Puyallup Tribe of Indians Settlement Act of 1989, 25 U.S.C. §1773.

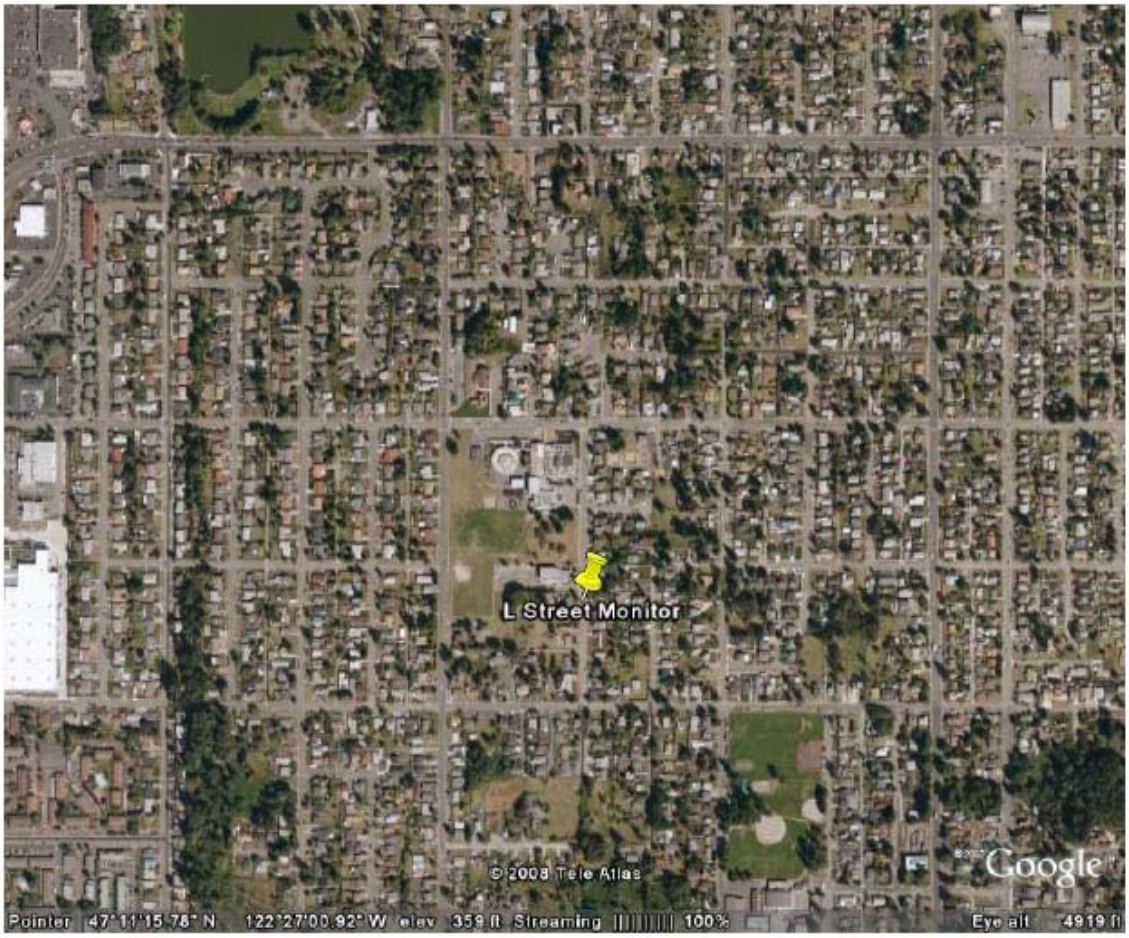
On March 13, 2008, the State submitted a supplement to the December 18th letter and included a boundary recommendation for the area surrounding the monitor at 7802 South L Street (South L Street monitor). Figure 3 is the State's recommendation included in the March 13, 2008 letter. Tribal trust lands are in brown. The reservation is shown with cross-hatch. See Figure 4 for an aerial image of the immediate area surrounding the monitor. In addition to the March 13th letter, the State submitted a letter dated July 28, 2008 containing addition technical information for EPA's consideration.[5]

Figure 3 Washington's recommended nonattainment area boundary for the Tacoma Area



[5] See July 25, 2008 letter from Stuart Clark, Program Manager, Air Quality Program, Washington Department of Ecology to Rick Albright, Director, Office of Air Waste and Toxics EPA Region 10.

Figure 4 South L Street Monitor Immediate Area



Air quality monitoring data on the composition of fine particle mass are available from a chemical speciation monitoring site co-located with the South L Street monitor and operated by the State. The State submitted data from this site along with its nine factors analysis and as an attachment to their July 28, 2008 letter. The State's analysis of this data indicates that the days with the highest fine particle concentrations occur exclusively in the winter, and the average chemical composition of the highest days in the winter season is over 70% carbonaceous $PM_{2.5}$, 3-4% percent sulfate, 6% nitrate and 18% other components including crustal $PM_{2.5}$.

Based on EPA's 9-factor analysis described below and currently available information, EPA agrees with the State's boundary recommendation for the Tacoma area. Under the Puyallup Tribe of Indians Settlement Act of 1989, 25 U.S.C. §1773, Congress explicitly provided State and local agencies in Washington authority over activities on non-trust lands within the 1873 Survey Area. Accordingly, EPA's designation of State's nonattainment area includes non-trust land within the boundary of the Puyallup Reservation. However, consistent with the Puyallup Tribe of Indians Settlement Act of 1989, 25 U.S.C. §1773, our intended State nonattainment area boundary does not include areas, sources and activities on restricted and trust lands within the Puyallup Reservation.

EPA will be designating restricted and trust lands within the boundary of the Puyallup Reservation separately and EPA and the Tribe will be responsible for air quality planning activities for those areas. However, since Puyallup tribal restricted and trust lands are surrounded by state lands and non-trust lands and share an airshed with these surrounding areas, this analysis also covers these restricted and trust lands within the exterior boundary of the Puyallup Reservation.

The following is a summary followed by EPA's detailed 9-factor analysis for the Tacoma area.

Summary of the State's submittal

The State submitted to EPA the partial county boundary shown in Figure 3 in its March, 2008 submittal. In its nine factors analysis included with this submittal, the State focused on local sources potentially contributing to the violating monitor at South L Street. The State explained in its submittal that air quality data indicates that exceedences occur during the winter months (November-February), when meteorology is conducive to inversions that trap pollutants and people use wood to heat their homes. Continuous air quality monitors and woodstove survey data indicate that concentrations are highest during evening hours, and this corresponds to times when people burn in woodstoves and fireplaces. The State also reviewed $PM_{2.5}$ speciation data from the South L Street monitor for the highest day in 2006 that indicates that carbonaceous $PM_{2.5,}$ which is an indicator of emissions from burning of wood, accounts for 74% or more of the total $PM_{2.5}$ observed at the South L Street monitor.

The State's conclusion from this air quality data as well as the other data it analyzed in its nine factors analysis was that elevated concentrations at the South L Street monitor are due to local emissions (dominated by woodstove and fireplace emissions) occurring under meteorological conditions conducive to trapping those emissions locally. Accordingly, the State used the comprehensive urban growth area (CUGA) as a starting point for defining the nonattainment area because it encompasses woodstoves and other sources in Tacoma, its suburbs and the Urban Growth Area. They further excluded areas in the CUGA from inclusion in the boundary based on lack of population or sources of emissions. These areas include Port Defiance Park, Fort Lewis Base and McChord Air Force Base to the south and a topographic bluff to the northernmost edge of the the (CUGA). See Figure 2. The State's basis for excluding these areas is:

1) The Fort Lewis and McChord Air Force Bases have minimal $PM_{2.5}$ emissions, population density and forecasted growth. The State also argued that these areas are not upwind of the violating monitor when it experiences elevated $PM_{2.5}$ concentrations.
2) The far eastern peninsula of the CUGA, east of the Puyallup River and White River valley do not likely have $PM_{2.5}$ emissions.
3) Throughout the area near the Pierce-King County line, sites are either on highlands or in valleys with little in between. The State's analysis found that the highlands along the northern county line are in a different air shed from the land to the south and that the bluffs bordering Commencement Bay and the river valley to the south help trap fine particulates and increase pollutant concentrations during inversions that occur in the winter months. The State drew the northwestern boundary of the proposed nonattainment area to exclude these bluffs. They used surrogates of a road (S.R 509) and a stream to

draw the boundary. This use of surrogates does not exclude any major sources from the nonattainment area.

4) The State excluded Point Defiance Park from the proposed nonattainment area because the area does not contribute to nonattainment. Only 105 of the Park's 702 acres are maintained.

In focusing its initial analysis on the CUGA and local sources, the State did not directly address whether or not contributions from areas outside of the CUGA contribute to the violations at the L Street monitor. After EPA shared information with the states from contributing emissions score (CES) modeling which indicated a potential contribution from regional sources to the north, the State submitted additional analyses and data that focused on assessing regional contributions to the Tacoma L Street Monitor. This information included the following:

1) Hourly monitoring data over 24-hour periods for the South L Street site and other sites in Puget Sound that show 24-hour patterns in $PM_{2.5}$ levels at sites in the southern King County industrial areas (Duwamish and Kent), differ from those observed at monitors in N. King County (Lake Forest Park) and in Tacoma. In N. King County and in Tacoma, "v" shaped diurnal patterns are observed. These patterns indicate that peak $PM_{2.5}$ concentrations occur at night and concentrations decrease during the day. These patterns generally correspond with periods of increased woodstove use in the evening hours noted on surveys conducted by the Puget Sound Clean Air Agency.

2) Speciated $PM_{2.5}$ data for the South L Street monitor compared with data for other sites indicating that carbonaceous PM impacts the Tacoma monitor predominantly in the winter when fractions of sulfate and nitrate compared with total $PM_{2.5}$ are low. The Duwamish monitor shows ratios of sulfate/total PM that are more consistent throughout the year.

3) Additional meteorological data for the L Street Monitor showing that exceedences occur in the winter during very low wind speeds (less than 5 mph) indicating stagnant conditions.

The State concluded from this additional analysis that high Tacoma concentrations are due to local emissions dominated by emissions of carbonaceous $PM_{2.5}$ occurring under conditions conducive to high concentrations (meteorology) and not transport.

EPA's review of the State's submittal

EPA examined data on counties in the Seattle-Tacoma-Olympia CMSA as well as the information that the State submitted on March 13, 2008 focused on the Tacoma CUGA as well as the information it later submitted on July 25, 2008 and has determined that the State's boundary is large enough to encompass sources that contribute to the exceedences and violations of the 24-hour $PM_{2.5}$ standard at the South L Street monitor. EPA is agreeing with the State's boundary recommendation. The State has noted that its boundary recommendation does not include trust lands within the boundary of the Puyallup Reservation and we agree. The State has defined a boundary for land within the state's jurisdiction. EPA and the Tribe are responsible for tribal trust lands.

The following information was important considerations in EPA's conclusion:

Chemical speciation data indicates 74% or more contribution from carbonaceous PM which is associated with burning in woodstoves and fireplaces, and 10% or less contribution from $PM_{2.5}$ components that are typically regional such as sulfate and nitrate. The State's boundary includes potential sources of these contributions in the Tacoma area including the Port of Tacoma and sections of Interstate 5 and State Highway 99.

EPA's analysis of positive matrix factorization data indicates that 60-90% of total $PM_{2.5}$ on exceeding days at the Tacoma L Street monitor is from wood smoke. There are no other sources of smoke during the winter season in the CUGA. By law outdoor burning is prohibited in this area.

Hourly $PM_{2.5}$ levels at the Tacoma L Street monitor peak in the evenings and decrease dramatically during the day. These patterns are consistent with woodstove surveys conducted in Tacoma which show that on high $PM_{2.5}$ days, woodstove use $PM_{2.5}$ peaks in the late evening and is lowest around noon.

Meteorological data shows very low mixing heights during stagnation events when the exceedences are occurring, and low wind speeds (typically less than 5 mph).

Local topographical features in the area influence pollution flow in the Tacoma area during stagnation events.

Population density in Pierce County is concentrated within the CUGA and emissions from the Fort Lewis and McCord Air force Military base to the south are less than .2% contribution to the total inventory of $PM_{2.5}$ emissions in the area.

Emissions from the Port of Tacoma are estimated at 90 tons per year. This does not include off-terminal emissions, which contribute additional $PM_{2.5}$. The Port projects a dramatic increase of its cargo handling capacity in the next two decades, with an estimated cargo growth factor of 4.8 from 1999 to 2015.

Factor 1: Emissions data

For this factor, EPA evaluated county level emission data for the following $PM_{2.5}$ components and precursor pollutants: "$PM_{2.5}$ emissions total," "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," "SO_2," "NO_x," "VOCs," and "NH_3." "$PM_{2.5}$ emissions total" represents direct emissions of $PM_{2.5}$ and includes: "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other", primary sulfate (SO_4), and primary nitrate. (Although primary sulfate and primary nitrate, which are emitted directly from stacks rather than forming in atmospheric reactions with SO2 and NOx, are part of "PM2.5 emissions total," they are not shown in Table 1 as separate items.) "$PM_{2.5}$ emissions carbon" represents the sum of organic carbon (OC) and elemental carbon (EC) emissions, and "$PM_{2.5}$ emissions other" represents other inorganic particles (crustal). Emissions of SO_2 and NO_x, which are precursors of the secondary $PM_{2.5}$ components sulfate and nitrate, are also considered. VOCs (volatile organic compounds) and NH_3 (ammonia) are also potential $PM_{2.5}$ precursors and are included for consideration. Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1.

In addition, the State of Washington submitted seasonal emissions data for Pierce County (Tacoma, WA), the location of the violating monitor. Table 1 shows emissions of $PM_{2.5}$ components (given in tons per year) and the CESs for potentially contributing counties to the violating monitor in Pierce County WA (Seattle Tacoma Olympia Area).

Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1. See http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html.

EPA also considered the Contributing Emissions Score (CES) for each county. The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Note that this metric is not the exclusive way for consideration of data for these factors. A summary of the CES is included in attachment 2, and a more detailed description can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.]

Table 1 $PM_{2.5}$ 24-hour Component Emissions, and CESs.

County	CES Score (Rank)	PM2.5 emissions - total (tpy)	PM2.5 emissions - carbon (tpy)	PM2.5 emissions - other (tpy)	SO2 emissions (tpy)	NOx emissions (tpy)	VOC emissions (tpy)	NH3 emissions (tpy)
King, WA	100 (1)	6,362	4,168	2,194	7,361	75,825	89,446	2,564
Pierce	60 (2)	3,766	2,255	1,511	3,200	31,905	32,097	1,410
Thurston	17 (3)	2,221	1,348	873	478	8,389	14,985	1,620
Kitsap	14 (4)	2,204	1,201	1,004	442	6,199	9,588	274
Snohomish	13 (5)	3,714	2,223	1,492	2,256	22,687	28,861	1,932
Skagit	11	1,605	819	786	10,345	12,417	11,173	1,809
Island	4	841	453	388	485	4,463	4,128	358
Mason	3	767	439	328	100	1,623	3,846	90

Total $PM_{2.5}$ emissions in King County as well as individual chemical precursor components of $PM_{2.5}$ are generally two times the emissions in Pierce County, the county which contains the violating monitor. In addition, the CES score of 100 indicates potential contributing emissions from King County. The next highest CES score of 17 was for Thurston County, which contains the City of Olympia located 36 miles to the South of the violating monitor. Given the low CES scores and relatively low emissions in Thurston County, Kitsap, Snohomish, Skagit, Island and Mason Counties these counties are less likely to contribute to the exceedences at the South L Street monitor than King County and Pierce County which have higher emissions and CES scores. We note that in large areas such as King County, the CES does not account for diurnal variation in hourly $PM_{2.5}$ and sharp spatial gradients in emissions within counties that represent large land areas. [6] Those factors were separately considered in developing the final conclusions.

The State of Washington submitted seasonal emissions inventory data as part of its nine factors analysis attachment to its letter to EPA dated December 18, 2007. Figure 5 and Table 2

[6] See supporting documentation section on limitations. Because of differences in county size, and topography across the country, the score may require careful interpretation for some areas, particularly in the western United States.

display seasonal emissions in Pierce County, Washington for 2005 from the State's submittal. $PM_{2.5}$ exceedences at the violating monitor in Pierce County have occurred in the months of November, December, January and February during the years 2004-2007.

