10. Appendices

10.1 Oregon Air Toxics Regulations

10.1.1 Air Toxics Program Rules including Ambient Benchmark Concentrations

Oregon's air toxics program rules can be found in Oregon Administrative Rules 340-246-0010 through 340-246-0230. **http://arcweb.sos.state.or.us/rules/OARs_300/OAR_340/340_246.html.**

Two internal management directives provide guidance for DEQ staff in implementing the program:

- ***Document Title: Policy and Implementation Guidance for the Oregon Air Toxics Program.*** This Internal Management Directive describes the procedures and policies DEQ will use in implementing the Oregon Air Toxics Program, including guidance on implementing the Geographic Program, Source Category Rules and Strategies and Safety Net Program. http://www.deq.state.or.us/aq/toxics/docs/imdaq00014.pdf
- ***Document Title: Technical Analysis Tools and Guidance for Implementation of the Air Toxics Program.*** This Internal Management Directive describes the technical tools DEQ will use in implementing the Oregon Air Toxics Program, including guidance on Determining and Using Background Air Toxics Concentrations, Calculating Annual Average Concentrations of Air Toxics, Monitoring Ambient Air Toxics, Using Toxicity Equivalency Factors, and Assessing Exposure to Air Toxics. http://www.deq.state.or.us/aq/toxics/docs/imdaq00013.pdf.

10.1.2 Air Toxics Benchmarks

Because there are no federal health standards for air toxics, Oregon has adopted air toxics benchmarks designed to help focus pollution reduction efforts. These benchmarks help DEQ identify, evaluate and address air toxics problems. Oregon air toxics benchmarks are based on concentration levels that would result in a cancer risk of one in a million excess cancers based on a lifetime of exposure. For non-carcinogens, levels you could breathe for a lifetime without any non-cancer health effects.
The ambient benchmark concentrations for 52 air toxics of concern in Oregon, which can be found at http://www.deq.state.or.us/aq/toxics/benchmark.htm, are based on consensus recommendations from the Air Toxics Scientific Advisory Committee, a panel that provides advice on the state air toxics program that is scientifically and technically sound, independent and balanced. Information on the Air Toxics Scientific Advisory Committee can be found at: http://www.deq.state.or.us/aq/toxics/atsac.htm.
The benchmark concentrations are based on levels that protect the health of our most sensitive individuals. These benchmarks provide consistent health-based goals, as DEQ develops strategies to reduce air toxics. Benchmarks are expressed as micrograms of a specific toxic compound per cubic meter of air.

10.2 PATSAC Charter and Operating Principles

10.2.1 PATSAC Charter

Document Title: PATSAC Charter. The PATSAC Charter describes the purpose, goals, and process of PATSAC, gives background on selection of Portland as the first air toxics reduction planning location, and discusses issues that are included or excluded from PATSAC.

The PATSAC Charter last updated on June 3, 2010 is included in full below:

Portland Air Toxics Solutions
Advisory Committee
CHARTER
6/3/2010

PATSAC

The Portland Air Toxics Solutions Advisory Committee, or PATSAC, is a broad based stakeholder group tasked with recommending the elements of a Portland air toxics reduction plan to DEQ and the Environmental Quality Commission (EQC). DEQ is collaborating with a diverse advisory committee and interested persons to develop an air toxics reductions strategy that fosters innovation, improves partnerships, and builds support to carry out emission reduction strategies. PATSAC includes representatives from neighborhoods, public interest organizations, government health and transportation departments and business. The purpose of PATSAC is:

- To make recommendations to DEQ and the EQC on an air toxics reduction plan for the PATS study area;
- To develop this advice through a collaborative stakeholder process that considers the best available science and information and community values, seeking areas of consensus where possible and clearly identifying areas of disagreement.

In making recommendations for an air toxics reduction plan, PATSAC will strive to:

- Improve public health and reduce risk to public health by meeting or making progress towards air toxics benchmarks under a ten-year plan;
- Facilitate early actions and reduce pollution;
- Coordinate local governments, stakeholders and communities in their shared efforts to ensure clean air in the Portland area.

Background

Based on ranking of county air toxics risk data statewide, DEQ selected the Portland area as the first community to participate in geographic air toxics reduction planning. The PATS project and study area includes portions of Multnomah, Clackamas and Washington Counties (see Figure 1). DEQ is also involving Clark County Washington near Vancouver and a portion of Yamhill County, since these areas share the same air shed as the Portland metro area. DEQ invited representatives from both these areas to serve as ex-officio members on the Portland Air Toxics Advisory Committee. To include perspective from other communities with air toxics above benchmarks, DEQ also invited ex-officio members from Eugene/Springfield and Medford/Ashland.

DEQ designated the PATS study area based on locations where people are most exposed to air toxics, coordination with the ozone pollution control area, geography and topography. PATS is distinct from other air toxics control efforts to date because it evaluates risk holistically to produce an area-wide plan to decrease emissions from sources roughly commensurate with their contribution to problems. DEQ will be working with local authorities, governments and community partners to implement PATS emission reductions. After addressing Portland area air toxics, DEQ plans to initiate similar efforts in other Oregon communities exceeding target risk levels from air toxics.

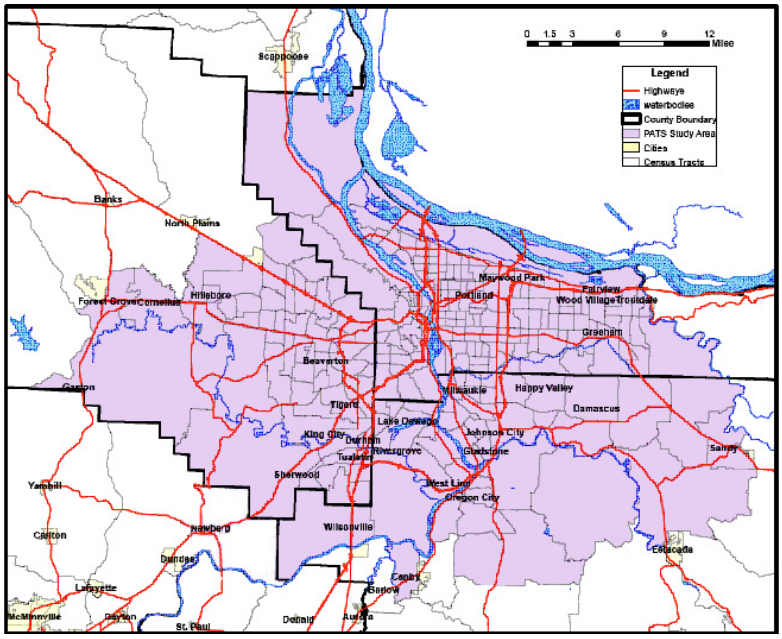


Figure 1 – PATS Study Area

1. Process

The PATSAC final report will include recommendations for an air toxics reduction plan, and will identify areas of consensus as well as areas of disagreement. Because of this, PATSAC will not make decisions by voting. DEQ expects the committee to operate in a collaborative fashion to help DEQ improve the quality of technical information and to explore the pros and cons of policy alternatives. The recommended emission reduction plan will be most useful to DEQ if it is clear, realistic, measurable and based on the best available science and information.

Requirements for a local air toxics advisory committee, such as PATSAC, are contained in Oregon Administrative Rules 340-246-0170 (1) through (4). Procedurally, the committee has a maximum of 18 months to recommend an air toxics reduction plan, with an opportunity to request an extension of time DEQ anticipates that PATSAC meetings will occur over a period of eighteen months or more. Because PATS is an innovative process based on developing science, additional time may be needed to address technical, policy and implementation challenges.

DEQ will use the PATSAC recommendations to develop an air toxics plan for presentation to the EQC following a public notice and comment period. Because the plan will address many pollutants from many source categories through many emission reduction strategies, it will serve as a blueprint or roadmap for reducing air toxics within the PATS study area. Following EQC approval of the plan, DEQ will work with local governments, other state agencies, the Oregon Legislature, the federal government and others to develop the programs needed to implement the plan. This work will take additional time, and will likely include additional advisory committees to develop specific regulations that will use the plan as a guide but incorporate specific implementation factors. The PATSAC report should include a recommended schedule for adopting new rules and ordinances, or seeking funding for new programs.

2. PATSAC Recommendations

a. Pollutants

The PATS emission reduction plan must focus on air toxics measured or modeled above ambient benchmarks in the study area. While reducing the highest risk air toxics will be a priority for PATSAC, it will also consider multi-pollutant benefits and health effects in air

toxics reduction measures. PATSAC will evaluate air toxics emissions from all types of sources.

b. Analysis

PATS is part of Oregon's risk-based effort to reduce air toxics. It must be based on sound analysis of the best available scientific environmental and health data. Specifically, air toxics problems to be solved by PATS are based on ambient air monitoring at six Portland area locations, a detailed computer modeling study, and the air toxics ambient benchmark concentrations, which serve as clean air goals. DEQ will analyze emission reduction strategies considered by PATSAC to provide a general assessment of their effectiveness, benefits, and costs. Strategies included in the final plan will be analyzed in detail at a later time when implementing rules and programs are developed. DEQ will also assess the health costs and benefits of the plan as a whole.

The PATS computer model is DEQ's primary tool for estimating the impact of emission reduction strategies and making future year projections to understand the effects of changes that will come about as the result of regulatory programs (such as cleaner fuel regulations and industrial emission limits) and voluntary measures being phased in over time; as well as population growth, housing, transit and business development. Future air toxics modeling and monitoring will provide information to measure and confirm progress in reducing emissions.

c. Emission Reduction Goals and Strategies

The air toxics ambient benchmark concentrations adopted in OAR 340-246-0090 serve as emission reduction goals for PATS. In cases where a benchmark is under development but not yet adopted, PATSAC may consider the concentration recommended by the Air Toxics Science Advisory Committee. When feasible, the reduction plan will be designed to reach air toxics levels that are equal to or below ambient benchmark concentrations as expeditiously as possible, with a base goal of 10 years from the date the EQC approves the plan.