Winter season (December through February) air emissions of $PM_{2.5}$ in Pierce County are balanced among:

(1) outdoor open burning (202 tons per season, 24%),

(2) mobile sources (230 tons per season, 27%),

(3) fireplaces and woodstoves (326 tons per season, 39%), and

(4) other sources (84 tons per season, 10%)

Washington noted that these are estimates for a countywide emission inventory, and that outdoor open burning (with an estimated 24% contribution) is likely not occurring in the urban portion of the county near the violating monitor. Open burning is prohibited in these areas.

Figure 5

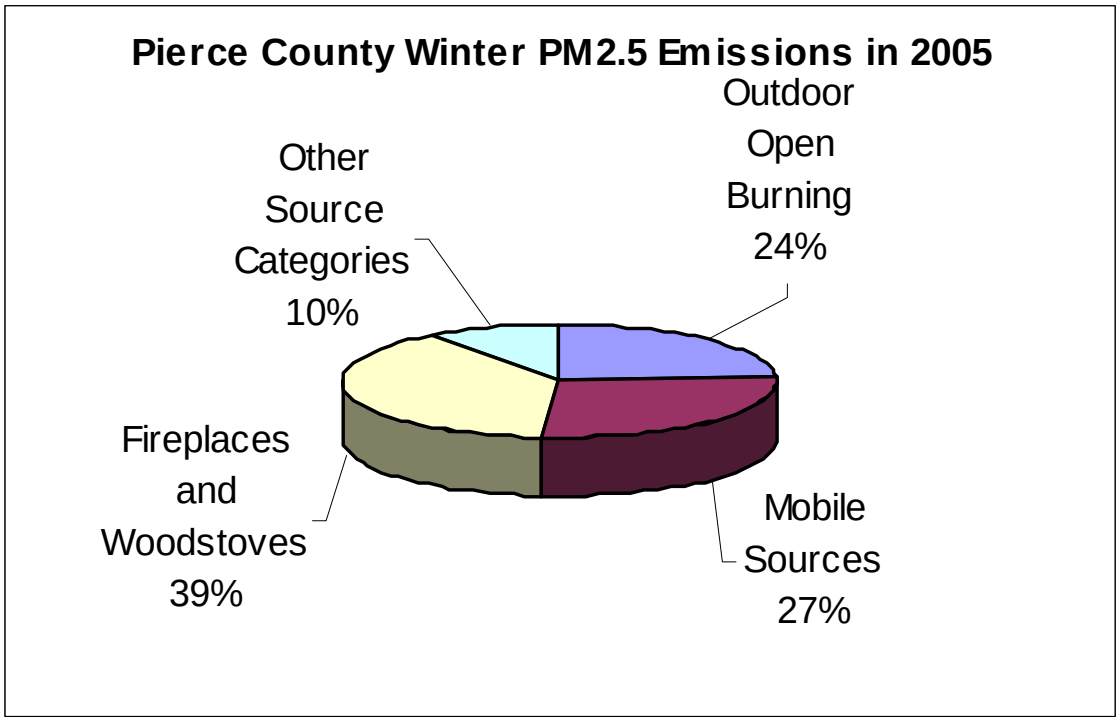


Table 2 Pierce County Seasonal $PM_{2.5}$ Emission Sources in 2005

2005 Category PM2.5 Emissions					PM2.5 Emission Source Categories and Subcategories	2005 Subcategory PM2.5 Emissions				
tpy	tons/season					tpy	tons/season			
Annual	Summer	Fall	Winter	Spring		Annual	Summer	Fall	Winter	Spring
1,258	**377**	**377**	**202**	**302**	**Outdoor Open Burning**					
					Land clearing burning	941	282	282	151	226
					Yard waste burning	185	56	56	30	44
					Forest wildfires and managed burns	117	35	35	19	28
					Structural fires	11	3	3	3	3
					Agricultural waste burning	4	1	1	1	1
1,036	**284**	**259**	**230**	**263**	**Mobile Sources**					
					On-road gasoline vehicles	296	77	74	71	74
					Non-road diesel engines	280	78	67	62	73
					On-road diesel vehicles	201	52	50	48	50
					Non-road gasoline engines	80	22	19	18	21
					Ocean-going vessels	54	14	14	14	14
					Harbor vessels	35	9	9	9	9
					Railroad diesel engines	27	7	7	7	7
					On-road CNG and LPG engines	4	1	1	1	1
					Aircraft ground support engines	3	1	1	1	1
					Aircraft	2	1	1	1	1
					Non-road LPG engines	2	1	1	1	1
					Recreational boats	52	22	17	0	13
679	**34**	**95**	**326**	**224**	**Fireplaces and Woodstoves**					
					Wood stove wood burning	430	22	60	206	142
					Fireplace wood burning	165	8	23	79	54
					Fireplace and wood stove firelog burning	78	4	11	37	26
					Pellet stove wood burning	6	0	1	3	2
261	**49**	**56**	**84**	**72**	**Other Source Categories**					
					Industrial point sources	181	45	45	45	45
					Natural gas burning	67	3	9	32	22
					Boiler and furnace distillate oil burning	11	1	2	5	4
					Propane furnaces and boilers	2	0	0	1	1
3,234	**744**	**787**	**842**	**860**	**Totals**	**3,234**	**744**	**787**	**842**	**860**

Fireplaces and woodstoves are the largest source of emissions in Pierce County (39%). The State conducted additional analyses to determine the spatial variation in wood burning activities. Figure 6 displays the number of people using wood as a primary source of heat in the immediate area of the South L monitor, per square mile. The information source is the 2000 census, and is presented at a block group level[7]. This information does not capture those who use wood as a secondary heat source, or those who use fireplaces for ambiance. The highest density of woodstove/fireplace use occurs within the urban growth boundary and in census blocks north of SR 512 in the vicinity of the monitor. See Figures 6 and 7.

Conclusion: Based on annual emissions inventory data for Pierce, King and surrounding counties, VOC and NOx emissions comprise the largest portion of total $PM_{2.5}$ emissions. However, this data is annual data and exceedences and violations at the South L Street monitor occur exclusively in the late fall-winter seasons. Seasonal emissions inventory data submitted by the State indicates that emissions from woodstoves and fireplaces account for over 40% of the total emissions in Pierce County, while mobile sources account for 27% of total emissions in Pierce County.

[7] US Census Bureau. http://factfinder.census.gov/home/saff/main.html

Figure 6

Tacoma Area Households
Using Wood for Primary Heat, per Square Mile

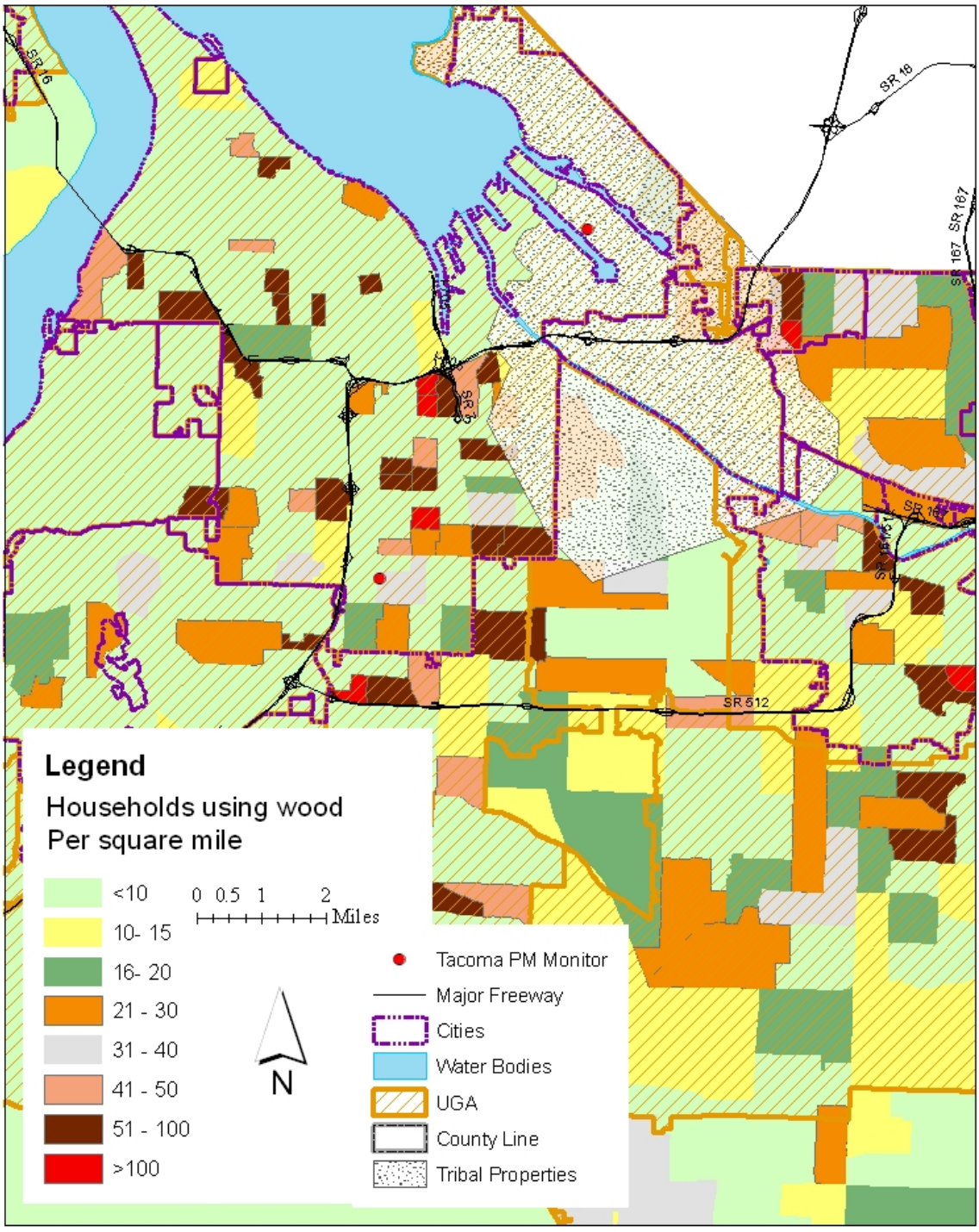
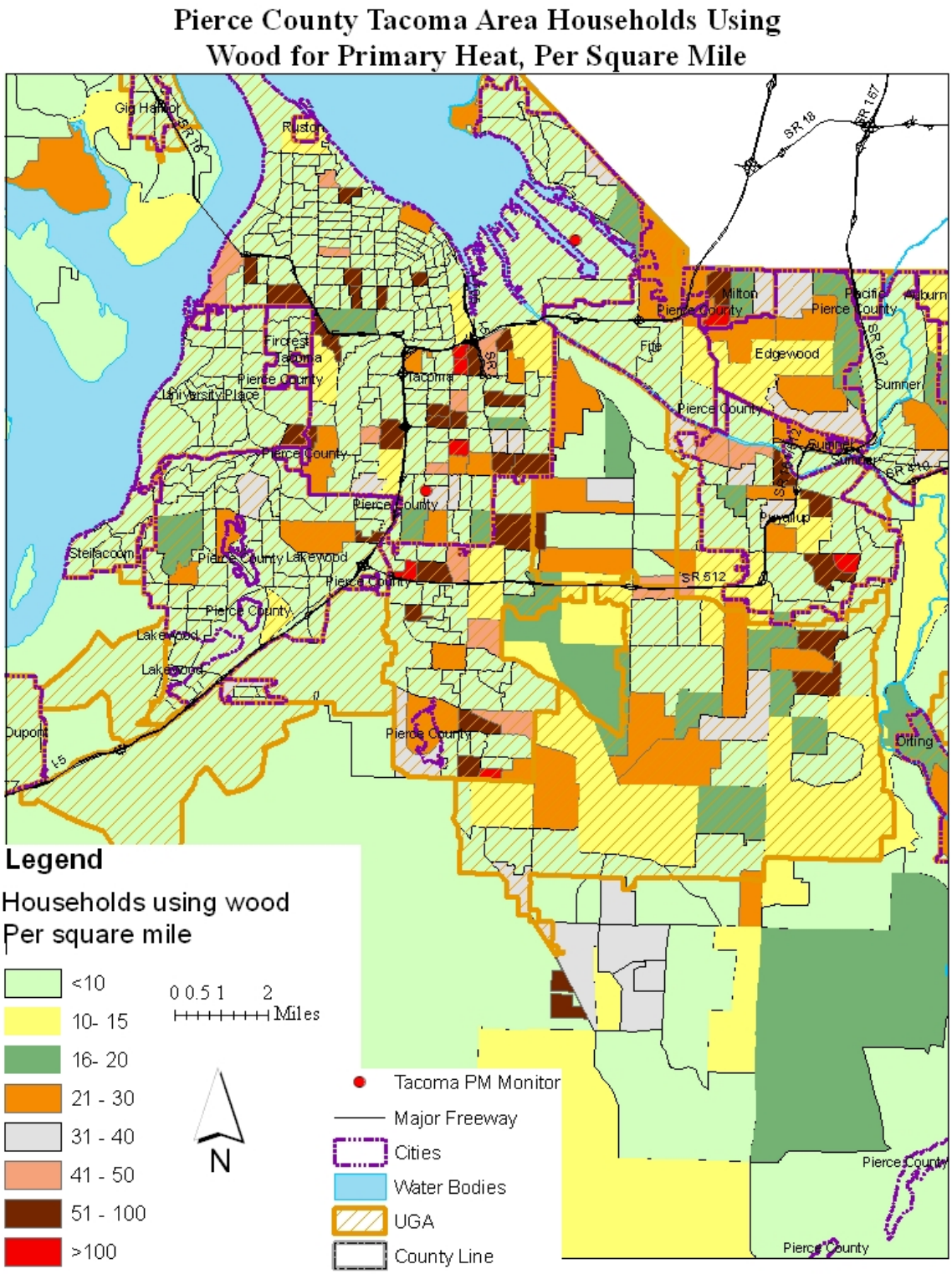


Figure 7


Pierce County Tacoma Area Households Using
Wood for Primary Heat, Per Square Mile
Gig Harbor
Ruston
SR 16
SR 18
SR 167
Milton
Pierce County
Pacific
Auburn
Fife
Edgewood
Sumner
Fircrest
Tacoma
University Place
Steilacoom
Lakewood
SR 512
Dupont
I-5
Orting
Legend
Households using wood
Per square mile
<10
10- 15
16- 20
21 - 30
31 - 40
41 - 50
51 - 100
>100
0 0.5 1 2
Miles
N
Tacoma PM Monitor
Major Freeway
Cities
Water Bodies
UGA
County Line

Factor 2: Air quality data

This factor considers the 24-hour $PM_{2.5}$ design values (in $\mu g/m^3$) for air-quality monitors in counties in the Seattle-Tacoma-Olympia area based on data for the 2005-2007 period. For a more robust analysis, this factor also considers data from the previous period 2004-2006. A monitor's design value indicates whether that monitor attains a specified air-quality standard. The 24-hour $PM_{2.5}$ standards are met when the 3-year average of a monitor's 98^{th} percentile values are 35 $\mu g/m^3$ or less. A design value is only valid if minimum data completeness criteria are met. [8]

The 24-hour $PM_{2.5}$ design values for counties in the Seattle-Tacoma-Olympia area are shown in Table 3.

Table 3 Air Quality Data for Seattle-Tacoma-Olympia Area

County	State Recommended Nonattainment?	Design Values 2004-06 ($\mu g/m^3$)	Design Values 2005-07 ($\mu g/m^3$)
Pierce, WA	Yes	42	43
King, WA	No	29	31
Snohomish, WA	No	33	35
Thurston, WA	No	N/A	N/A
Island, WA	No	N/A	N/A
Kitsap, WA	No	N/A	N/A
Mason, WA	No	N/A	N/A

In Washington State, the monitor at 7802 South L Street in Tacoma (Pierce County) is the only monitor that violates the 24-hour $PM_{2.5}$ standard based on 2005-2007 data. King and Snohomish County do not violate based on 2004-2006 or 2005-2007 data. The remaining counties do not have Federal Reference Method monitor, therefore Federal Reference Method[9] data is not available for these counties.

Although the surrounding counties of King and Snohomish do not violate the standard, this alone is not sufficient information to eliminate King County or Snohomish County as candidates for inclusion in the nonattainment area. Nearby counties could be contributing to the violations at the South L Street monitor even though there are no violating monitors in those counties. Washington included in its nine factor analysis additional air quality data for the Pierce, King and Snohomish County Areas to better understand sources contributing to the violations at the L Street monitor. EPA will consider this as well as additional air quality data and the other 8 factors in determining whether or not to include King County and other counties

[8] Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) at population-oriented locations with a FRM or FEM monitor. All data from Special Purpose Monitors (SPM) using an FRM, FEM, or Alternative Reference Method (ARM) which has operated for more than 24 months is eligible for comparison to the relevant NAAQS, subject to the requirements given in the October 17, 2006 Revision to Ambient Air Monitoring Regulations (71 FR 61236). All monitors used to provide data must meet the monitor siting and eligibility requirements given in 71 FR 61236 to 61328 in order to be acceptable for comparison to the 24-hr PM2.5 NAAQS for designation purposes.

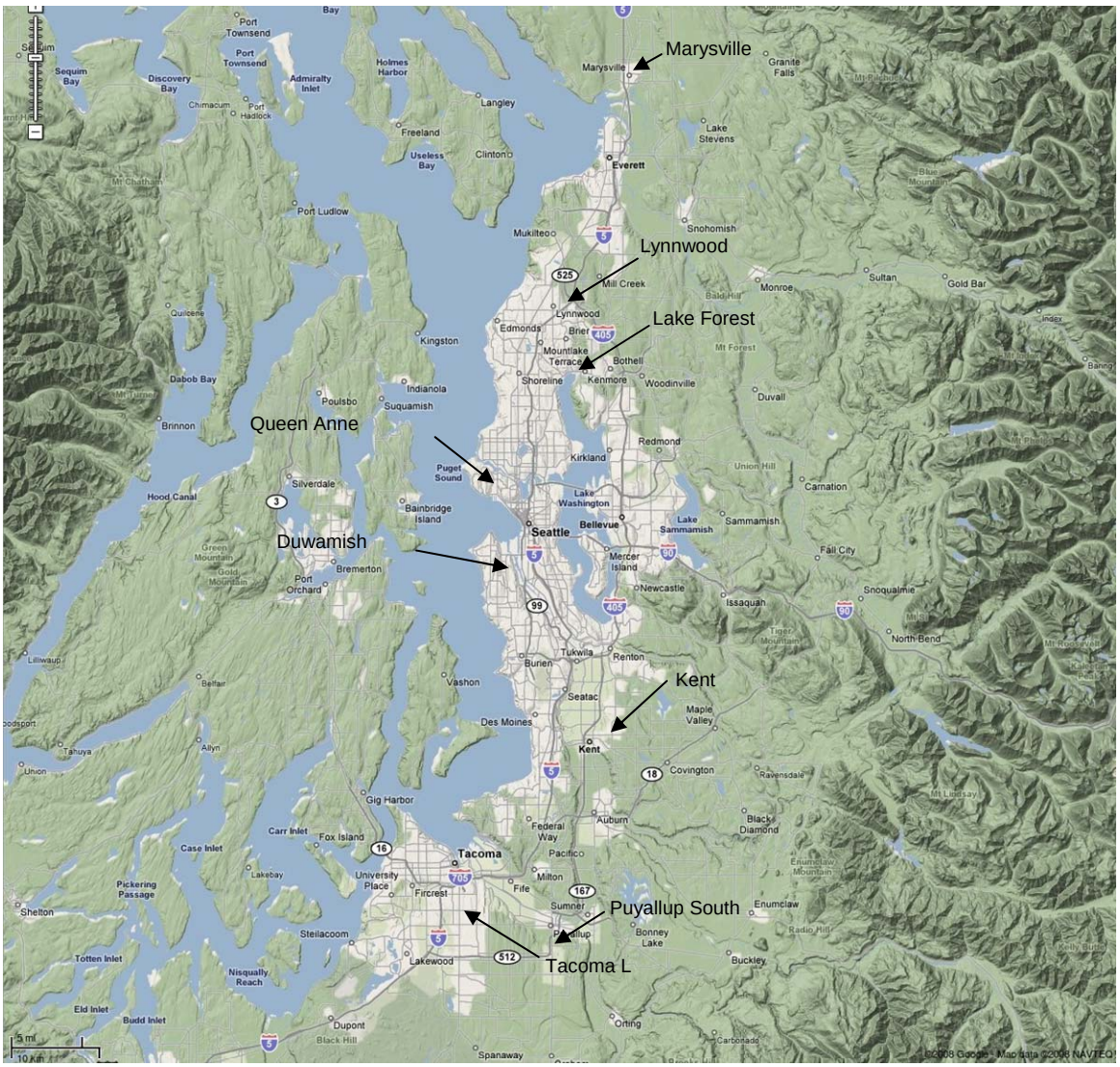
[9] Design values are based on data collected at FRM or FEM monitors. The State operates other monitors in these counties but they are not FRM or FEM monitors.

in Puget Sound Area in the nonattainment area. Figure 8 shows the location of monitors in the Puget Sound area. EPA analyzed data from several sites in addition to the Pierce County Tacoma South L Street Site to better characterize $PM_{2.5}$ in Tacoma and in the surrounding counties. As mentioned above, this analysis will focus on further examining contributions from King County since the CES indicates a potential contribution from these areas. The following is a discussion of air quality data from these sites. Marysville, Lynnwood, Lake Forest Park and Tacoma are suburban, residential areas, while the Duwamish, Puyallup South and Kent Valley are industrial areas. Table 4 displays the top 5% of concentrations at Tacoma L Street Monitor from 2004-2007 from EPA's Air Quality System (AQS) repository of ambient air quality data. All of these concentrations occurred during the months of November, December, January or February with the exception of one which occurred in late October, 2007. The exceedences at the South L Street monitor occur during the winter as the State suggests in their nine factor analysis.

Table 4 Top 5% values at Tacoma L Street Monitor from 2004-2007

Top 5% PM2.5 Values at L Street FRM for 2004-2007								
Rank	Date	ug/m3	Date	ug/m3	Date	ug/m3	Date	ug/m3
1	11/4/2004	57.00	12/15/2005	45.50	12/16/2006	68.00	1/15/2007	58.60
2	11.20/2004	51.30	12/6/2005	43.50	12/31/2006	50.20	2/2/2007	46.70
3	1/7/2004	43.70	11/15/2005	40.50	12/28/2006	42.70	11/23/2007	45.20
4	11/13/2004	39.50	2/9/2005	40.30	2/19/2006	33.70	1/12/2007	44.70
5	1/13/2004	33.50	1/25/2005	39.00	12/19/2006	32.60	1/30/2007	38.20
6	12/23/2006	31.90	12/9/2005	38.70	11/1/2006	32.30	10/27/2007	31.70
7			2/21/2005	38.70				

Figure 8 Puget Sound Area



Speciation Profiles

Beginning on January 11, 2006, the State began chemical speciation monitoring at the L Street monitoring site. Monitoring data was collected on a 1:6 schedule with a total of 59 samples collected in 2006. Out of these 59 samples, three days were above 30 µg/m^3, one day was above 30 µg/m^3 and 55 days were below 20 µg/m^3. Figure 9 displays percentage of the speciated components of total $PM_{2.5}$ for the two highest days in 2006 for which the speciation data was collected. On December 19th,21.57 µg/m^3 (74%) of the total $PM_{2.5}$ was organic and elemental carbon. Sulfate and nitrate were .87 µg/m^3 (3%) and 1.86 (6%) respectively of the total PM $_{2.5}$. On December 31, 37.67 µg/m^3 of $PM_{2.5}$ (69%) was organic carbon, 2.86 µg/m^3 was elemental carbon (5%), 1.94 (4%) was sulfate and 1.54 µg/m^3 (3%) was nitrate.

Figure 9 Speciated components from the L Street Monitor on high days in 2006

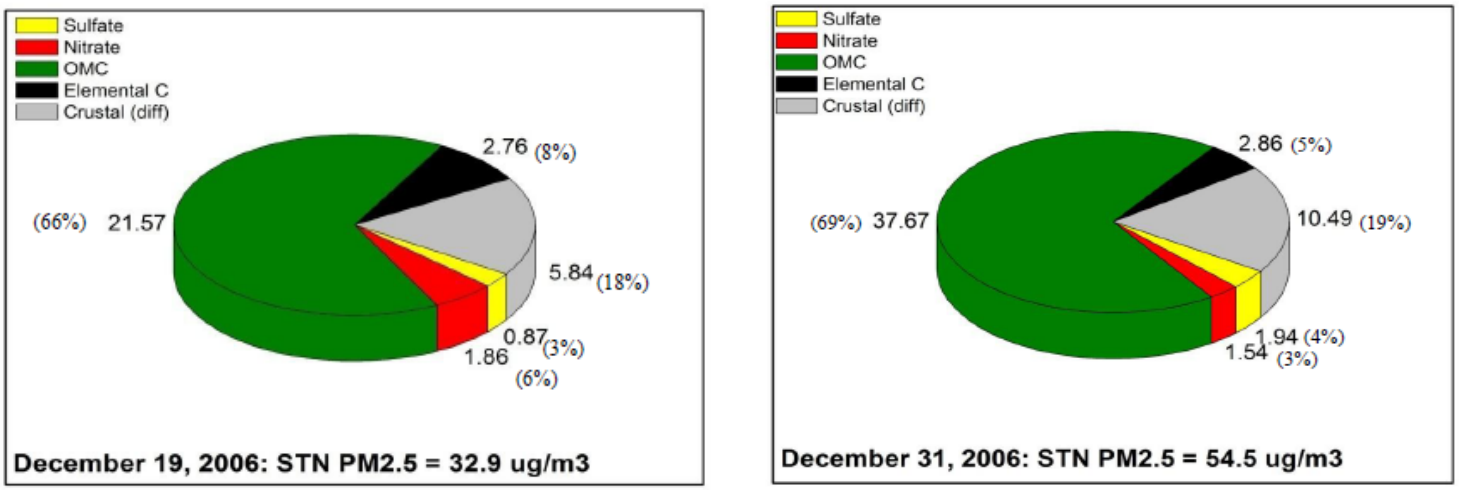
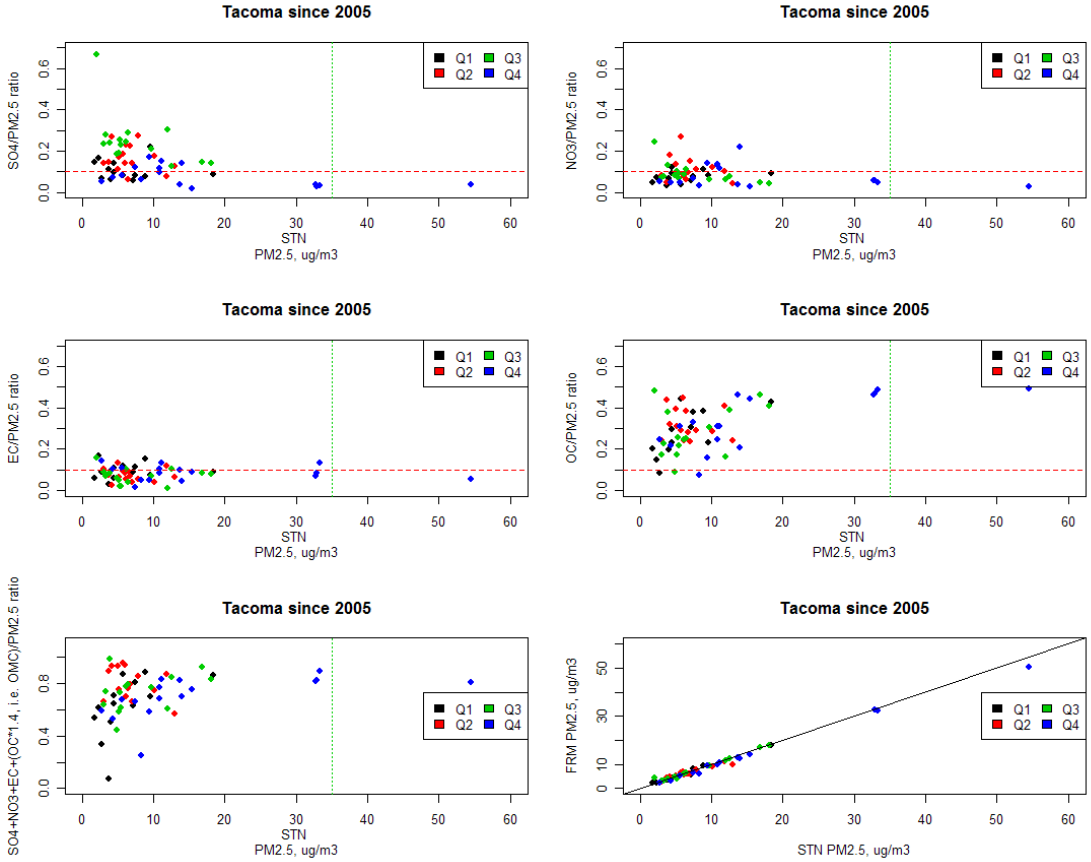


Figure 10 is a plot of $PM_{2.5}$ fraction components by season against $PM_{2.5}$ concentration. The highest concentrations of $PM_{2.5}$ occur at the L Street monitor in November and December. During the first (Jan- March winter) and fourth (Oct-Nov-Dec late fall) quarters when the exceedences occur, the ratios of sulfate and nitrate with total $PM_{2.5}$ are generally less than 0.2. The highest ratios of sulfate to nitrate (above 0.2) occur in the second (April-June) and third (June-August) quarters when $PM_{2.5}$ concentrations are less than 15 µg/m^3. The organic carbon fraction to total $PM_{2.5}$ ratio is highest of any component at all times during the year ranging from 0.2-0.5). In the fourth quarter, the OC/total PM reaches its highest levels when $PM_{2.5}$ concentrations are greater than 30 µg/m^3.

Figure 10 Seasonal PM2.5 components at the L Street monitor (Tacoma) in 2006.



Positive Matrix Factorization analysis of chemical components on Pierce County filter

EPA conducted a positive matrix factorization analysis data from the co-located speciation monitor at L Street to provide more information on sources potentially contributing to the violations at the L Street Monitor. The Tacoma 2006-07 data set included 111 data points (a sample every 6th day). EPA's PMF indicates that wood smoke contributed 60-90% of the mass on 6 out of 7 days when total $PM_{2.5}$ mass exceeded 30 $\mu g/m^3$. See Table 5.

Table 5 Positive Matrix Factorization Results for L Street monitor for days over 30 in 2006 and 2007

Date	Nitrate	Soil	Sulfate	Marine	Mobile	Smoke	% Smoke
11/1/06	1.46	4.76	0.70	0.04	5.39	23.14	65
12/19/06	2.87	1.50	0.00	0.08	2.64	22.77	76
12/31/06	0.71	1.04	2.11	0.03	0.71	43.73	90
1/12/07	5.97	0.00	0.00	0.11	2.23	28.80	78
1/30/07	5.47	4.94	1.20	0.05	3.47	26.75	64
10/27/07	3.79	1.82	1.69	0.09	4.27	18.05	61
11/8/07	5.10	4.24	4.84	0.04	5.77	9.93	33

Comparison with monitoring data from other sites in King County

Figure 12 contains seasonal $PM_{2.5}$ components from two monitors, one in an industrialized area the southern portion of King County (Duwamish) and the other in northern King County in a residential area, Lake Forest Park. The Lake Forest Park monitor is a neighborhood scale site and is representative of the Lake Forest Park general area. [10]Figure 11 shows the location of these monitors in relation to the L Street Monitor in Tacoma. The Duwamish monitor is about 30 miles north of the L Street Monitor and the Lake Forest Park Monitor is about 50 miles N of the L Street Monitor.

The Lake Forest Park monitor generally shows the same pattern observed at the Tacoma L Street monitor. Organic carbon dominates all fractions but the highest (>20 ug/m3 occur) fraction occurs in the first and third quarter. The highest fractions of sulfate and nitrate occur in the second and third quarters of the year when $PM_{2.5}$ concentrations are lowest (generally below 10). The Duwamish monitor chart shows a shift upward of sulfate/ $PM_{2.5}$ ratio for all quarters. Ratios of sulfate to total $PM_{2.5}$ are more consistent throughout the year at the Duwamish monitor and generally range between .1-.3. The data points at this monitor are more tightly clustered showing less seasonal variation then at the Lake Forest Park and Tacoma monitor.