"Feasibility" is not defined in DEQ's air toxics regulations, but is generally understood to require consideration of practical, economic, social, scientific and health factors for each pollutant and associated source. Because diesel particulate matter, polycyclic aromatic hydrocarbons (PAH) and benzene, are produced by engines and combustion sources which are ubiquitous, it may not be feasible to reduce emissions quickly enough to reach benchmark levels in a ten year period.

PATSAC will analyze the potential timeframe for reaching benchmarks and make recommendations that achieve them in as expedient a manner possible. To develop the best strategies for successful emission reductions, PATS will also consider the relationship of the pollutants to their sources, to one another, and the chemical background associated with each. For example, there are strategies which may cause one pollutant's emissions to decrease, but another pollutant's to increase, as is the case with biodiesel, which reduces diesel particulate matter and increases nitrogen oxides.

d. Plan Elements

The following plan elements can be found in Oregon Administrative Rule (OAR) 340-246-0170. DEQ and PATSAC will strive to achieve the greatest benefits on the most expeditious timeline considering the effectiveness, benefits, and cost of emission reduction options.

<u>i. Voluntary and Mandatory</u>

The plan may contain a mix of voluntary and mandatory emission reduction measures that may be administered region-wide or in separate jurisdictions. Depending on the type of

source, the plan may include public education, pollution prevention, economic incentives and disincentives, technical assistance, local ordinances and DEQ regulations.

ii. Proportionality
The plan must include emission reduction measures that are roughly commensurate with source contributions, considering relative emissions, toxicity, exposure, technical feasibility, cost effectiveness, public health and the economic impacts air toxics have on public health and equity. The plan will include commensurate reductions from point, area and mobile sources.

iii. Milestones
The PATS emission reduction plan will include three year milestones to be evaluated by DEQ and PATSAC representatives. If the Department finds lack of progress at year three, it will consult with PATSAC to evaluate the need for corrective measures. If the Department finds lack of progress at year six, and projects that ten year goals will not be met, it will implement the contingency plan.

iv. Regulatory Coordination
The plan elements must be coordinated with other local, state and federal requirements to the extent possible.

v. Data Elements
If necessary, the plan will include specific recommendations to develop ongoing emission inventory or ambient monitoring to track local air toxics trends.

vi. Address Wide-Spread and Localized Impacts
The plan must include strategies to reduce concentrations of air toxics above ambient benchmark concentrations in smaller portions of the geographic area, as well as pollutants causing risk above benchmarks throughout the study area.

vii. Contingency Plan
The plan must include a contingency plan to be implemented if the year six evaluation shows lack of progress toward milestones and is projected to fall short of the ten year goals. The contingency plan must include, but is not limited to, re-evaluation of planning assumptions, evaluation of existing conditions and effectiveness of emission reduction strategies and new or progressively more stringent strategies to be considered.

e. Evaluating Milestones
Every three years in coordination with DEQ's air toxics emission inventory updates, DEQ will evaluate progress under the PATS emission reduction plan. DEQ will use both monitoring and modeling data to evaluate progress. For pollutants that can't be monitored, only modeling will be used. For those that can be monitored, DEQ will also rely mainly on modeling data and check it against monitored values. Unlike monitoring data, which is limited to measuring only the area near the monitor, modeling data will cover the entire PATS study area.

Based on new information, DEQ may make recommendations for plan revision. New information could include adoption of a new or revised benchmark, new emission reduction technology or legal requirements. If DEQ finds lack of progress towards milestones, it will work with PATSAC representatives to provide corrective measures. If at year six DEQ finds lack of progress and projects that ten year goals will not be met, it will implement the PATS

contingency plan. If at year nine DEQ determines the ten year goals will not be met, it will work with PATSAC representatives to adopt measures necessary to reach the goals.

3. Issues included/excluded from PATSAC consideration

To maximize its efficiency, PATSAC will focus its efforts as outlined in 340-246-0170 (1) through (4).

a. Issues included in PATSAC consideration

In developing recommendations, PATSAC will use monitoring and modeling analysis to understand air toxics in the study area, including distribution of concentrations, causes, and potential solutions.

PATSAC will consider and recommend solutions for the entire study area as well as smaller areas where people are exposed to air toxics above benchmarks because of localized source emissions. Strategies will address adverse impacts on sensitive or vulnerable populations and environmental justice communities.

b. Issues not directly related to PATSAC recommendations

To focus the scope of the PATS project, DEQ is not seeking direct recommendations on the issues listed below. However DEQ will document committee input on these issues and, when possible, will refer them for follow-up in an appropriate forum.

- Ambient benchmark concentrations.
- Statewide air toxics regulations.
- Conditions to be placed directly in the permit of a specific regulated source, though strategies may include pollution reductions from types of stationary sources identified as significant contributors to ambient concentrations and exposures above benchmarks.
- Worker exposure.
- Measures specifically designed to improve indoor air quality.

The committee is faced with various challenges in recommending a Portland Air Toxics Reduction Plan, including: multiple pollutants, technical and scientific complexity, a large geographic area, risk conceptualization and communication, difficulty affecting various emissions, and implementation needs. Despite these challenges, many factors align to make this a very opportune time to address air toxics in the Portland area. PATSAC can take advantage of increasing interest in and awareness of air toxics, initiatives for renewable and low carbon energy, upcoming improvements in transportation and development, and many other local efforts to improve livability and public health. In addition, data and understanding about air toxics has improved to the point where PATSAC will be able to describe the major air toxics problems, propose solutions and track progress toward improvements.

The following organizations and interests were represented on PATSAC:

Portland Office of Neighborhood Involvement	North Portland Neighborhoods	Southwest Portland Neighborhoods
NW Portland Neighbors for Clean Air	Pacific Environmental Advocacy Center	OPAL
American Lung Association of Oregon	Oregon Toxics Alliance	Multnomah County Health Department
Washington County Health Department	Commissioner Cogen's Office	Oregon Health Authority

Clackamas County Sustainability Program	Metro	TriMet
Portland Department of Transportation	Oregon Department of Transportation	Port of Portland
Intel	Associated Oregon Industries	The Boeing Company
Oregon Trucking Association		

The following organizations and interests participated as ex-officio members of PATSAC:

Lane Regional Air Protection Agency	Sierra Club	Southwest Clean Air Agency

10.2.2 PATS Operating Principles

- ***Document Title: PATSAC Operating Principles.*** This document describes the process and procedures by which the PATSAC advisory committee governed its discussions, deliberations, and decision-making. Descriptions of the structure, member participation, meetings and materials, decision-making and commitments, process reminders/ground rules, and safeguards are included.
  The PATSAC Operating Principles last updated June 3, 2010 are included in full below:

Portland Air Toxics Solutions
Advisory Committee

OPERATING PRINCIPLES
6/3/2010

For any collaborative process to operate smoothly, it is necessary for those involved to agree at the outset on the purpose for the process and on the procedures by which the group will govern its discussions, deliberations, and decision-making.

I. Purpose of the Portland Air Toxics Solutions Advisory Committee

The primary purpose of the Portland Air Toxics Solutions Advisory Committee is to review air toxics data provided by DEQ and potential emission reduction strategies and recommend to the Department of Environmental Quality (DEQ) and/ or the Environmental Quality Commission (EQC) a plan to reduce air toxics in the Portland area as expeditiously as possible, with a base goal of 10 years.

II. Portland Air Toxics Solution Advisory Committee Structure

The Advisory Committee will be the advisory level forum for collaborative efforts related to development of a Portland air toxics reduction plan. The participants are voluntarily working together to achieve a mutually acceptable outcome that satisfies, to the greatest degree possible, the interests of all participants. The Advisory Committee will be responsible for all decisions and actions that are publicly identified as Advisory Committee products.

The Advisory Committee members (i.e., representatives, subgroup/team members, and alternates) will strive to:

- Work together to develop consensus on the components of an air toxics reduction plan;
- Agree on the desired level of specificity of plan components;
- Concur in all Advisory Committee decisions, as well as designate a signatory for the final agreement;
- Ensure integration of the scientific, technical, available health, economic (benefit/cost analyses), and policy information needed to begin the air toxics reduction plan to the maximum extent practicable; and

- Concur in decisions about the Advisory Committee process, including overseeing the implementation of these operating principles.

To focus the scope of the process, DEQ is not seeking recommendations on the issues listed below. However, DEQ will document committee input on these issues and, when possible, will refer them for follow-up in an appropriate forum.

- Ambient benchmark concentrations
- Statewide air toxics regulations
- Conditions to be placed directly in the permit of a specific regulated source, though strategies may include pollution reductions from classes and categories of sources identified as significant contributors to ambient concentrations and exposures above benchmarks.
- Worker exposure
- Measures specifically designed to improve indoor air quality

In order for this scope to be acceptable to and implementable by all authorities, those involved in this process agree to work together and will strive to produce recommendations that integrate the mandates, concerns, and ideas of all those significantly affected by the structure and implementation of the air toxics reduction plan.

Subgroups may be formed at the direction of the Advisory Committee, which will designate subgroup members as needed for the anticipated tasks and outcomes. At the direction of the Advisory Committee, subgroup members may develop draft products and make recommendations to the Advisory Committee. Subgroups will not make decisions on behalf of the Advisory Committee.

Scientific and Technical Input will be provided on an "as-needed" basis by Advisory Committee members' staff, consultants or other designated entities or experts as agreed upon by the Advisory Committee. To the extent an Advisory Committee member is relying on the expertise of scientific or technical staff, those scientific or technical staff must be made available for discussion with other members of the Advisory Committee if requested or needed. These technical advisers will not make decisions on behalf of the Advisory Committee.