[10] Washington State Department of Ecology 2008 Ambient Air Monitoring Network Report

Figure 11 Location of monitors in the Southern Puget Sound Area

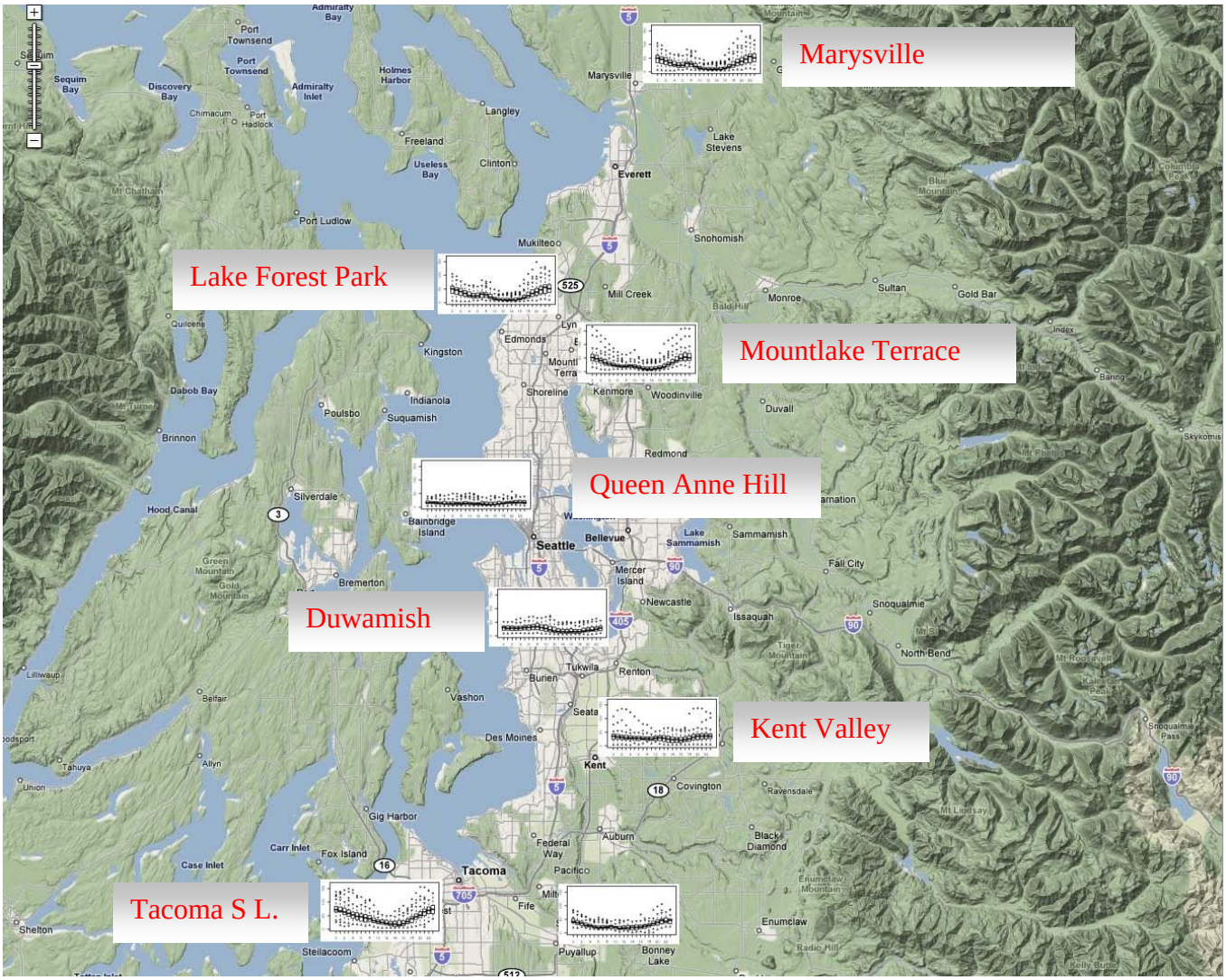
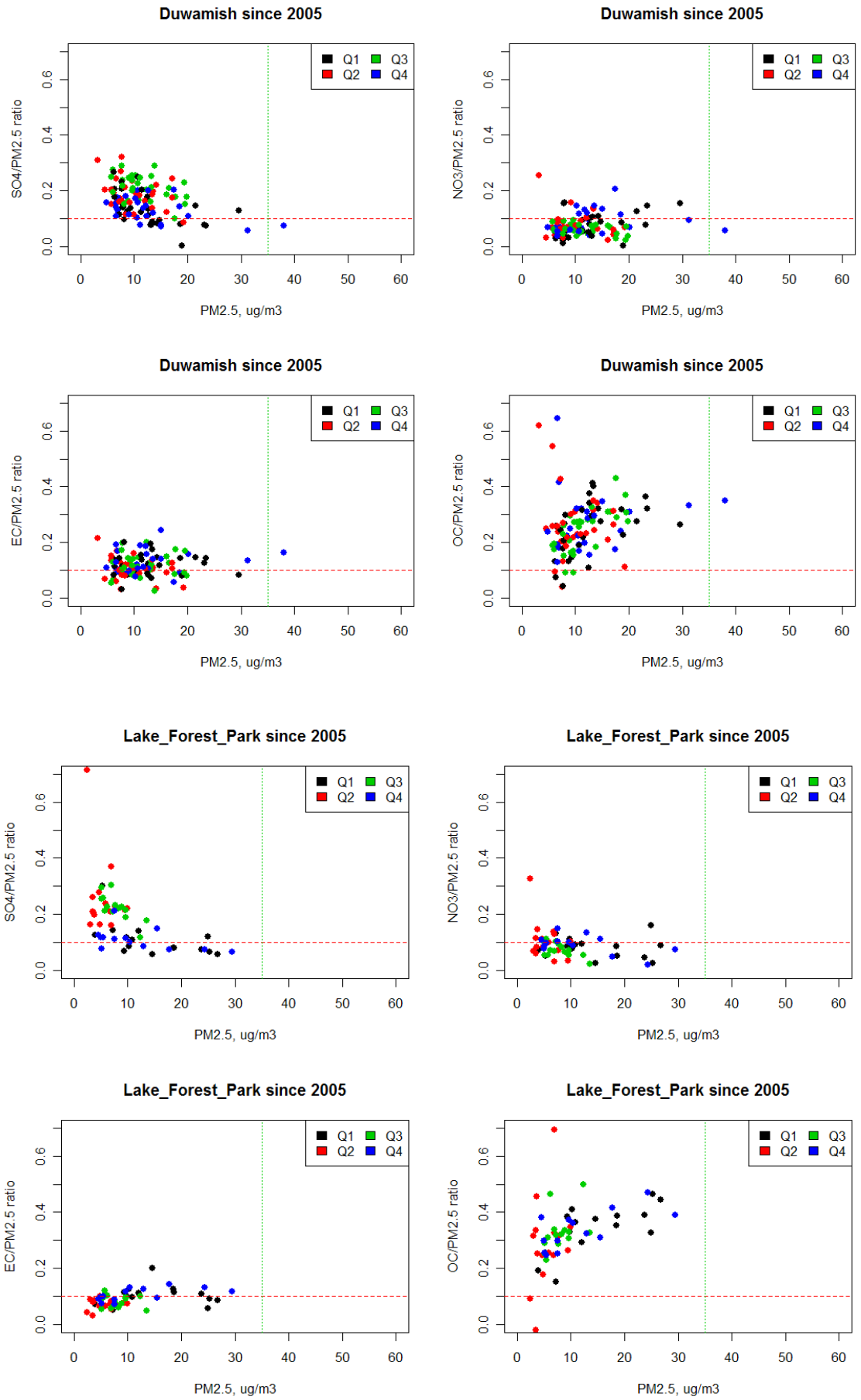


Figure 12 Seasonal $PM_{2.5}$ components at Lake Forest Park and Duwamish since 2005



Diurnal Profiles

Figures 13-15 display diurnal $PM_{2.5}$ concentrations at monitors throughout the Puget Sound Area. Figure 13 shows diurnal $PM_{2.5}$ concentrations at the South L Street monitor for the period 2001-2007. PM concentrations at the L Street monitor rise sharply beginning in the late afternoon and then peak around midnight then tail off around mid day. Survey data from Washington State indicate that this profile is related to woodstove use[11]. Surveys indicate that individuals ignite or add fresh fuel in the late afternoon or early evening and often add fuel before bedtime resulting in peak concentrations at night and lowest concentrations during the day while individuals are away from home. The diurnal profile for the Lake Forest Park monitor (Figure 14) shows a similar "V" shaped profile to the profile observed at the L Street monitor while the profile while the profile for the Duwamish monitor (Figure 15) is relatively flat. Figure 16 shows a map of the entire Puget Sound area. The "V" shaped profile is observed at monitors in the communities in Snohomish County to the North (Lynnwood, Lake Forest Park and Marysville). A flatter profile is observed at the monitors in central and southern King County; the Queen Anne monitor, the Seattle Duwamish Valley monitor and the Kent Valley monitor.

Figure 13

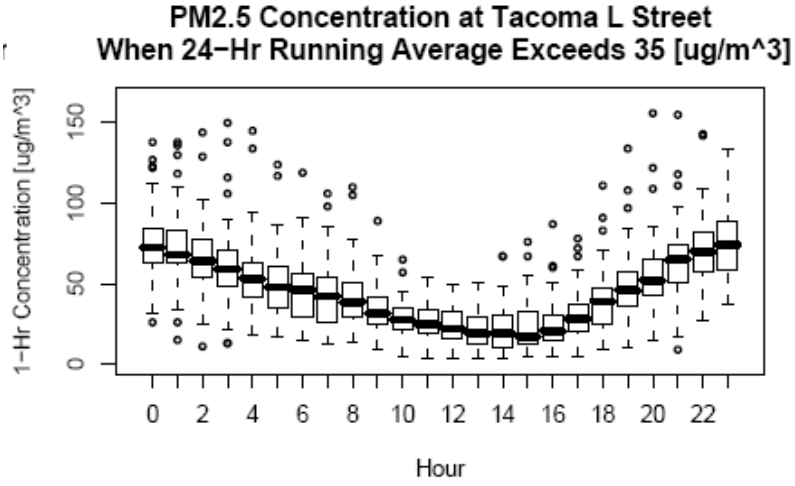
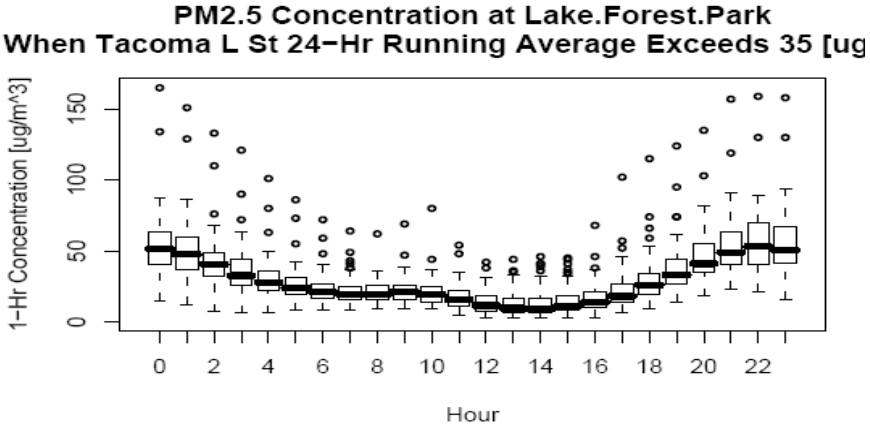


Figure 14



[11] Puget Sound Clean Air Agency 2007 woodstove use survey

Figure 15

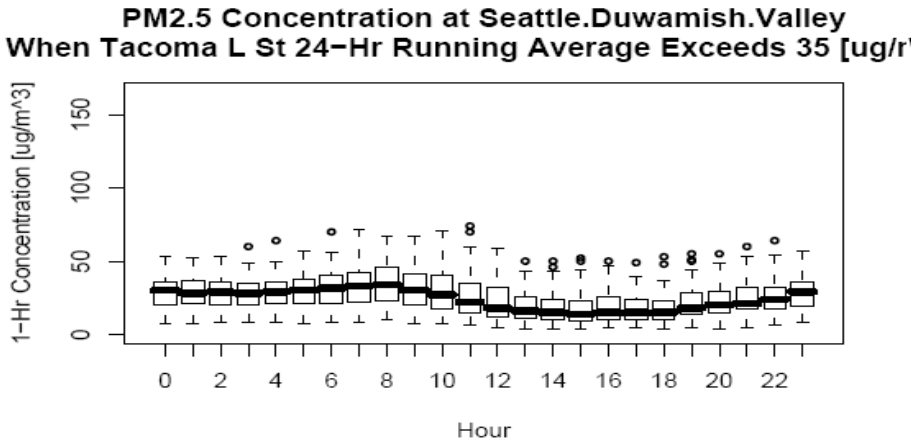


Figure 16 Diurnal profiles at monitoring sites in Pierce, King and Snohomish Counties

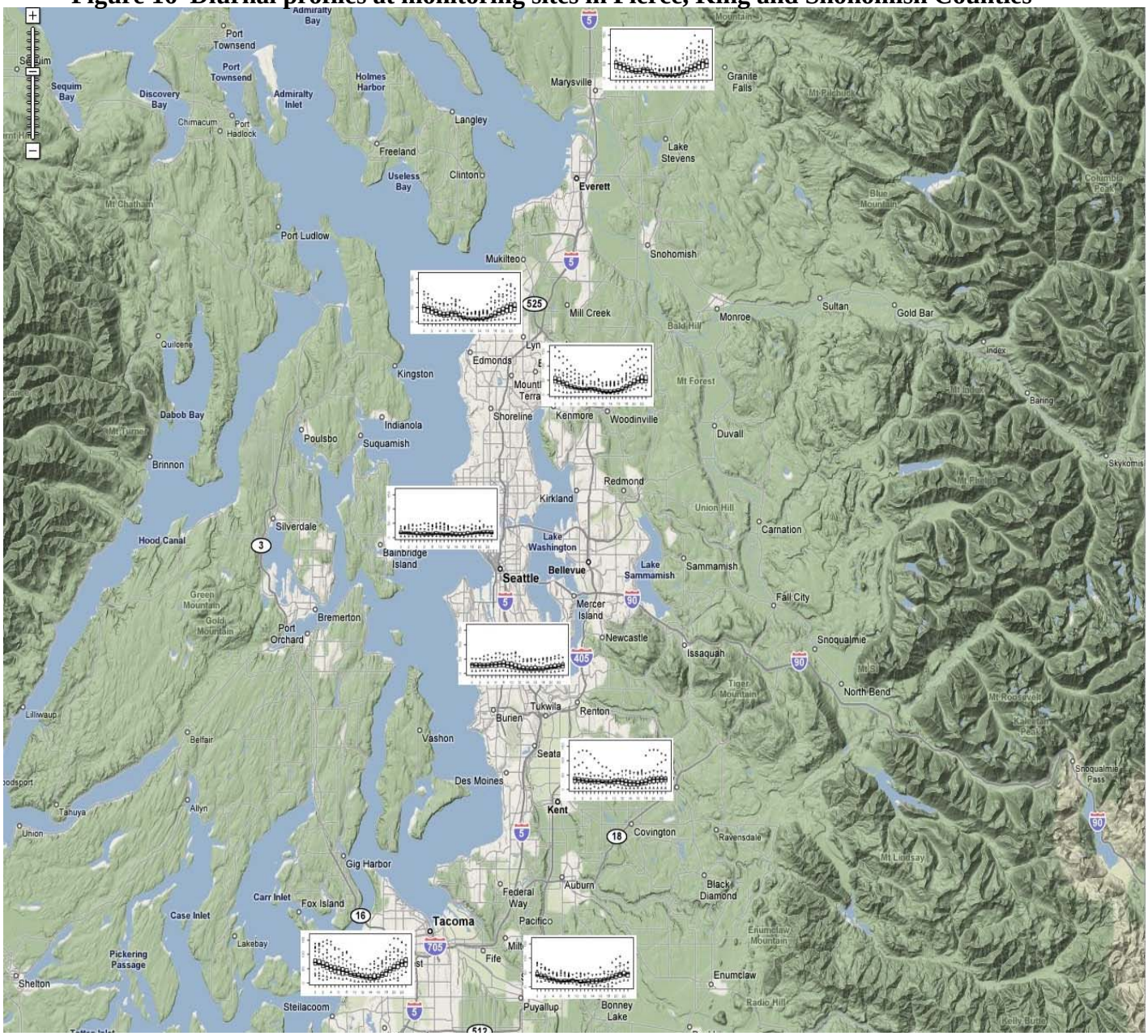
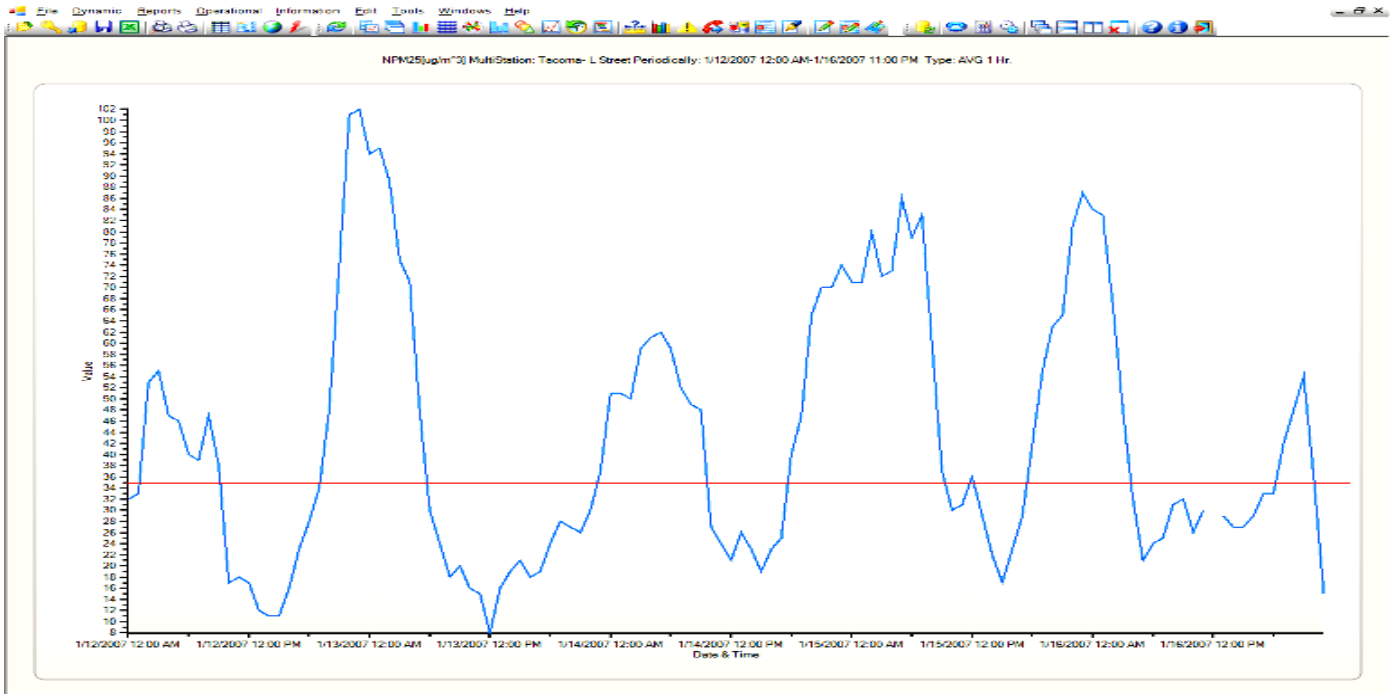