Ex officio Members are invited to participate in discussions about the air toxics reduction plan and all related matters. Ex officio members may offer input but may not concur on procedural or substantive decisions, agree on specific elements of the plan or provide signatures on any PATSAC documents or recommendations. Ex officio members must abide by PATSAC operating principles.

III. Participation

Interests Represented. Advisory Committee parties, identified on the signature page for these Operating Principles, represent public and private entities that have an interest in the Portland Air Toxics Solutions project or an interest, role and/or responsibility in achieving an air toxics reduction plan.

Additional Parties. Additional entities may join the Portland Air Toxics Solutions Advisory Committee as appointed by the Director of DEQ. Any new party must agree (a) to abide by these Operating Principles, and (b) to accept the status of discussions as of the time of joining the Advisory Committee, unless otherwise agreed by the Advisory Committee.

Attendance at Meetings. Each member will make a good faith effort to attend each Advisory Committee meeting. If an Advisory Committee member cannot attend, he or she may designate a regular alternate to attend, and the alternate must be appointed as a committee member by the Director of DEQ. It is the responsibility of the member and alternate to stay fully briefed on all Advisory Committee meeting discussions and deliberations. It is the responsibility of the member to inform the alternate concerning the deliberations. All alternates are also bound by these Operating Principles.

Constituent Interests. Advisory Committee members are expected to consult with and represent the concerns and interests of the organizations and constituents they were appointed to represent. Members with established organizations and constituents are responsible for ensuring that all significant issues and

concerns of their organizations and constituents are fully and clearly articulated during Advisory Committee meetings. These members are also responsible for ensuring that any eventual recommendations or agreements are communicated to their constituents and/or the agencies they were appointed to represent.

IV. Meetings and Materials

Agendas. Proposed meeting agendas will be drafted by the Project Team in consultation with Advisory Committee members. The Project Team will strive to circulate draft agendas for review at least one week in advance of Advisory Committee meetings. Agendas will be approved or revised at the beginning of each meeting.

Meeting Summaries. The facilitator will prepare Advisory Committee meeting summaries. They will be provided electronically in draft form to the DEQ website for review and comment within one week of the Advisory Committee meeting. Meeting summaries will be approved by the Advisory Committee at the following meeting. Final meeting summaries will also be posted on the project website.

Action Items. Action item lists will be prepared by the facilitator to assist the Advisory Committee in documenting its progress and activities. The facilitator will ensure that items included on the lists are tracked and that Advisory Committee members are informed of progress.

Breaks/Caucus. Meetings may be suspended at any time at the request of any member to allow consultation among group members. Requests should be respectful of all members' time. If the use of a caucus or break becomes disruptive, the Advisory Committee will revisit the process. The facilitator may be used to assist parties during the caucus if requested.

Facilitator. Advisory Committee meetings will be facilitated by Kearns & West. The facilitator will be funded by the Oregon Department of Environmental Quality through the Oregon Consensus Program but will remain independent and not take positions on the issues. The facilitator will work to ensure that the process runs smoothly. The facilitator's role usually includes developing draft agendas, distributing meeting materials, facilitating meetings, working to resolve any impasse that may arise, preparing action items and other tasks as requested. The facilitator will work directly with all Advisory Committee members to ensure their ability to represent the concerns and interests of their organizations and constituents. The facilitator will serve at the will of the group and may be replaced by another facilitator upon consensus by the members.

Materials. The Advisory Committee will have intensive work sessions. This format requires more extensive preparations for members. The Project Team will strive to circulate all draft materials for review at least two weeks in advance of Advisory Committee meetings, giving members the opportunity to raise initial questions for either the facilitator or Department of Environmental Quality staff.

V. Decision-Making and Commitments

Consensus. The Advisory Committee will strive to make decisions by consensus. Consensus is defined as all Advisory Committee members can live with the recommendation or decision. If the group cannot reach consensus, the differing views will be documented in the committee's final report.

Decision Making. Decisions throughout the PATS process will be made by Advisory Committee members present at each meeting. Major products, which would include any final components of the air toxics reduction plan, will be reached through discussion among all Advisory Committee members. Those absent from the meeting will be asked to provide written comments (by email or fax) within one week of a decision being conveyed to the absent members.

It is understood that Advisory Committee members are representing interests of their agency, organization, and/or constituents. As such, ultimate decision-making authority may reside with an individual not at the table. Advisory Committee members agree to regularly brief the decision-makers within their respective organizations to ensure support and buy-in for decisions developed through the Advisory Committee process, as well as the greatest likelihood of successfully implementing an agreement.

Commitments of Members. All Advisory Committee members agree to:

Attend meetings and follow through on promises and commitments;

Come to meetings prepared, having read all materials provided for the meeting;

Bring concerns from their interest group or organization up for discussion at the earliest point in the process;

Share all relevant information that will assist the group in achieving its goals;
Participate in a free, open, and mutually respectful exchange of ideas, views, and information prior to achieving consensus;
Resolve issues being addressed by the Advisory Committee within the Advisory Committee structure;
Articulate to the best of their ability interests that underlie issues and concerns in an effort to find common ground among the parties;
Communicate the expectation to subgroups and those providing scientific and technical input that these Operating Principles are also applicable to them;
Characterize individual, caucus, or subgroup viewpoints as fully and accurately as possible;
Keep the group or organization represented by the member informed of potential decisions and actions, in order to expedite approval for the final product; and
Support the products recommended by the Advisory Committee if the member concurred in the recommendation.

VI. Process Reminders/Ground rules

- Seek to learn and understand each other's perspective.
- Encourage respectful, candid and constructive discussions.
- Provide balance of speaking time.
- Seek to resolve differences and reach consensus.
- Discuss topics together rather than in isolation.
- Make every effort to avoid surprises.
- Limit side conversations.
- Turn off cell phones or place in the non-ring mode during formal meeting sessions.

VII. Safeguards

Good Faith. All members agree to act in good faith in all aspects of the collaborative effort. Specific offers made in open and frank problem solving conversations will not be used against any other member in future litigation or public relations. Personal attacks and prejudiced statements are not acceptable. Good faith requires that individuals not represent their personal or organization's views as views of the Advisory Committee, and that they express consistent views and opinions in the Advisory Committee and in other forums.

Open Meetings. Meetings of the Advisory Committee are open to the public and will include an opportunity for public comment. Notice of Advisory Committee meetings will be posted in advance of meetings on the DEQ website.

Public Comment. The facilitator will provide periodic public comment opportunities for non-Advisory Committee members during meetings. Comments from the public will be limited in time to allow sufficient opportunity to conduct the other portions of the Advisory Committee agenda. Citizens are encouraged to participate in the PATS process and to submit written comments to DEQ Staff for circulation to the full Advisory Committee.

Public Records and Confidentiality. Advisory Committee records, such as meeting documents, discussion drafts and meeting summaries are public records. Advisory Committee communications (oral, written, electronic, etc.) are not confidential and may be disclosed. However, the private documents of individual Advisory Committee members and the private documents of the facilitator that are not shared with the Advisory Committee are not considered public records and are not subject to disclosure under public records laws.

Press. Advisory Committee members will strive to keep each other apprised of communications with the press regarding the Portland Air Toxics Solution Advisory Committee process. Upon request, contact from the press related to the Advisory Committee process may also be referred to the DEQ project team.

Right toWithdraw. Any member may withdraw from the Advisory Committee at any time after discussing the reasons for withdrawal with the facilitator and Advisory Committee members. Any entity that withdraws from the Advisory Committee shall remain bound by the good faith and other provisions of these Operating Principles.

VIII. Schedule

The Advisory Committee as a whole will meet as needed to meet its responsibilities. It is anticipated that the Advisory Committee will complete its work by May, 2011.

10.2.3 PATS Considerations

PATSAC developed the following draft considerations for use in evaluating and selecting emission reduction strategies.

PATSAC DRAFT Considerations 2/7/11

I. PATS Threshold Regulatory Requirements

1. The PATS emission reduction plan must focus on air toxics measured or modeled above ambient benchmarks in the PATS study area. (OAR 340-246-0170 (4)(1))
2. Mandatory emissions reduction strategies must be commensurate with source contributions, considering relative emissions, toxicity, technical feasibility, cost-effectiveness and equity. (OAR 340-246-0170 4(f)). [Note: initially PATSAC will consider equal percent reductions for point, area and mobile sources, but may vary these percentages consistent with this rule.]

II. Considerations

This list of considerations will be used by PATSAC as an informal tool to understand toxics reduction strategies. If the committee chooses, it may also use these considerations to shape its recommended package of strategies or implementation steps.

1. **Effectiveness** – consider the following as appropriate:
   - **a.** Magnitude: amount of each air toxic reduced by the strategy.
   - **b.** Timeframe: Length of time required by measure to reduce emissions. How readily are results measureable? (OAR 340-246-0179 4(d))
   - **c.** Effect on exposures: How well does the measure target spatial extent of the emissions? Some reductions may have more pronounced effects on localized concentrations; others may do more to reduce pollutants area-wide. (OAR 340-246-0170 4(g)). Ability to address short term or acute exposures if relevant.
   - **d.** d. Pollution prevention: Where does the strategy fit in the pollution prevention hierarchy? 1. Modify the process, raw materials, or product to reduce the quantity and toxicity of air contaminants generated. 2. Capture and reuse air contaminants. 3. Treat to reduce the quantity and toxicity of air contaminants released. (OAR 340-246-0050)
   - **e.** e. Other pollutants: Effect of measure on criteria pollutant emissions, greenhouse gas emissions, and
   - **f.** emissions of other priority toxic substances on the DEQ Agency Wide Toxics List

2. **Implementability/Feasibility/Barriers** – consider the following as appropriate:
   - **a.** Legal authority: Does the measure fall under existing regulations or are new laws/ rules required? Does federal pre-emption preclude new laws/rules? Is/will the proposed measure be addressed through other planned Federal, state, or local rulemaking or other processes?
   - **b.** Technical feasibility: How well will the emission reduction measure work from an engineering and/or logistical perspective? Is the technology or fuel readily available? (OAR 340-246-0170 4(f)). Is the technology EPA or third party verified/certified?
   - **c.** Funding: What is the cost to DEQ or other agency to implement the measure? How could the agency cost be funded? How certain is the funding mechanism?
   - **d.** Implementation: Is there a ready structure for implementation or ability to coordinate with existing programs?
   - **e.** Acceptance: Is there public and stakeholder support for the measure?

f. Non-regulatory approaches: Could the measure be implemented through incentives or education? Is there an opportunity to implement the measure through a community-based multi-stakeholder collaborative process? Could the measure begin as voluntary and later become mandatory as necessary in a contingency plan?

3. **Cost** – consider the following as appropriate:
   - **a.** Cost: What is the cost of emission reduction measure and implementation (OAR 340-246-0170 4(f))? If the measure is a regulation, what is the cost of compliance? If the measure is an incentive, what is the cost of the incentives?
   - **b.** Cost effectiveness: What is the cost per unit of air toxics reduced?
   - **c.** Other environmental impacts: Potential for the emission reduction measure to transfer pollutants to soil or water, or cause harm to human health or the ecosystem.
   - **d.** Energy: Effect of measure on energy use.
   - **e.** Public safety: What is the affect of the measure on public safety? For example, would emission reductions restrict activities related to adequate lighting, heat, ventilation, signage or access to emergency services?
   - **f.** Indirect economic costs: What are the potential indirect costs to communities, the local economy or business sectors?

4. **Benefits** - consider the following as appropriate:
   - **a.** Health: What are the health benefits of meeting the benchmarks? This could be measured as the number of cancer cases avoided and/or value of statistical life and medical costs avoided.
   - **b.** Livability: Improved quality of life associated with improved nuisance conditions such as odor or noise.
   - **c.** Indirect economic benefits: What are the potential benefits to communities, the local economy or business sectors?

5. **Distribution of Benefits and Costs** - consider the following as appropriate:
   - **a.** Risk distribution: Could the measure change the social distribution of risk in the PATS area, i.e. sensitive populations and environmental justice communities?
   - **b.** Cost distribution: Could the measure impose disproportionate costs or economic impacts to environmental justice communities in the PATS study area?

10.3 Emission Inventory

The 2005 emission inventory was used for two purposes. First, to create 2005 model results for comparison with the 2005 monitored concentrations for pollutants in the PATS area. Second, the 2005 emission inventory was used to project a future 2017 emission inventory by taking into account future growth and emission reductions from regulations. At each step, DEQ improved the information based on PATSAC comments.

10.3.1 Emission Inventory List of Emission Source Categories

- ***Document Title: Emission Inventory List of Source Categories***. This spreadsheet lists the emission inventory emission source categories used for both 2005 and 2017 projections, and includes details. http://www.deq.state.or.us/aq/planning/report/appendix/2005EI.pdf

10.3.2 Special Categories

DEQ staff compared 1999, 2002, and 2005 emission inventory data and determined source categories to be modeled. The following categories listed in priority order were selected due to their potential contribution to air toxics in the PATS study area and also to the feasibility of addressing these toxics through strategies.

- **Residential Wood Combustion:**
  - Fireplaces
  - Inserts: Non-Certified
  - Inserts: Certified, Non-Catalytic
  - Inserts: Certified, Catalytic
  - Woodstoves: General (non-certified)
  - Woodstoves: Certified, Non-Catalytic
  - Woodstoves: Certified, Catalytic
  - Pellet Stoves

- **Residential Open Burning:**

As a category of emissions, residential open burning has not been well characterized. Because it is a known source of air toxics, DEQ made an effort to estimate emissions using available information and assumptions. DEQ's complaint database was queried for the record of illegal open burning complaints, the location of the complaint, the number of open burn permits issued by DEQ, if any, and what type of material was burned. There were no burn permits issued for 2005; in fact, the last burn permit issued by DEQ was in June 2002. The types of material burned were categorized into two types: garbage or yard debris, construction or demolition debris, and wood waste (y/w/c). The following complaints were on record for 2005 from the database; material burn type was smeared across the two categories to the best of DEQ personnel's ability.

- Clackamas County
  - Total = 36
  - Garbage = 16
  - Yard debris, construction or demolition debris, and wood waste = 20
- Washington County
  - Total = 43
  - Garbage = 17
  - Yard debris, construction or demolition debris, and wood waste = 26
- Multnomah County
  - Total = 49
  - Garbage = 28
  - Yard debris, construction or demolition debris, and wood waste = 21

An average burn pile size and pile density was used. Tonnage burned for both municipal (household) waste and yard debris were estimated based on: material and location provided by the database, average pile sizes from historical burn complaint data, and on densities from EPA and Emission Inventory Improvement Project documents. The activity within the burn ban boundary (from the complaints data) was divided by the county-wide activity (from the DEQ's emission inventory data). The assumptions for this was that roughly one in five illegal burns occurred within the burn ban boundary and were reported as a complaint and that illegal burning is equally distributed within the burn ban boundary, with the exception that no burning is occurring within downtown Portland.

- **Additional Area Sources:**
  - Stationary Source Fuel Combustion
  - Commercial Cooking
  - Non-Permitted Industrial Processes
  - Asphalt Production
  - Fuel Storage & Transport (small gas cans, truck transport)
  - Agricultural Field Burning
  - Orchard Heaters
  - Prescribed Burning

- Structure Fires
- Cremation
- Open Burning of Construction Debris

- **Lawn and Garden Commercial & Residential**
  - Rotary Tillers
  - Chainsaws
  - Trimmers/Edgers
  - Leafblowers
  - Snowblowers
  - Turf Equipment
  - Lawnmowers
  - Chippers/Stump Grinders
  - Shredders
  - Lawn & Garden Tractors

- **Solvent Use Specifically Including para Dichlorobenzene:**
  - Surface Coating: Architectural
  - Surface Coating: Plastic Products
  - Surface Coating: Misc. Manufacturing
  - Surface Coating: Industrial Maintenance
  - Surface Coating: Special Purpose
  - Graphic Arts
  - Misc. Industrial Solvent Use (non-permitted)
  - Consumer and Commercial Products (household, automotive, coatings/adhesives, FIFRA[1], misc)

10.3.3 Prepare Clark County Emission Inventory Data

For mobile sources, DEQ obtained on road annual and seasonal data for Clark County from Metro. For point sources, SWCAA provided point source toxics data for 2007 and criteria pollutant data for 2005. DEQ adjusted 2007 data to 2005 levels by comparing criteria pollutants. SWCAA provided specific drycleaner and gas station data. For area source data, Washington Department of Ecology provided area source calculations for 2005. DEQ ensured that marine vessel emissions in OR and WA were not double counted. Washington Department of Ecology provided rail emissions by line haul and yard; DEQ allocated the emissions by county.

10.3.5 Growth Factors

- ***Document Title: Portland Air Toxics Solutions 2017 Emission Inventory Forecast.*** This document contains graphs of growth factors from Metro's forecast correlated with emission inventory and modeling source categories. http://www.deq.state.or.us/aq/toxics/docs/pats/forecast.pdf

- ***Document Title: Unofficial Interim Metro 2017 Regional PMSA Forecast (7 Counties) - Unpublished - DEC. 2009. Metro Growth Categories and 2017 Compounded Growth Factor.*** This document details Metro's growth categories and the 2017 growth factors for those categories. http://www.deq.state.or.us/aq/planning/report/appendix/metroGFcompoundFactors.pdf

- ***Document Title: Draft PATS Modeling Growth Factors 5/7/2010 2005 PATS Area Source, Perc Drycleaner, Aircraft/Airport, Locomotive, Commercial Marine Emission Inventory: Source Category Matched to Metro Growth Factor.*** This spreadsheet contains growth factors for emission inventory

[1] Federal Insecticide, Fungicide and Rodenticide Act: http://www.epa.gov/regulations/laws/fifra.html

emission area source categories from the Metro forecast.
http://www.deq.state.or.us/aq/toxics/docs/pats/2005patsAreaSource.pdf

- ***Document Title: Draft PATS Modeling Growth Factors 5/7/20102005 PATS Point Source EI: Facility Matched to Metro Growth Factor Using Facility Primary NAICS Code and Growth Factor NAICS Code.*** This spreadsheet contains point source growth factors from the Metro forecast.
http://www.deq.state.or.us/aq/toxics/docs/pats/2005patsPointSource.pdf

10.3.6 Data Quality

- ***Document Title: Data Quality Summary Tables.*** DEQ has developed a qualitative approach to describing PATS data quality. This spreadsheet summarizes the 2005 data quality for all pollutants from all modeled source categories.
http://www.deq.state.or.us/aq/toxics/docs/pats/dataQualitySummary.pdf

10.3.7 Emission Inventory Improvements

- ***Document Title: PATS Emission Inventory Improvements: Point Sources Added.*** The emissions from twenty-five point sources were added to the 2005 emission inventory through review of the US EPA Toxics Release Inventory (TRI) and on the recommendation of DEQ regional staff. The emission inventory for point sources is a mixture of TRI data, DEQ estimates, and source calculations.
http://www.deq.state.or.us/aq/planning/report/appendix/2005EIchangesHandout.pdf

- ***Document Title: PATS 2005 Modeling Improvements Documentation.*** This document summarizes the iterative changes DEQ made to the PATS technical work from August 2009 through March 2010. This document includes both modeling improvements and emission inventory improvements.
http://www.deq.state.or.us/aq/toxics/docs/pats/finalReport2005model.pdf

- ***Document Title: Department of Environmental Quality Residential Wood Combustion Survey: Results Report.*** This report is a summary of a telephone survey of Oregonians' behaviors associated with residential wood burning. The Portland State University Survey Research Lab (SRL) conducted the survey between March 5th and March 14th, 2009. The Survey Research Lab simultaneously conducted a random statewide survey and oversamples of four specific Oregon communities (Klamath Falls, Lakeview, Medford, and the Burns/Hines/Paiute Tribe boundary area). A total of 1,298 respondents completed the survey, with 1,036 respondents from throughout the state and 262 respondents from the oversamples. The survey results were used to refine the residential wood combustion emission inventory.
http://www.deq.state.or.us/aq/toxics/docs/pats/octoberFollowUpSurvey.pdf

- ***Document Title: Formula for Calculating 2017 Residential Wood Combustion Emissions***
This document contains the formula for calculating 2017 residential wood combustion emissions using the *DEQ Residential Wood Combustion Survey: Results Report* and accounting for Oregon's Heat Smart regulation that requires removal of an uncertified wood stove upon sale of a home.
http://www.deq.state.or.us/aq/planning/report/appendix/2017griddedRWC.pdf

- ***Document Title: Benzene Reductions due to the Mobile Source Air Toxics Rule.*** This document describes how DEQ characterizes benzene emissions in light of the new EPA Mobile Source Air Toxics (MSAT) Rule.
http://www.deq.state.or.us/aq/planning/report/appendix/benzeneReductionDueMSAT.pdf

- Additional information on the mobile source air toxics rule is available on the Environmental Protection Agency's website: http://www.epa.gov/oms/toxics.htm#regs .