Figure 17 plots one hour averages from a co-located nephelometer at the Tacoma L Street monitor during an episode. On January 12, 2007 the 24-hour design value at the L Street monitor was 44.7ug/m3 and on January 15, 2007, the 24-hour design value at the L Street monitor was 58.6. The red line indicates the 24-hour standard, 35 µg/m^3. Peak $PM_{2.5}$ during this episode occurred around midnight on January 13 and January 15. During the day of the 12th and the 13th $PM_{2.5}$ levels dropped to less than 10 µg/m^3. The pattern repeats with nighttime highs climbing well above the standard and daytime lows.

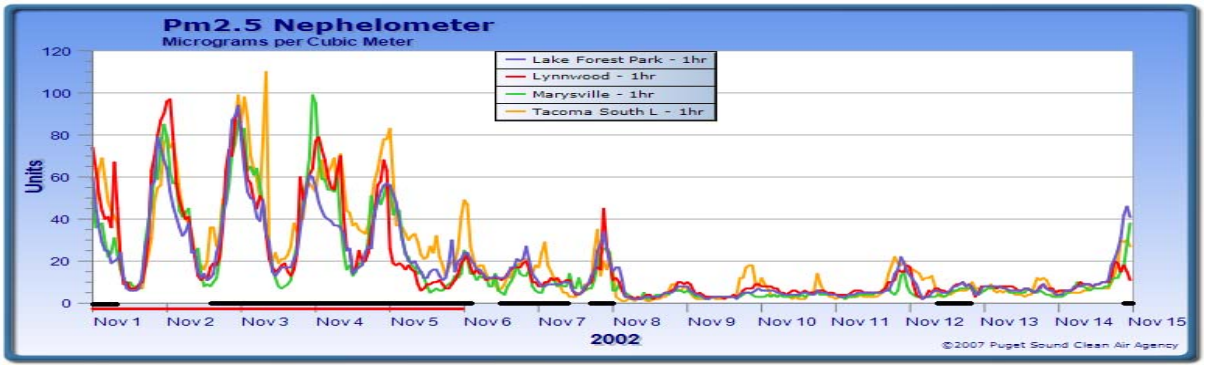
Figure 17 $PM_{2.5}$Tacoma L Street January 11-16 2007



When this pattern is observed at Tacoma, an identical pattern is noted at the other monitors throughout the Region with the V shaped profile.

WA has noted that the background concentrations in the Tacoma area would be elevated at all times due to transport from either the north or the south. However, in between events, $PM_{2.5}$ levels generally drop to very low levels (<10 µg/m^3) indicating that there is not significant transport of PM precursors from other areas (Figure 18). Days that do not drop to very low levels are days where inversions have not broken down completely. All of the monitors in Figure 16 are neighborhood scale monitors (DOE Monitoring Report)

Figure 18 simultaneous $PM_{2.5}$ peaks at Southern Puget Sound monitors



Air Quality Data Discussion/Conclusions

Concentrations of $PM_{2.5}$ throughout the Southern Puget Sound area peak at night and in the winter. The diurnal patterns are observed at neighborhood scale monitors in Pierce and King County and show peaks consistent with use of woodstoves collected through woodstove surveys. Industrial monitors in southern King County (Kent and Duwamish) between the neighborhood scale monitors to the north and the L Street monitor to the south do not exhibit strong diurnal patterns consistent with woodstove use surveys. Seasonality of sulfate and nitrate concentrations at these monitors is also less variable than the seasonality of sulfate, nitrate and organic carbon observed at the L Street monitor and other neighborhood monitors (Lake Forest Park). This suggests that there is an inconsistent influence of the regional $PM_{2.5}$ precursors (SOx, NOx) that dominate the King County 2005 emissions inventory at sites throughout the southern Puget Sound and that the variability during exceedences at individual sites may be more influenced by local (in the Tacoma area) pollution than pollution transported from neighboring counties.

Based on EPA's PMF analysis, organic carbon/woodstoves contribute 60-90% of $PM_{2.5}$ to the exceedences at the Tacoma L Street Monitor. Contributions of regional $PM_{2.5}$ precursors (SOx and NOx) that dominate the King County emissions inventory contribute less than 20-30% of the total to the Tacoma monitor. Based on speciation monitoring at the L Street monitoring site, organic carbon and elemental carbon (species that are associated with burning of wood) contribute over 70% of the $PM_{2.5}$ concentration on the highest days in 2006 and sulfate and nitrate contribute less than 10% combined of the total $PM_{2.5}$ concentration on these days.

Based on speciation monitoring, emissions from King County (over 75,000 tpy NOx and 7500 tpy SOx combined) as well as the other counties in the CMSA potentially contribute less than 10 % of total $PM_{2.5}$ concentrations on high days at the South L Street Monitor. This information along with the information discussed in the other factors, particularly factors 6 and 7 (meteorology and topography) indicates that the State's boundary which generally contains sources within the Tacoma UGA and does not include King County is sufficiently large enough to include sources contributing to the violations at the South L Street monitor.

Factor 3: Population density and degree of urbanization (including commercial development)

Table 6 shows the 2005 population for each county in the Seattle-Tacoma-Olympia area being evaluated, as well as the population density for each County in that area. Population data give an

indication of whether it is likely that population-based emissions might contribute to violations of the 24-hour $PM_{2.5}$ standards. King County, Pierce County and Snohomish County contain large cities with large populations. Most of the areas in between are urban or suburban. The City of Everett is the largest city in Snohomish County. King County has the highest population (1.73 million) and the highest population density with 824 people/square mile. Pierce County has the next highest population at 753,209 with the third highest population density in the Seattle-Tacoma-Olympia area. Snohomish County has the third highest population in the area. King County and Pierce Counties have the highest CES scores at 100 and 60 respectively. The CES Score for Snohomish County is much lower at 13.

Table 6 Population in the Puget Sound area

County	State Recommended Nonattainment?	2005 Population	2005 Population Density (people/sq mi)	Percent Population Change (2000-05)
King	No	1,799,119	824	3
Pierce	Yes	753,209	445	7
Thurston	No	228,881	305	10
Kitsap	No	241,525	583	4
Snohomish	No	655,564	312	8
Skagit	No	113,181	65	9
Island	No	79,983	377	11
Mason	No	54,169	54	9

The State addressed population density in its nine factor analysis. Figure 19 shows population density for the city of Tacoma and surrounding Pierce County areas, at the 2000 census block group level.i Highest population density occurs inside of the CUGA in the vicinity of the L Street monitor, and along the eastern shore of the Puget Sound to the north of the Port of Tacoma. Population density generally decreases to the south and the east of the Port of Tacoma and the CUGA. Figure 20 shows the population of the recommended nonattainment area and the surrounding portions of Pierce County. Generally, the areas with the highest population density in Pierce County are contained within the boundary of the State's recommended nonattainment area.

EPA is concluding based on population density information for the Tacoma area that shows that population is concentrated in the CUGA as well as the air quality data we reviewed above and the additional factors that we review below that indicate that local sources cause the violations at the South L Street monitor, that the State's boundary includes populations/potential sources in the Tacoma area contributing to the violations at the L Street monitor.

Figure 19

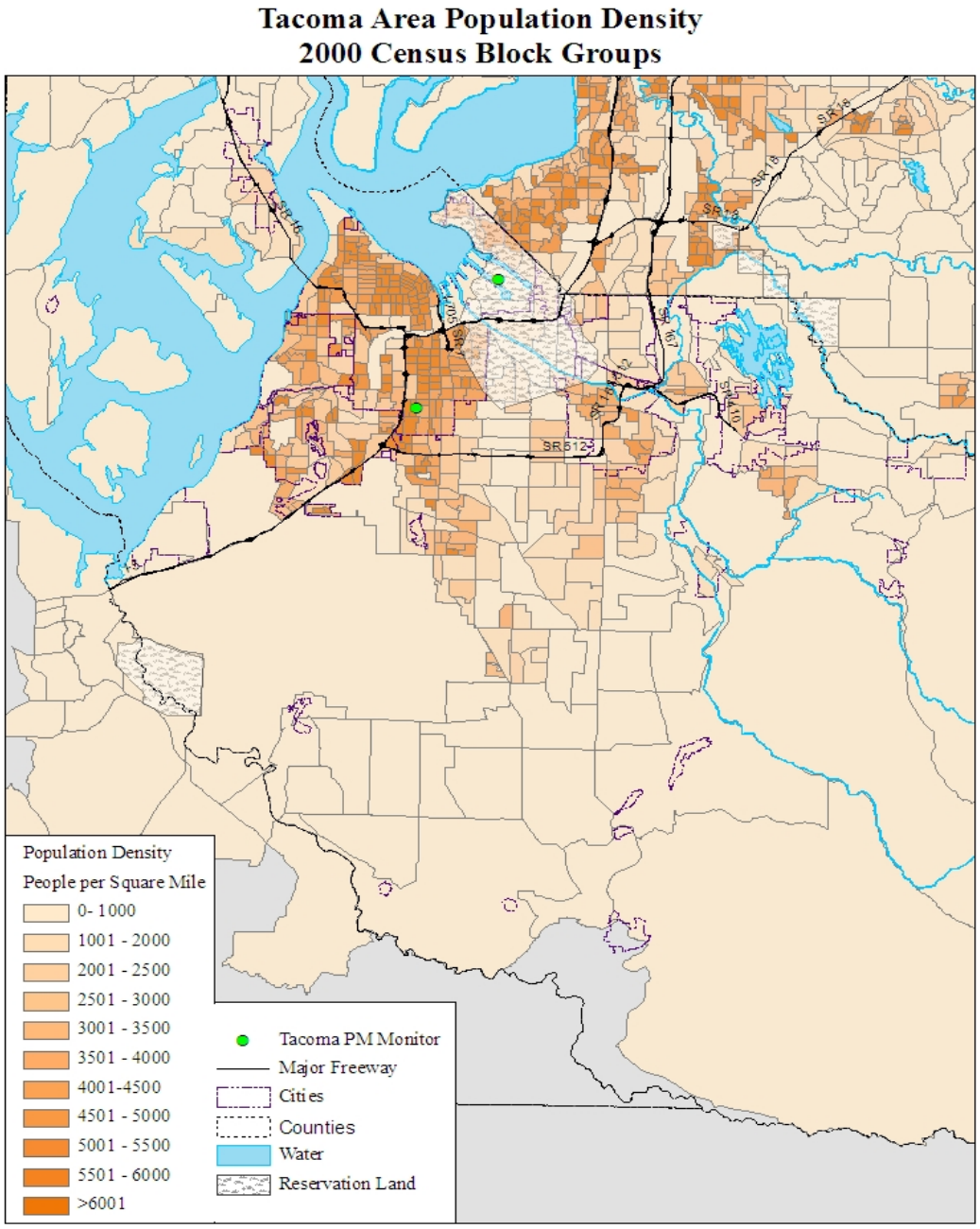
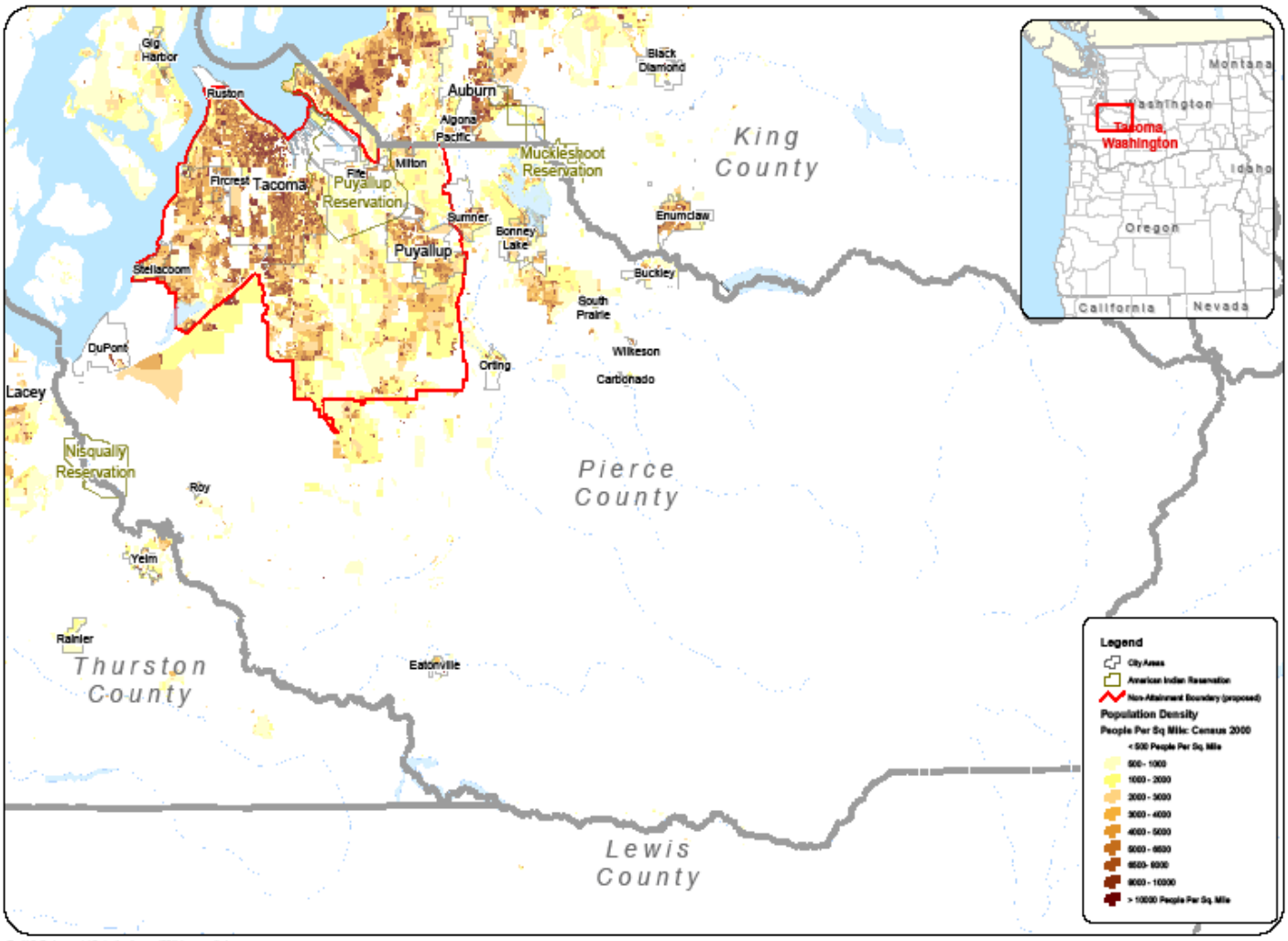

Tacoma Area Population Density
2000 Census Block Groups
SR 16
SR 18
SR 167
SR 512
Population Density
People per Square Mile
0- 1000
1001 - 2000
2001 - 2500
2501 - 3000
3001 - 3500
3501 - 4000
4001-4500
4501 - 5000
5001 - 5500
5501 - 6000
>6001
Tacoma PM Monitor
Major Freeway
Cities
Counties
Water
Reservation Land

Figure 20 Pierce County Population Density with recommended nonattainment area boundary



The U.S. Environmental Protection Agency (EPA) has compiled this computer representation from data or information sources that may not have been verified by the EPA. This data is offered here as a general representation only, and is not to be re-used without verification by an independent professional qualified to verify such data or information. The EPA does not guarantee the accuracy, completeness, or timeliness of the information shown, and shall not be liable for any loss or injury resulting from reliance upon the information shown.