10.3.8 Emission Inventory Results

- ***Document Title: 2017 Emission Inventory Pollutant Matrix.*** This spreadsheet contains the 2017 emission inventory results. An emission inventory is a database, by source, of the amount of pollutants discharged into the atmosphere during a given period. The projected estimates for the Portland Air Toxics Solution geographic area (domain) for 2017 are shown in this spreadsheet. The projected 2017 emission inventory displayed in this spreadsheet represents the 19 pollutants studied in the Portland Air Toxics Solutions Project. This table is useful to see at a glance what sources are most responsible for emissions of each pollutant over the entire PATS domain. It should not be used to predict a toxic concentration at a specific location. Its primary purpose is as an input to the 2017 air quality model. The model transports and disperses pollutant emissions using characteristics of the atmosphere, including wind speed, wind direction, and turbulence, and predicts concentrations of these pollutants at specific locations. The model will be used to help determine both local and regional impact areas by illustrating the source contributions for each pollutant in the PATS study area. http://www.deq.state.or.us/aq/toxics/docs/pats/matrix.pdf

10.4 PATS 2017 Modeling

10.4.1 Model Overview

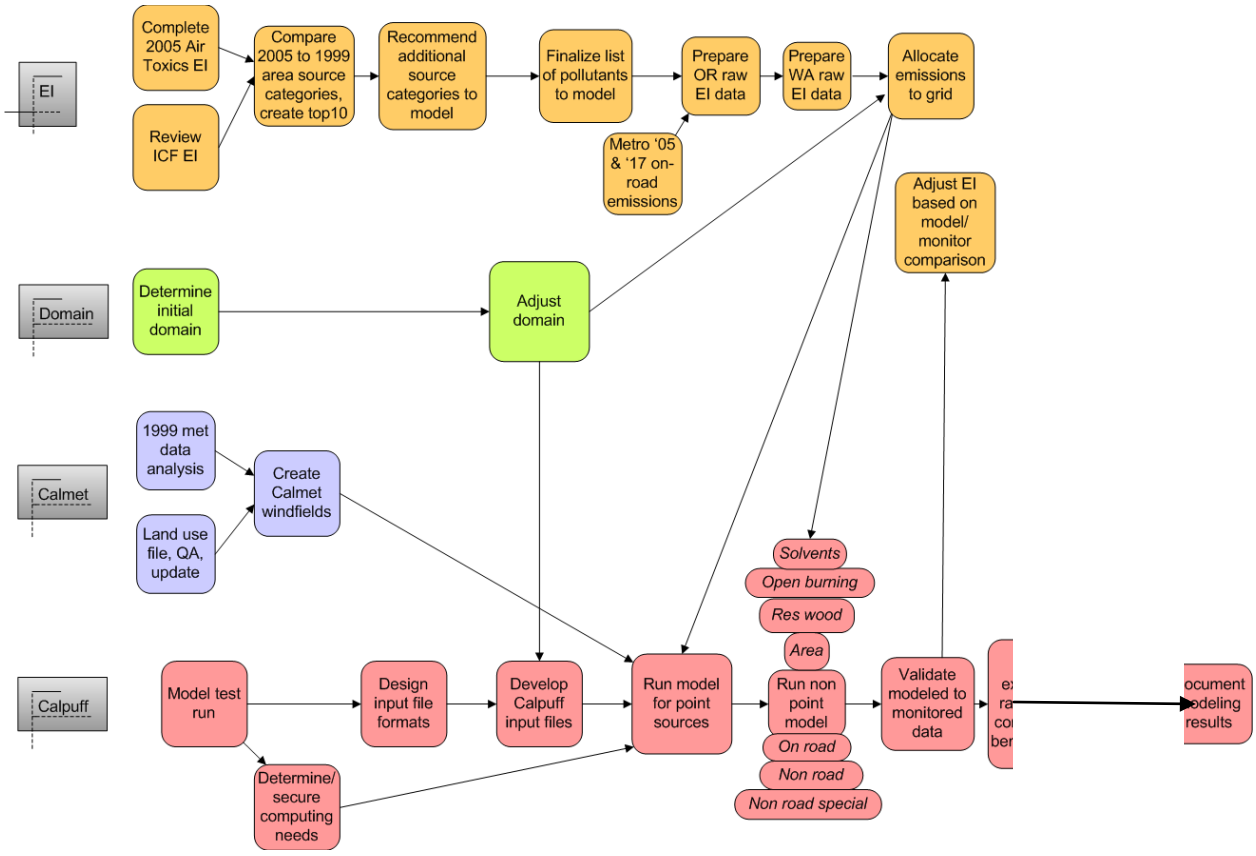
The dispersion model selected for PATS is called CALPUFF (version 5.8). The CALPUFF modeling system includes a meteorological model CALMET (version 5.8), a dispersion model CALPUFF (version 5.8), and a postprocessor CALPOST (version 5.394). This is the same modeling system that was used for Portland Air Toxics Assessment (PATA). CALPUFF is a non-steady-state Gausian puff dispersion model that simulates the effects of time and space varying meteorological conditions on pollution transport, transformation, and removal. The movement and dispersion of puffs occur within spatially and temporally varying wind fields that reflect complex terrain. CALPUFF contains simple chemistry mechanisms for daytime secondary aerosol formation, but does not contain more complex chemistry mechanisms needed to estimate several pollutants that form from reactions in the air. Up to 75% of measured formaldehyde can originate through secondary formation. Despite the lack of chemical mechanisms, this model was extensively evaluated in PATA study and was reselected in PATS as the best fit due to its ability to account for complex weather conditions, local terrain (such as mountains and rivers), and to handle various types of emission sources. DEQ's 2005 emission inventory and Metro's mobile data were used as input for CALPUFF. As with the PATA study, the PATS model runs used a combination of census tracts and block group data.

CALMET, which was used in PATA, was again used to handle the meteorological data. Since the 1999 meteorological data was comparable to 2005, the 1999 meteorological data was used for CALPUFF. DEQ reviewed the following factors to determine that the 1999 meteorological data was representative for a ten year period: surface meteorological stations, upper air data, geophysical data, terrain elevations, and land use. The meteorological data comes from nine sites in Portland, each containing nine vertical layers.

While PATSAC considered concentration rather than exposure data, DEQ has generated exposure data by applying ratios of concentrations and modeled exposure data from previous studies. This approach is the same used by EPA in the National Air Toxics Assessment (NATA). DEQ expects that exposure assessment information will be useful in developing emission reduction measures for priority emission categories.

Figure 98 below provides an overview of the steps in the PATS model.

Figure 98 PATS Modeling Flowchart



10.4.2 Dispersion Model

Sections 12.4.2.1 to 12.4.2.4 below outline the steps taken to prepare the PATS model.

10.4.2.1 Model Selection

CALPUFF version 5.8 was selected as the PATS dispersion model. It is a non steady-state Gaussian puff model that can model reactive decay and physical pollutant removal, or deposition. Due to the model's limited chemistry, it is unable to model secondary organic aerosols. However, the movement and dispersion of puffs occur within spatially and temporally varying wind fields that reflect complex terrain.

10.4.2.2 Modeling Domain

- Determine modeling domain based on risk, population and development.
- Adjust domain size and grid size based on land use, met review and census data.

10.4.2.3 Calpuff Modeling Data and Parameters

10.4.2.3.1 Calmet and Meteorology

- Determined 1999 meteorological data was representative for ten year period.
- Performed quality assurance of data and compared land use files, obtained updated land use file.
- Created Calmet windfields.

10.4.2.3.2 Calpuff Modeling Options

- Ran each source category separately.
- Identified and assigned receptor locations.
- Performed post processing.
  - Summed concentrations from all source categories.

10.4.2.3.3 Pollutants of concern to model

- Compared emission inventory 1999, 2002, and 2005 data for four counties and listed pollutants.
- Looked at estimates and compared to monitoring analysis.
- Sent list of pollutants to be modeled and description of why we selected each pollutant on GovDelivery list for public comment.

10.4.2.4 Quality Assurance/Quality Control

- Compared modeled to monitored data.
- Evaluated Confidence in Ambient Modeled Data.
- Adjusted emission inventory based on model to monitor comparison.