PM 2.5 Non-Attainment Area
Tacoma Washington Area
shown with Population Density

Factor 4: Traffic and commuting patterns

This factor considers the number of commuters in each county who drive to another county within the Seattle-Tacoma-Olympia area, the percent of total commuters in each county who commute to other counties within the Seattle-Tacoma-Olympia area, as well as the total Vehicle Miles Traveled (VMT) for each county in thousands of miles (see Table 4). A county with numerous commuters is generally an integral part of an urban area and could be an appropriate county for implementing mobile-source emission control strategies, thus warranting inclusion in the nonattainment area. [12]

Table 7 Traffic and commuting patterns in the Puget Sound area

County	State recommended Nonattainment?	Vehicle Miles Traveled in 2005 (millions annually)	Percent VMT Growth (1996-2005)	Number commuting into any violating counties	Percent commuting into any violating counties	Number commuting into statistical area	Percent commuting into statistical area
King	No	16,806	10	18,560	2	903,520	99
Pierce	Yes (P)	6,247	13	228,280	70	319,830	99
Thurston	No	2,146	7	14,350	14	96,030	95
Kitsap	No	1,633	(10)	5,120	5	104,640	98
Snohomish	No	5,225	9	1,240	0	296,750	99
Skagit	No	1,185	35	140	0	42,950	95
Island	No	397	(5)	50	0	31,510	97
Mason	No	438	13	860	5	18,310	97

The listing of Counties on Table 7 reflects a ranking based on the number of people commuting to other Counties. King County VMT in 2005 was the highest in the area with historic VMT growth of 10%. 2% of commuters from King County commute into Pierce County, the County with the violating monitor. 70% of commuters in Pierce County remain within Pierce County. VMT growth in Pierce County was 13% between 1996-2005. Both King County and Pierce County contain major Ports (the Port of Tacoma and the Port of Seattle), so there are increased levels of diesel traffic to move goods at the Ports. Interstate 5 is a major N-S corridor along the West Coast of the United States with significant diesel truck traffic.

Washington looked at Pierce County VMT growth in its nine factors analysis. Washington obtained information from the Puget Sound Regional Council's recently released draft Vision 2040ii transportation plan for the region, incorporating known travel improvements and the preferred growth options emphasizing core centers for development. The output from

[12] Note: The 2005 VMT data used for table 5 and 6 of the 9-factor analysis has been derived using methodology similar to that described in "Documentation for the final 2002 Mobile National Emissions Inventory, Version 3, September 2007, prepared for the Emission Inventory Group, U.S. EPA. This document may be found at:
atftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/mobile/2002_mobile_nei_version_3_report_092807.pdf
The 2005 VMT data were taken from documentation which is still draft, but which should be released in 2008.

PSRC's transportation demand model provides some travel growth estimates for the Pierce County area and is shown in Table 8.[13]

Table 8 Pierce County Daily Travel Measures by Category in 2000 and 2040iii

Daily Category of Travel	2000 Reference Data	2040	Units
Work Person Trips	293,886	535,330	Trips
Non-work Person Trips	1,757,784	3,183,447	Trips
Freeways Vehicle Miles Traveled	6,288,090	8,870,622	VMT
Arterials/Local Streets VMT	10,650,108	16,299,840	VMT
Freeways Vehicle Hours Traveled	129,929	191,106	VHT
Arterials/Local Streets VHT	363,175	617,769	VHT

Even with planned road and transit improvements, work and non-work person trips are estimated to increase by over 80%, while vehicle miles traveled and vehicle hours traveled are estimated to increase by 40% and 60%, respectively, from 2000 to 2040. However, based on EPA's analysis of air quality data, mobile emissions likely do not contribute more than 5-10% of total $PM_{2.5}$ at the L Street monitor on high days so the State's inclusion of information on growth in Pierce County was not an important consideration in our decision. The State's boundary includes potential mobile source related contributions in the Tacoma area including the Port of Tacoma as well as sections of Interstate 5 and State Highway 99 and EPA has concluded that the inclusion of these areas is sufficient to capture potential contributions from these sources.

Factor 5: Growth rates and patterns

This factor looks at expected population and VMT for Counties in the Seattle-Tacoma-Olympia area from 2000 to 2005, as well as patterns of population and VMT growth. A county with rapid population or VMT growth is generally an integral part of an urban area and could be an appropriate county for implementing mobile-source and other emission-control strategies, thus warranting inclusion in the nonattainment area.

Table 9 below shows population, population growth, VMT and VMT growth for counties that are included in the Seattle-Tacoma-Olympia area. Counties are listed in descending order based on VMT growth between 2000 and 2005.

[13] Puget Sound Regional Council. Draft Vision 2040 Supplemental Draft Environmental Impact Statement (SDEIS). July 2007. http://www.psrc.org/projects/vision/pubs/sdeis/index.htm and http://www.psrc.org/tpbgrowthandtrans2.pdf.
Puget Sound Regional Council. Vision 2020 Update DEIS. Transportation Demand Model Output Data. Appendix D-5, pages D-18 to D-29. http://www.psrc.org/projects/vision/deis/appd.pdf.

Table 9 Population and VMT Growth and Percent Change

County	2005 Population	Percent Population Change (2000-05)	Percent VMT Growth (1996-2005)
King, WA	1,799,119	3	10
Pierce, WA	753,209	7	13
Thurston, WA	228,881	10	7
Kitsap, WA	241,525	4	(10)
Snohomish, WA	655,564	8	9
Skagit, WA	113,181	9	35
Island, WA	79,983	11	(5)
Mason,WA	54,169	9	13

King County has the highest population but had the lowest population growth rate from 2000-2005 (3%). Pierce County growth was double that of King County for the same time period. Thurston County and Island Counties experienced the highest growth in population from 2000-2005 at 10 and 11% respectively. However, the population of both of these areas is 2 orders of magnitude lower than that of King County and 3-8 times lower than that of Pierce County. As stated above, based on air quality data, mobile emissions likely do not contribute more than 5-10% of total $PM_{2.5}$ to L Street monitor $PM_{2.5}$ concentrations on high days. The State's boundary recommendation includes most of the Pierce County Growth area including the Port of Tacoma.

Factor 6: Meteorology (weather/transport patterns)

For this factor, EPA considered data from National Weather Service instruments in the area. Wind direction and wind speed data for 2004-2006 were analyzed, with an emphasis on "high $PM_{2.5}$ days" for each of two seasons (an October-April "cold" season and a May-September "warm" season). These high days are defined as days where any FRM or FEM air quality monitors had 24-hour $PM_{2.5}$ concentrations above 95% on a frequency distribution curve of $PM_{2.5}$ 24-hour values.

For each air quality monitoring site, EPA developed a "pollution rose" to understand the prevailing wind direction and wind speed on the days with highest fine particle concentrations. The figure identifies 24-hour PM2.5 values by color; days exceeding 35 ug/m3 are denoted with a red or black icon. A dot indicates the day occurred in the warm season; a triangle indicates the day occurred in the cool season. The center of the figure indicates the location of the air quality monitoring site, and the location of the icon in relation to the center indicates the direction from which the wind was blowing on that day. An icon that is close to the center indicates a low average wind speed on that day. Higher wind speeds are indicated when the icon is further away from the center.

Figure 21 is a pollution rose from instrumentation at the Seattle Tacoma International Airport (Sea-Tac), a site which is located about 25 miles north of the violating monitor. Based on this pollution rose, the average prevailing surface wind direction for high $PM_{2.5}$ days in Pierce County is from the northeast, or the southeast of the violating monitor.

However, given terrain influence and complex meteorology in the area, EPA created a pollution rose using local data from the Puget Sound Clean Air Agency's meteorological

instrumentation co-located with the South L Street monitor. Figure 22 is a pollution rose created with data from this co-located meteorological station. Based on this pollution rose, during high days at the Tacoma L Street monitor, wind speeds are less than 4 miles per hour and there is no average prevailing surface wind direction for high $PM_{2.5}$ days.

Figure 21 Pollution rose for Pierce County WA (Source: Sea-Tac Airport)

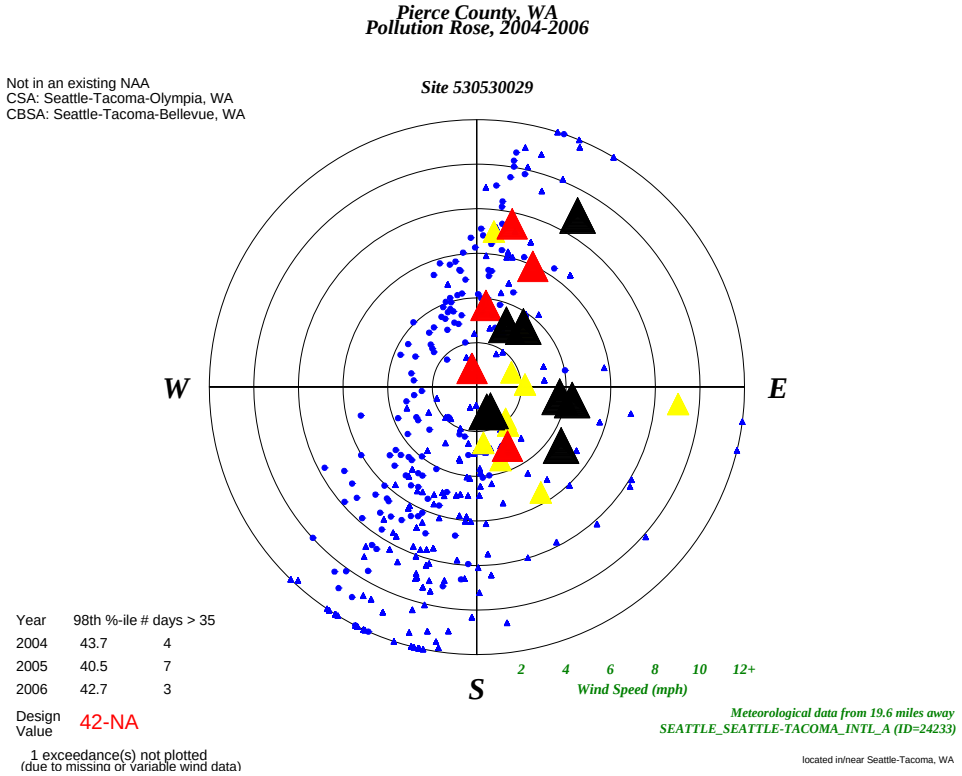
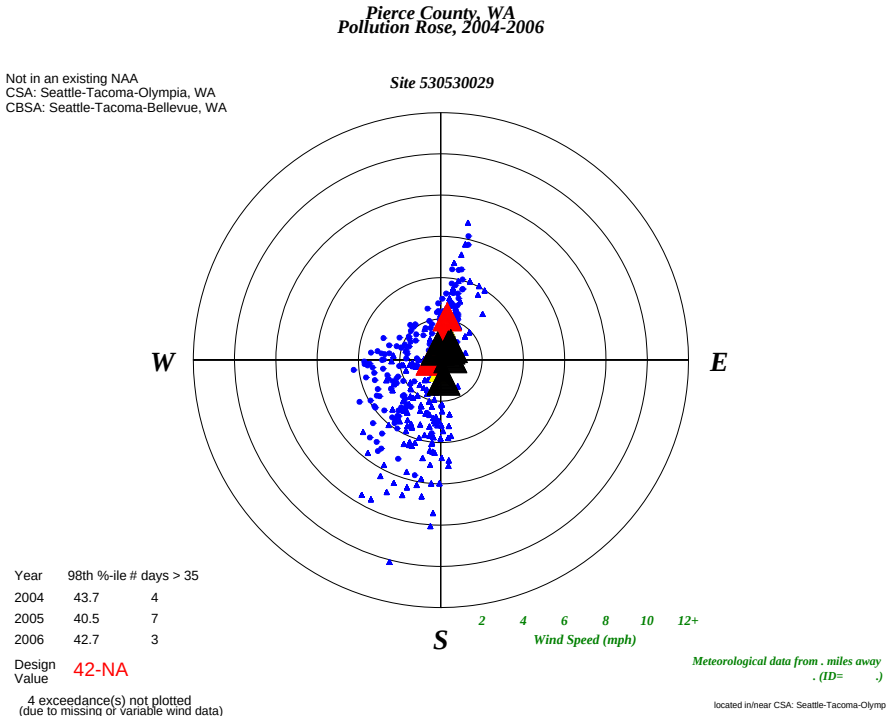


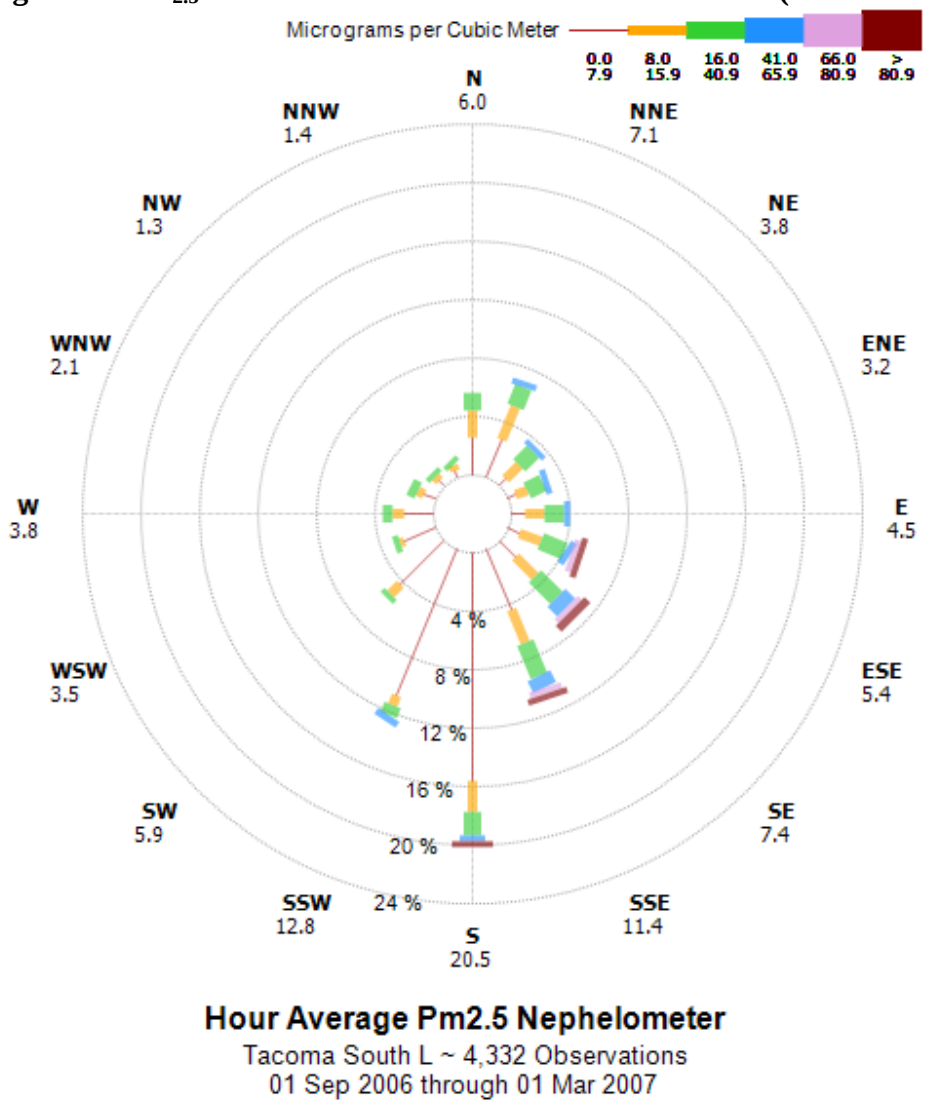
Figure 22 Pollution rose for Pierce County WA (Source: South L Street Met Station)



We note that the meteorology factor is also considered in each county's Contributing Emissions Score because the method for deriving this metric included an analysis of trajectories of air masses for high $PM_{2.5}$ days. The data used to create the CES for the Tacoma monitor was from the Sea-Tac Airport. Given the complex meteorology and topography of the area, and given that EPA's pollution roses for the co-located meteorological site and the site at Sea-Tac Airport show very different wind patterns, EPA considered the data from the co-located meteorological site in lieu of the CES for the meteorological factor analysis for the Tacoma area**.**

The State's nine-factors analysis also contained wind rose data collected from a meteorological station co-located with the L Street monitor. Figures 23 and 24 are wind roses for the area from the State's nine factors analysis for the winter season and for the summer season.