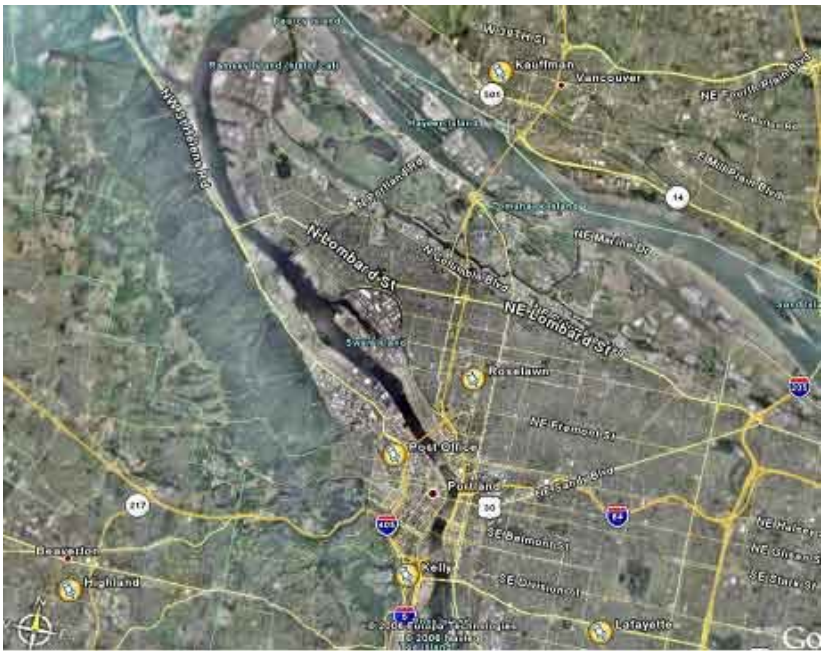
10.5 PATS Monitoring Analysis

10.5.1 Monitoring Sites

The Portland, Oregon and Vancouver, Washington metropolitan area has significant topographic features that separate the airshed into distinct sections. Located at the confluence of two rivers, much of it is within a broad valley/floodplain, with a range of hills on the west separating the central city from the western suburbs. The Columbia River on the north separates Portland from Vancouver, although it has traditionally been considered a single airshed for planning purposes. The Willamette River, which divides Portland into its east and west sides, influences air flow to some extent.

In 2005, there were six monitoring sites in the Portland metro area. Monitoring sites were located in all the major quadrants of the city, in order to provide information about the effect of topography as well as source influence. Each site, described below, met EPA's neighborhood-scale siting criteria, representing a mix of surrounding land uses, although in most cases neither point, area, or mobile sources predominated. An aerial photo of the Portland/Vancouver urban area with monitoring sites indicated is shown in Figure 99.

Figure 99 Portland / Vancouver Airshed with Monitoring Sites



10.5.2 Sample Collection and Analysis

DEQ's primary objective in the 1999 monitoring study was to determine annual average concentrations of air toxics to compare to exposure concentrations responsible for potential chronic health effects and cancer risk. Sampling for the project began in January 2005 and continued until February 2006. Several different sampling schedules were followed: carbonyls, volatile organics, PM_{10} metals, and chromium (VI) were

done on a one in six day schedule, to coincide with the national particulate network; and semi-volatile organics (polycyclic aromatic hydrocarbons or PAH) on a one in 12 day schedule. DEQ collected integrated 24 hour samples for air toxics analyses that could then be averaged over a 12 month period.
It is important to use standard methods along with adequate control and assessment to assure quality data collection. The Oregon Department of Environmental Quality has an agency-wide Quality Management Plan; the DEQ Laboratory Division has a Quality Management Plan for the ambient air monitoring program, including air toxics. Both Quality Management Plans have been reviewed and approved by EPA Region X.

EPA Compendium Methods for both sampling and analysis were used to measure gas phase pollutants, ensuring consistency with studies being done across the country. Method TO-14a (six liter Summa canisters) couples gas chromatography with mass spectrometry (GC/MS) to measure forty volatile organic pollutants. For PATA this sampling method included the air toxics benzene, 1, 3-butadiene, and tetrachloroethylene. For PATS, this sampling method is the same. Method TO-11 (DNPH cartridges) employs ion chromatography (IC) to measure sixteen carbonyls; PATA's focus was primarily on acetaldehyde and formaldehyde. GC/MS, Method TO-13A (PUF), was used to measure concentrations of twenty seven semi-volatile organics, including the fifteen carcinogenic PAHs.

Federal Reference Methods were used for particulate (PM 2.5) sampling and mass analysis, providing consistency with our historic data and with other national studies. After particulate mass was determined, samples were analyzed for their metal content (21 elements) using EPA Method IO-3, X-Ray Fluorescence (XRF) Spectroscopy. Over 100 individual chemical species were measured during this year-long monitoring study and included arsenic and nickel.

There was only one toxic that was outsourced and not processed and analyzed by the DEQ laboratory. A local contract Laboratory, certified by the National Environmental Laboratory Accreditation Program for hexavalent chromium, was responsible for the hexavalent chromium analysis.
There was no acceptable method for measuring acrolein or diesel particulate so there is no monitoring comparison for the model for these two air toxics.

10.5.3 Data Limitations and Results

Over 85% of the scheduled samples were collected and analyzed, and duplicate/replicate sample analyses indicated a better than 15% precision in results. Detection limits did not reach concentrations corresponding to the one in a million risk threshold for all the parameters measured. Accuracy was not always better than 15%, as measured by EPA coordinated inter-laboratory Performance Evaluation studies (PE). Between December 2004 and July 2006, when sample analyses were completed, the DEQ Lab participated in six PE for carbonyls, four PE for VOC, and three PE for metals. Analyses of formaldehyde and acetaldehyde were generally within 5% of the known values. Metals, except for beryllium, were usually within a few percent as well; although in May of 2006 reported values were high, as much as 15%. Accuracy of the volatile organics showed considerable variation over the course of the project, and with accuracy of measurement compound-specific. In late 2004, most of the reported values were much better than the 15% objective; some high and some low, indicating no particular bias in results. But studies in April and July of 2005 generally showed results to be low on the order of 20% or more across all pollutants. In December, most parameters were improved and were again less than 10% different from the known value, however they remained consistently low.

Table 46 compares the annual averages of core urban pollutants for all six sites. Annual averages were calculated from quarterly averages from January 2005 – February 2006. Quarterly median data was substituted for missing values to complete data sets. In particular, Beaverton had no data for the 3rd quarter, so the annual average was calculated based on the 1st, 2nd, and 4th quarters only. However, benzene has been measured since 1997 until current. For some pollutants, monitoring began in February

2005 and ran until February 2006 since not all the equipment was set up for all sites within the month of January. In these cases, January 2006 data was used instead of January 2005 data for annual averages. Regardless, all averages were calculated per DEQ protocol. Many of the core VOC were never, or seldom, measured above the minimum reporting limit. This includes 1,3-butadiene, carbon tetrachloride, chloroform, 1,2-dichloropropane, tetrachloroethene, trichloroethene, and vinyl chloride. Where the annual average was less than the minimum reporting limit it is reported as < minimum reporting limit.

The PAH annual average values are questionable because quality controls (holding times and surrogate recoveries) were not always within acceptable limits, resulting in down-graded reported results. All valid samples were used in calculating the annual averages.
Benzene's annual average was not calculated due to a pump contamination issue, which affect sampling. Since more than 75% of the samples in three of the calendar quarters of 2005 were determined to be invalid, an annual average was not calculated. The sampling problems encountered with these VOC canisters were identified because of the Laboratory's comprehensive quality controls. Although benzene data values are not complete for calendar year 2005, this pollutant has been measured at the NE Roselawn site since 1997 until current. Therefore, sufficient data for benzene is available for analyses.

Table 46 Annual Averages

Pollutant Name	Units	Beaverton	SE Lafayette	Post Office	NE Roselawn	Kelly & Curry	Vancouver
Acetaldehyde	ug/m3*	1.25	1.64	1.66	1.53	1.48	1.43
Formaldehyde	ug/m3*	1.58	2.14	2.4	2.17	2.16	1.97
1,3-butadiene	ppbv**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Carbon tetrachloride	ppbv**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloroform	ppbv**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
1,2-dichloropropane	ppbv**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Methylene Chloride	ppbv**	0.08	0.33	0.16	0.13	0.11	0.13
Tetrachloroethene	ppbv**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Trichloroethene	ppbv**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Vinyl chloride	ppbv**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
o-Xylene	ppbv**	0.11	0.33	0.25	0.19	0.12	0.14
m,p-Xylene	ppbv**	0.28	0.51	0.69	0.55	0.33	0.39
Toluene	ppbv**	0.69	1.12	1.93	1.13	0.89	0.91
PAH	ug/m3*	0.00071	0.00085	0.00064	0.00062	0.00057	0.00085
Naphthalene	ug/m3*	0.0015	0.0014	0.0016	0.0012	0.0014	0.0019
Arsenic	ng/m3***	1.06	1.32	0.93	1.74	1.22	1.03
Beryllium	ng/m3***	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium	ng/m3***	0.38	0.50	0.63	2.57	0.92	0.49
Chromium	ng/m3***	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2
Chromium (VI)	ng/m3***	<0.042	<0.042	0.045	<0.042	<0.042	<0.042
Lead	ng/m3***	3.18	5.72	6.60	11.7	5.79	3.82
Manganese	ng/m3***	3.8	6.4	41.9	15.9	19.2	8.0
Nickel	ng/m3***	<1.0	1.75	4.24	1.76	1.78	1.09

*ug/m3 = micrograms per cubic meter – an air pollutant concentration
** ppb = parts per billion by volume – an air pollutant concentration
*** ng/m3 = nanograms per cubic meter – an air pollutant concentration

10.5.4 PATSAC Monitoring Presentation

- ***Document Title: Portland Air Toxics Solutions Air Monitoring*** A PowerPoint monitoring presentation for PATSAC including data plotted by year is available at: http://www.deq.state.or.us/aq/toxics/docs/PATSMonitoring.pdf .

10.5.4 Pollutant Monitoring Charts

- ***Document Title: 2005 Monitoring.*** This presentation contains graphs and ambient benchmark concentrations for PATS 2005 air toxics monitoring for PATS pollutants. http://www.deq.state.or.us/aq/toxics/docs/2005monitoringArsenic.pdf

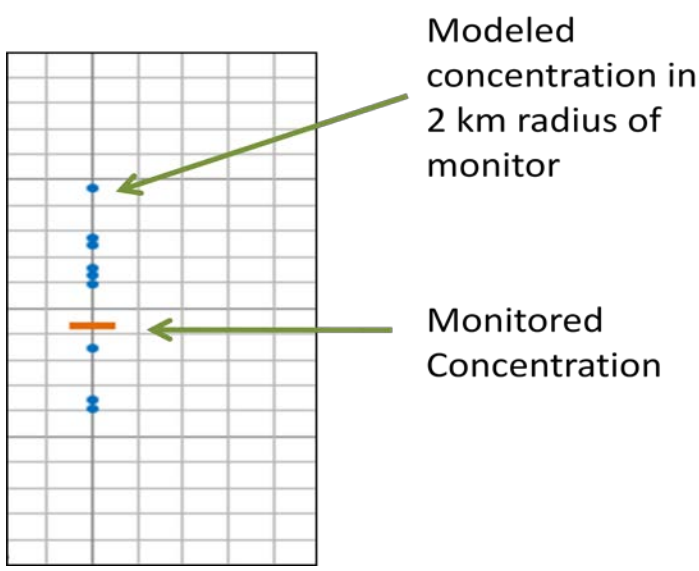
10.6 2005 Model to Monitor Comparison Results

Model to monitor comparison is usually conducted to validate model performance. Extensive work on 1999 model/ monitor comparison was done within the original PATS study and is described in PATS report. We compared the 2005 ambient concentrations with 2005 modeled concentrations. The difference between modeled and monitored concentrations may be attributed to underestimated, overestimated or missing emissions data and/or uncertainty in chemical transformation (for aldehydes).
2005 annual average ambient concentrations of eight air toxics (acetaldehyde, formaldehyde, benzene, arsenic, cadmium, lead, nickel, and manganese) were measured at six monitoring stations within the PATS domain.

10.6.1 Modeled data

In order to conduct a model to monitor comparison, the annual average of model estimates at all receptors within a radius of 2km of the monitor were compared to the annual average concentrations measured by the monitor. This approach was used to account for the variability in the spatial allocation of emissions, the variability in meteorological data quality, and the limitations inherent in matching paired-in-space-and-time concentrations.

Figure 100 Example Model to Monitor Comparison Results



Background concentrations were added to all modeled values to account for transport of regional emissions from outside the PATS study area, unidentified emission sources, natural emission sources, and for the aldehydes, the secondary formation through chemical transformation. These background estimates were

developed by EPA for the 2002 National Air Toxics Assessment (NATA), and are based on measured air toxics concentrations throughout the United States.

10.6.2 Meteorological data

The annual average modeled concentrations, which were developed using 1999 meteorology, are compared to monitored concentrations measured during 2005. However, an analysis of annual average meteorology for 1999 and 2005 showed no significant differences, and the 1999 meteorological data is considered representative for 2005.

Figure 101 Wind Speed, 1999 and 2005 Comparison

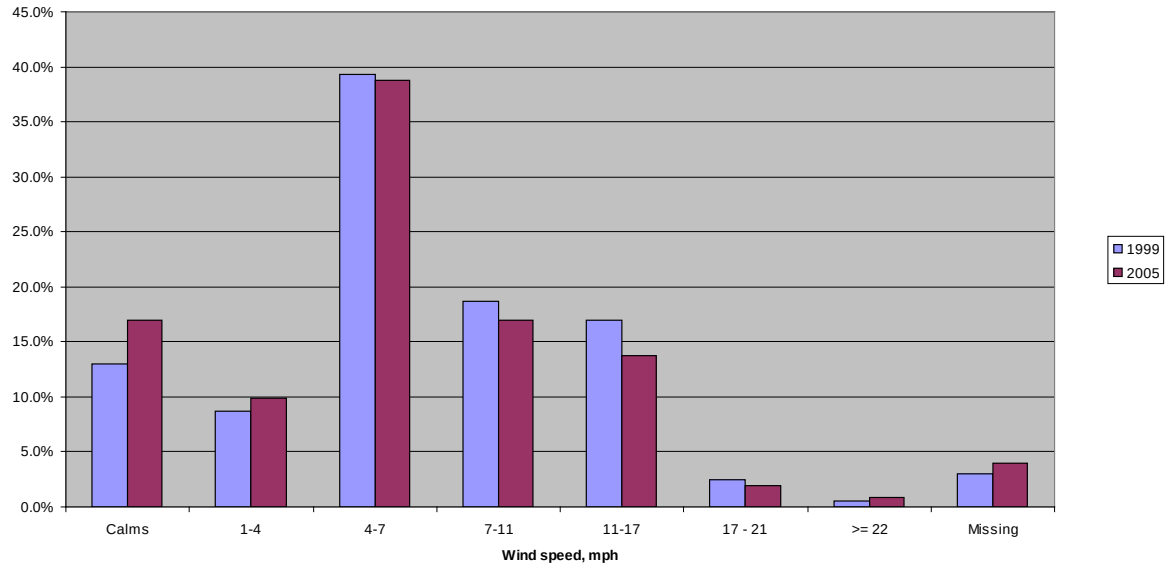
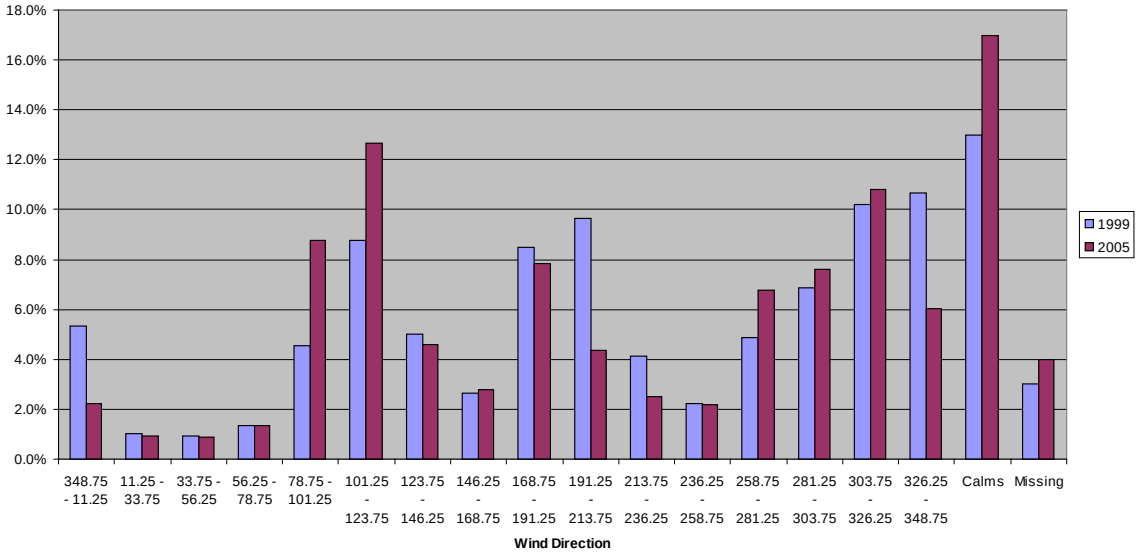


Figure 102 Wind Direction, 1999 and 2005 Comparison



10.6.3 Acetaldehyde and Formaldehyde

Ambient monitored concentrations of acetaldehyde and formaldehyde are largely the result of secondary formation from precursor VOC emissions. Modeled concentrations are of primary emissions only, and the 2002 NATA background concentrations have been added to the primary concentrations in order to account for the contribution from the secondary formation. In general, the corellation between modeled and monitored values is good for these two pollutants.