Figure 23 $PM_{2.5}$ Pollution rose for South L Street monitor (Winter Months)

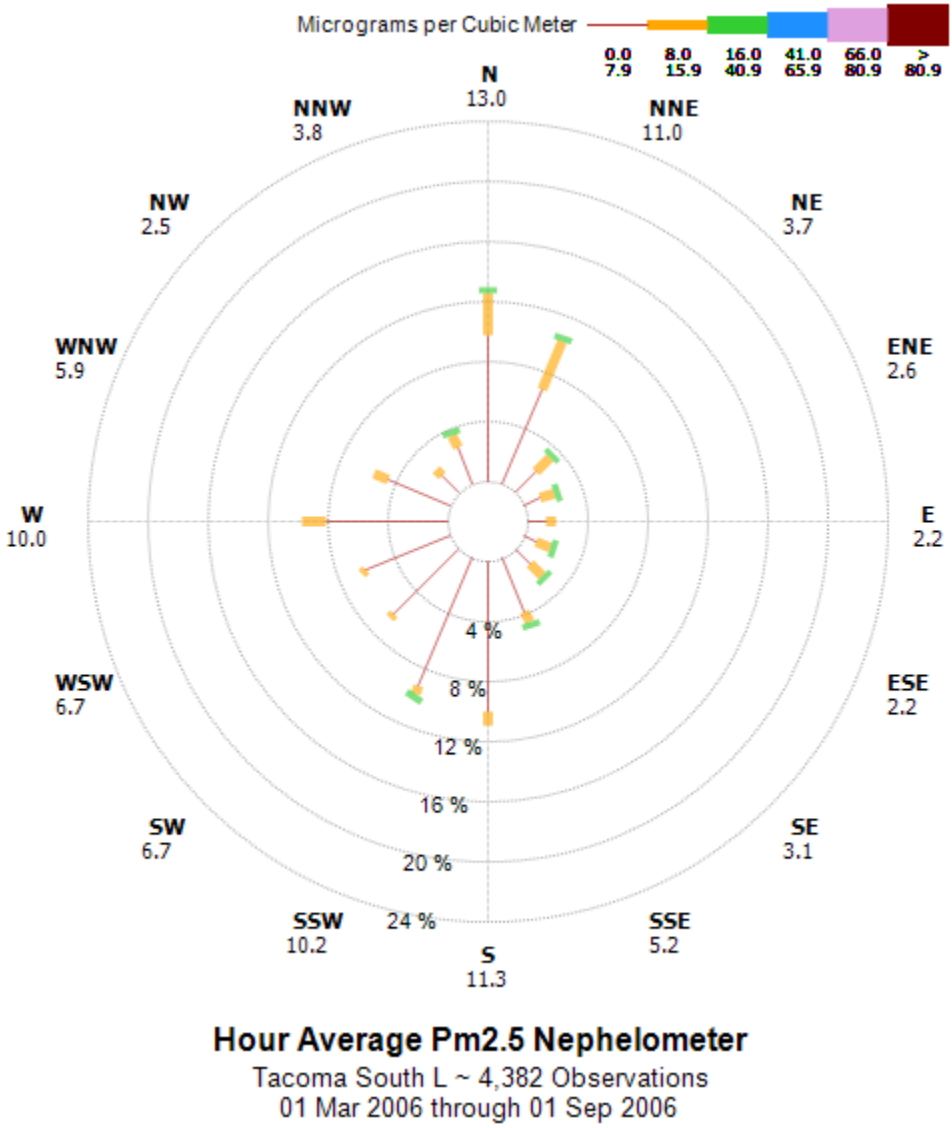


The State's analysis indicated that meteorology plays a critical role in $PM_{2.5}$ concentrations at the South L Tacoma monitor and drives a consistent seasonal relationship to $PM_{2.5}$ concentrations.

The State noted in its submittal that elevated levels of $PM_{2.5}$ occur only during the fall and winter seasons, when regional air stagnations interrupt westerly wind flows and strong subsidence temperature inversions trap pollution levels. During these seasons, colder mean temperatures stimulate the use of residential heating devices. The winter month pollution rose in Figure 23 indicates the highest contributions of $PM_{2.5}$ during the winter months when winds are predominantly from the south/southeast.

Figure 24 is a pollution rose for the period of the spring of 2006 through the fall of 2006. This spring-summer month wind rose indicates the highest contributions of $PM_{2.5}$ during the spring-summer months occur when winds are predominantly from the north and northeast.

Figure 24 $PM_{2.5}$ Concentrations and wind direction at violating monitor, summer months

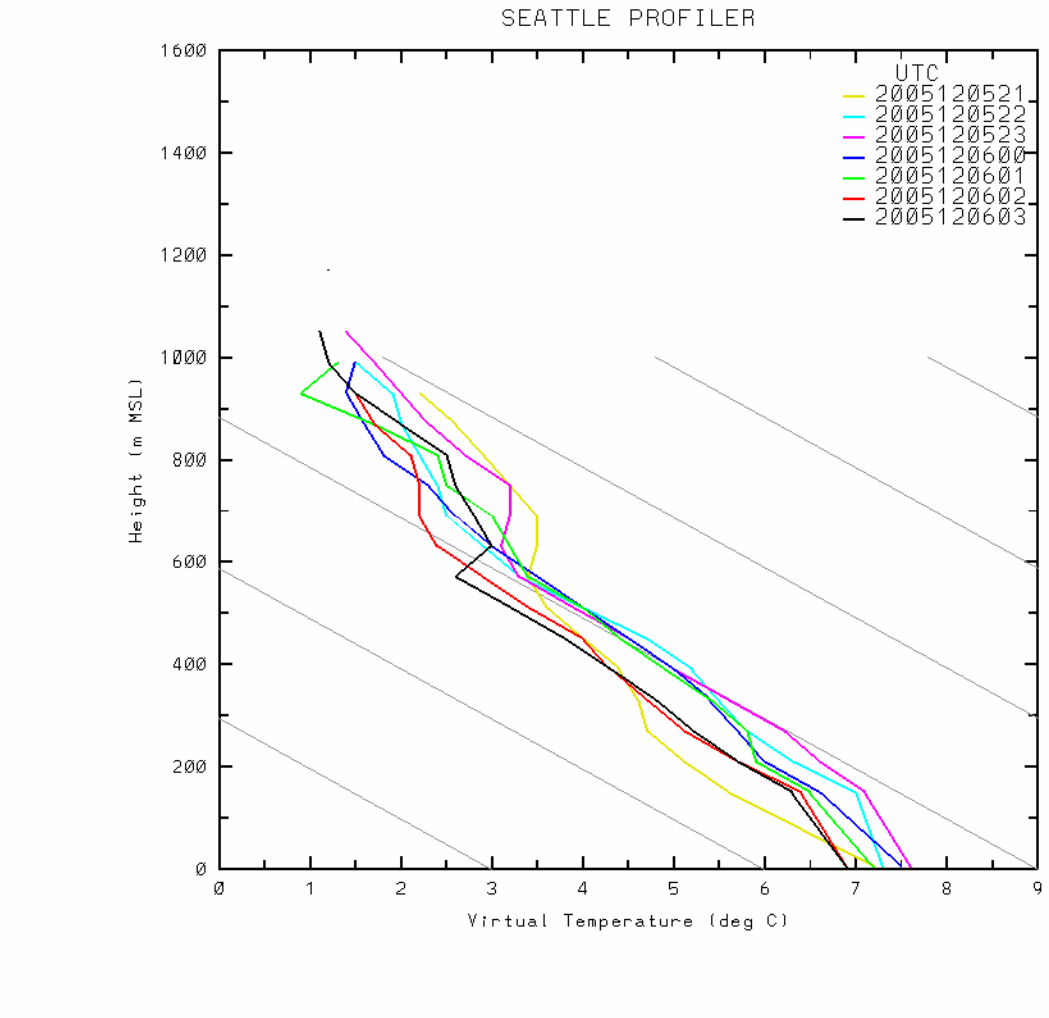


The State of Washington's nine factors analysis described the weather pattern influencing the Tacoma area as typical of the mild Pacific Coast climate, which is modified by the Cascade Mountains to the east and to a lesser extent, by the Olympic Mountains to the Northwest. The area's climate is characterized by mild temperatures, a pronounced though not sharply defined rainy season, and considerable cloudiness, particularly during the winter months.

These three factors are heavily influenced by persistent Pacific onshore wind patterns and storm tracks. These features intensify in the late fall and diminish in the late spring. Periodically, the cleansing westerly flows are diverted away from the area and replaced by high pressure systems. During these periods, wind flows become offshore and the area's most extreme temperatures are observed. Temperature inversions of varying intensity form routinely during these patterns. These inversions change the mixing layer depth dramatically but generally lower the layer to less than 800m. During persistent winter stagnations, mixing heights less than 300m are frequently observed. The eastward movement of this synoptic pattern is variable. When stationary or slow moving, the area stagnates allowing air quality levels to decline. Typically these conditions occur when the duration of stable conditions extends beyond three days. This occurs approximately 3-4 times during the fall and winter seasons.

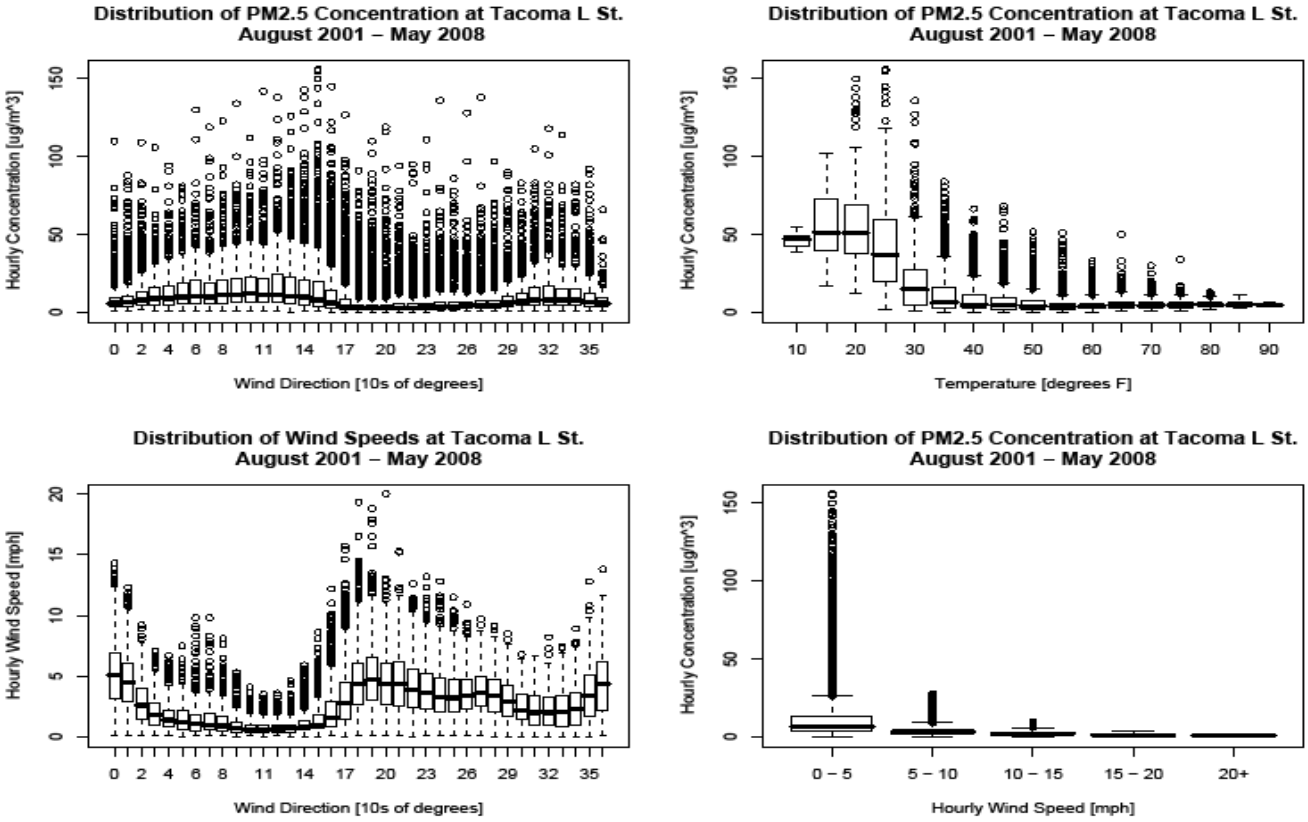
Puget Sound Clean Air Agency in coordination with the National Weather Service office in Seattle operates a radar wind profiler at the Sand Point Laboratory of the NOAA. Figure 25 displays the mixing height during the typical stagnation event in the Puget Sound area. Mixing heights at 600 meters or less are observed during the typical $PM_{2.5}$ event.

Figure 25 Typical inversion profile for the Southern Puget Sound Region stagnation.



The area surrounding the South L St. monitoring station is influenced by the same meteorological conditions. Figure 26 plots wind direction against hourly concentrations, wind direction against wind speed, wind speed against hourly concentrations and temperature against hourly concentrations. The highest hourly concentrations are observed when temperatures are the lowest, and are observed when wind speeds are less than 5 mph. The meteorological conditions during the 2001-2007 temporary monitoring study were typical of the area's fall and winter seasons including periods influenced by moderate temperatures, strong Pacific storms, and air stagnations. Highest hourly concentrations occur at temperatures below freezing, highest concentrations associated with winds below 5 mph and often times less than 1 mph, the highest winds from the south and the southwest quadrant correspond to lowest $PM_{2.5}$ concentrations and the lowest winds from the east to southeast correspond to highest $PM_{2.5}$ concentrations. These low wind-speeds indicate transport from King County and other areas is not occurring during the periods of the highest concentrations and that the boundary submitted by the State is sufficiently large enough to include local sources of emissions that contribute to the violations at the South L Street monitor.

Figure 26 Hourly concentrations and wind speed at Tacoma L Street Monitor from 2001-2008



Factor 7: Geography/topography (mountain ranges or other air basin boundaries)

Tacoma lies east of the Cascade Mountains, which act as a topographical barrier to pollution flow from east to west. The Olympic Mountains to the west result also influence pollution flow. Air flow from the west typically flows around the Olympics and converges in the Seattle Tacoma area. See Figure 27. As stated above, this flow is interrupted during periods of stagnation during which low lying topographic features can influence the flow of pollution. Local topography also has an influence on pollutant transport. Figure 28 displays topography in the Tacoma area. The Port area of Tacoma is surrounded by bowl like topography. Beyond the Port to the north, hills rise to 400 ft creating a topographical barrier between the north and the south. The northernmost boundary occurs at the foot of this bluff along SR 509. Based on our review of topographical information, as well as air quality data which shows that local sources contribute to the violations at the South L Street monitor and meteorology data which indicates that wind speeds are less than 5 mph during exceedences, EPA is concluding that the State's boundary and particularly the northernmost boundary which follows the topographical bluff along SR 509 is sufficiently large enough to capture the sources in the area contributing to the violations at the South L Street monitor.

Figure 27 Seattle-Tacoma-Olympia area topography

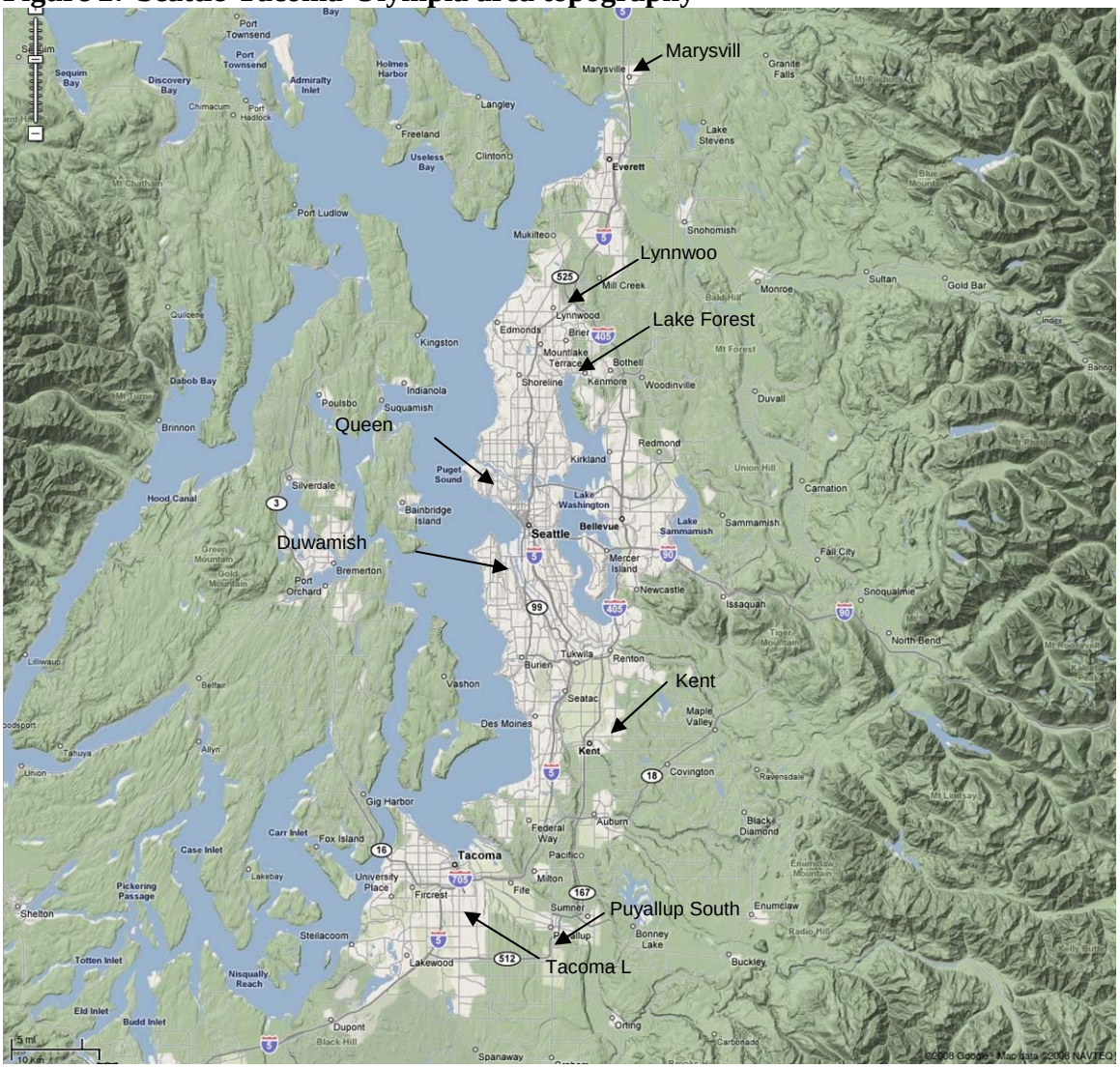
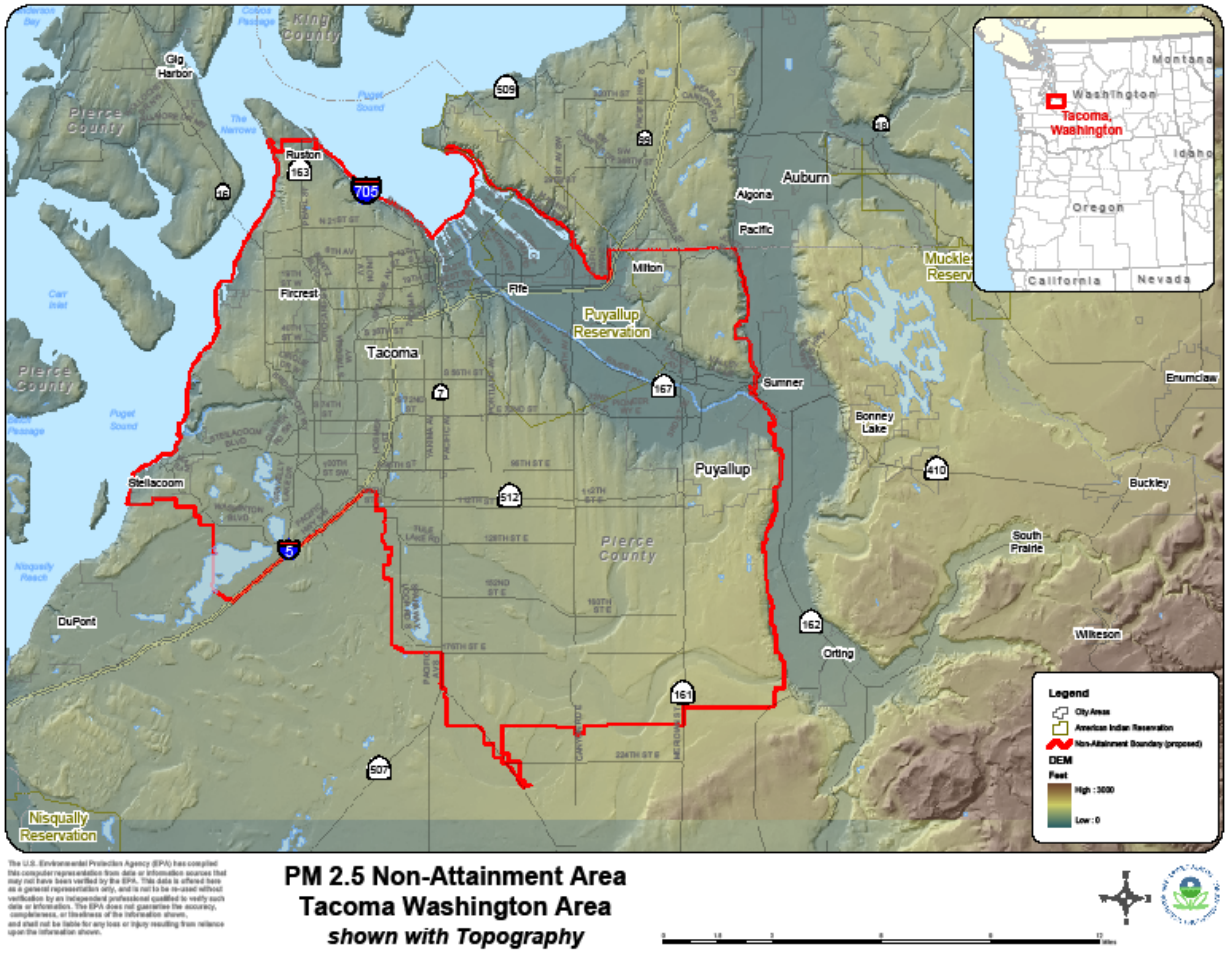


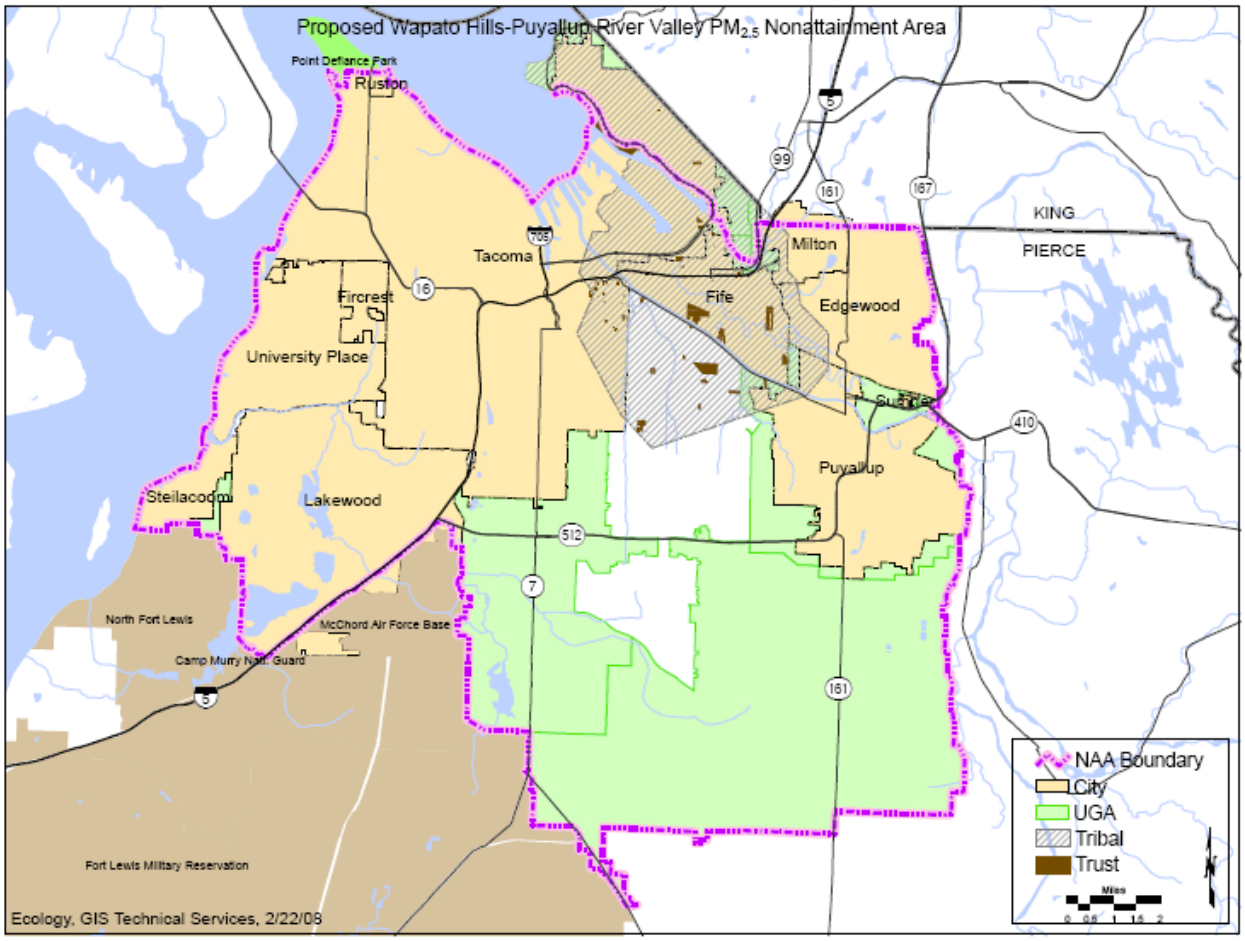
Figure 28 Tacoma area topography



Factor 8: Jurisdictional boundaries

The analysis of jurisdictional boundaries considered the planning and organizational structure of the Seattle-Tacoma-Olympia area to determine if the implementation of controls in a potential nonattainment area can be carried out in a cohesive manner. The boundary of King and Pierce County is less than 5 miles north of the Port of Tacoma and runs east-west along the top of the bluff north of the Port of Tacoma. Puyallup Tribal trust land parcels are located within 5-10 miles to the north and northwest of the L Street monitor and are contained within the boundary of the nonattainment area recommended by the State. To the south of the L Street monitor, Fort Lewis and the McChord Airforce base form a jurisdictional boundary (federal/state) land. (Figure 29).

Figure 29 Tacoma area nonattainment area and jurisdictional boundaries of surrounding areas



The State addressed comments on emissions from the McChord Airforce base during their public comment period. They found emissions to be less than 1.5 tons in 2006. On base housing units include only 11 wood burning fireplaces and no woodstoves. Additionally, emissions at Fort Lewis are 5 tons per year or less than .2% of the total $PM_{2.5}$ for the PM2.5 inventory for Pierce County

Tribal land is within the jurisdiction of EPA. As stated above, the State's recommended nonattainment area does not include trust lands within the boundary of the Puyallup Indian Reservation. Congress explicitly provided state and local agencies authority over activities only on non-trust lands within the Puyallup Indian Reservation under the Puyallup Tribe of Indians Settlement Act of 1989, 25 U.S.C. 1773. Trust lands within the boundary of the Puyallup Reservation are the responsibility of EPA and the Tribe. EPA will be making a separate designation for Puyallup tribal trust lands.

Given the low potential contributions of the McChord Airforce Base, the Fort Lewis Military Base, and King County to the north (based on the air quality, topography and meteorology data discussed above), EPA is concluding that the State's boundary which follows jurisdictional boundaries to the south and north roughly along the Pierce-King County line and along the boundaries of the military bases, appropriately considers jurisdictional boundaries as well as includes sources contributing to the violations at the South L Street monitor.

Factor 9: Level of control of emission sources

This factor considers emission controls currently implemented in the Seattle Tacoma Olympia area. The emission estimates on Table 1 (under Factor 1) include any control strategies implemented by the States in the Seattle Tacoma Olympia area before 2005 that may influence emissions of any component of $PM_{2.5}$ emissions (i.e., total carbon, SO_2, NOx, and crustal $PM_{2.5}$).

The State addressed the level of control of emission sources in the Seattle-Tacoma-Olympia area in their nine factors analysis noting a number of regulatory and non-regulatory programs in the area.

However, given that EPA's analysis of the other eight factors has shown that the State's boundary is sufficient to capture sources contributing to the violations at the South L Street monitor, this information was not an important consideration in our decision on our intended boundary.

In certain cases where level of control of emission sources is important, EPA will consider additional information on emission controls in making final designation decisions. In cases where specific plants already have installed emission controls or plan to install such controls in the near future, EPA requests additional information on:

- the plant name, city, county, and township/tax district
- identification of emission units at the plant, fuel use, and megawatt capacity
- identification of emission units on which controls will be installed, and units on which controls will not be installed
- identification of the type of emission control that has been or will be installed on each unit, the date on which the control device became / will become operational, and the emission reduction efficiency of the control device
- the estimated pollutant emissions for each unit before and after implementation of emission controls
- whether the requirement to operate the emission control device will be federally enforceable by December 2008, and the instrument by which federal enforceability will be ensured (e.g. through source-specific SIP revision, operating permit requirement, consent decree)

Attachment 2
Description of the Contributing Emissions Score

The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Using this methodology, scores were developed for each county in and around the relevant metro area. The county with the highest contribution potential was assigned a score of 100, and other county scores were adjusted in relation to the highest county. The CES represents the relative maximum influence that emissions in that county have on a violating county. The CES, which reflects consideration of multiple factors, should be considered in evaluating the weight of evidence supporting designation decisions for each area.

The CES for each county was derived by incorporating the following significant information and variables that impact $PM_{2.5}$ transport:

- Major $PM_{2.5}$ components: total carbon (organic carbon (OC) and elemental carbon (EC)), SO_2, NO_x, and inorganic particles (crustal).
- $PM_{2.5}$ emissions for the highest (generally top 5%) $PM_{2.5}$ emission days (herein called "high days") for each of two seasons, cold (Oct-Apr) and warm (May-Sept)
- Meteorology on high days using the NOAA HYSPLIT model for determining trajectories of air masses for specified days
- The "urban increment" of a violating monitor, which is the urban $PM_{2.5}$ concentration that is in addition to a regional background $PM_{2.5}$ concentration, determined for each $PM_{2.5}$ component
- Distance from each potentially contributing county to a violating county or counties

[A more detailed description of the CES can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.]

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