Figure 103: 2005 Acetaldehyde Model to Monitor Results

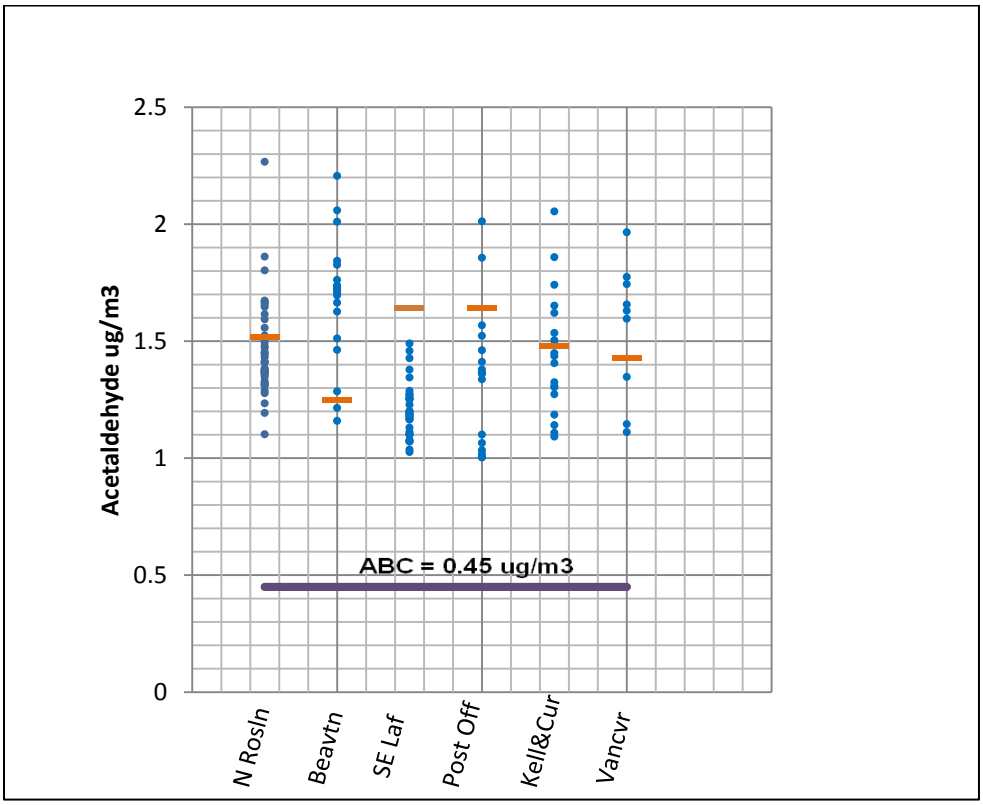
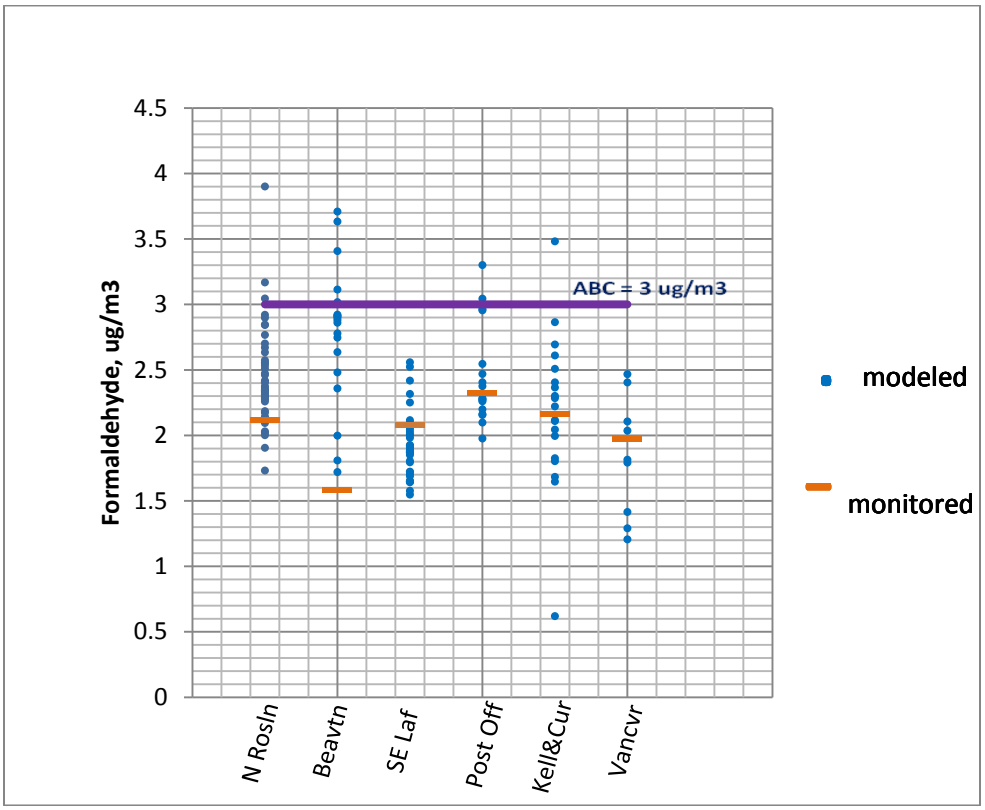


Figure 104: 2005 Formaldehyde Model to Monitor Results



10.6.4 Benzene and Nickel

Modeled concentrations of benzene are over predicted throughout the domain. With the exception of the NW Post Office, Vancouver, and possibly North Roselawn, nickel is also over predicted. Benzene is found in airborne emissions from burning coal and oil, motor vehicle exhaust, and evaporation from gas stations and industrial solvents. Nickel emissions can be from oil and coal combustion, nickel metal refining, sewage sludge incineration, manufacturing facilities, and other sources. It is not clear if there is a common cause of over-prediction for these two toxics.

Figure 105: 2005 Benzene Model to Monitor Results

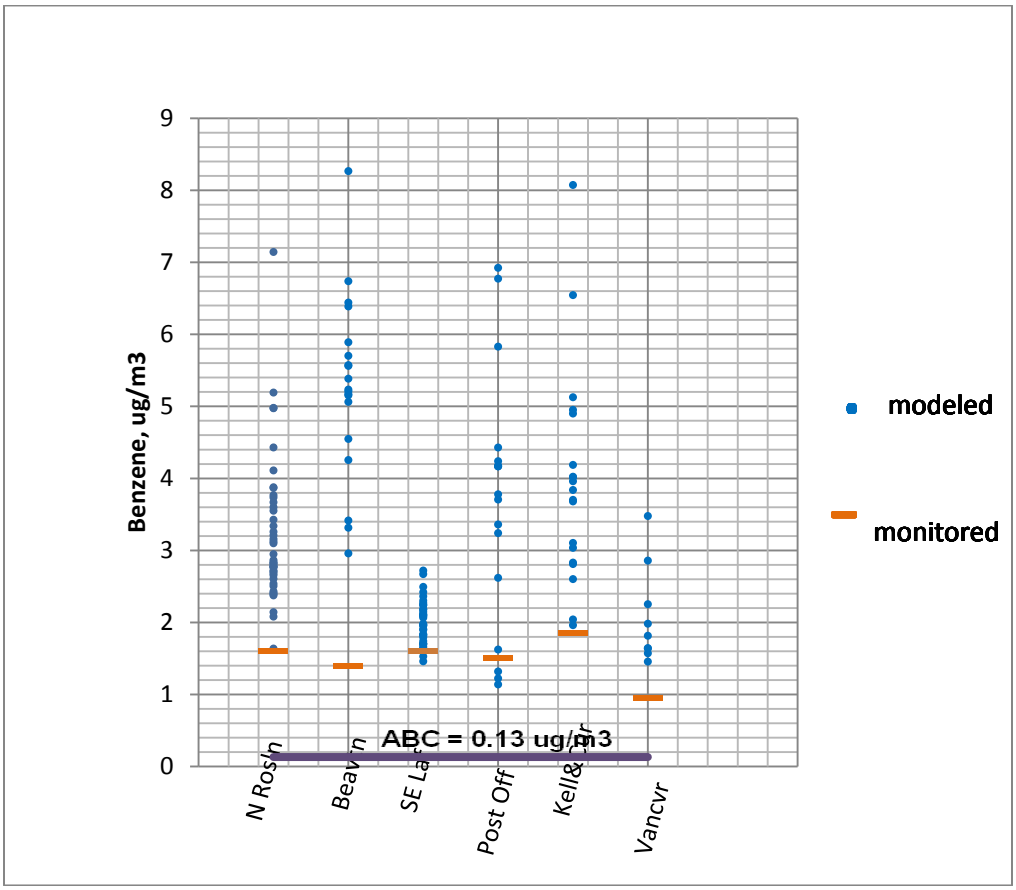
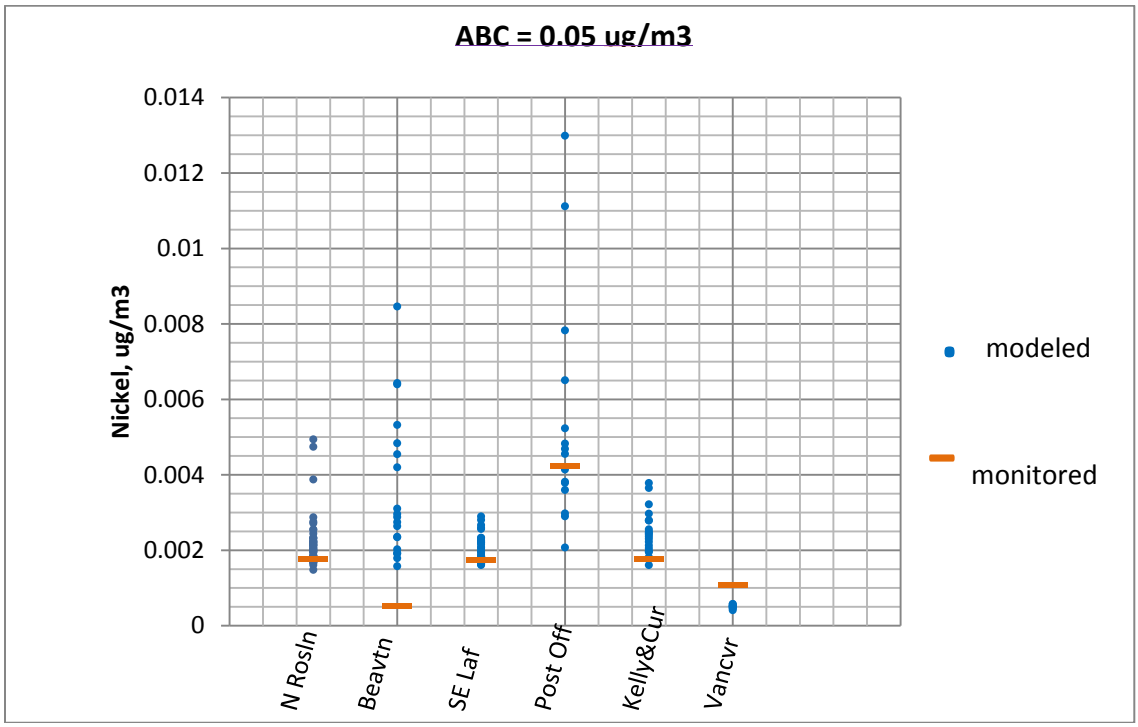


Figure 106: 2005 Nickel Model to Monitor Results



10.6.5 Arsenic, Cadmium, Lead and Manganese

The other metals (Lead, Arsenic, Manganese, and Cadmium) are under predicted at North Roselawn and SE Lafayette, cadmium and lead are also under predicted at Kelley & Curry, and manganese is under predicted throughout the domain.

Figure 107: 2005 Arsenic Model to Monitor Results

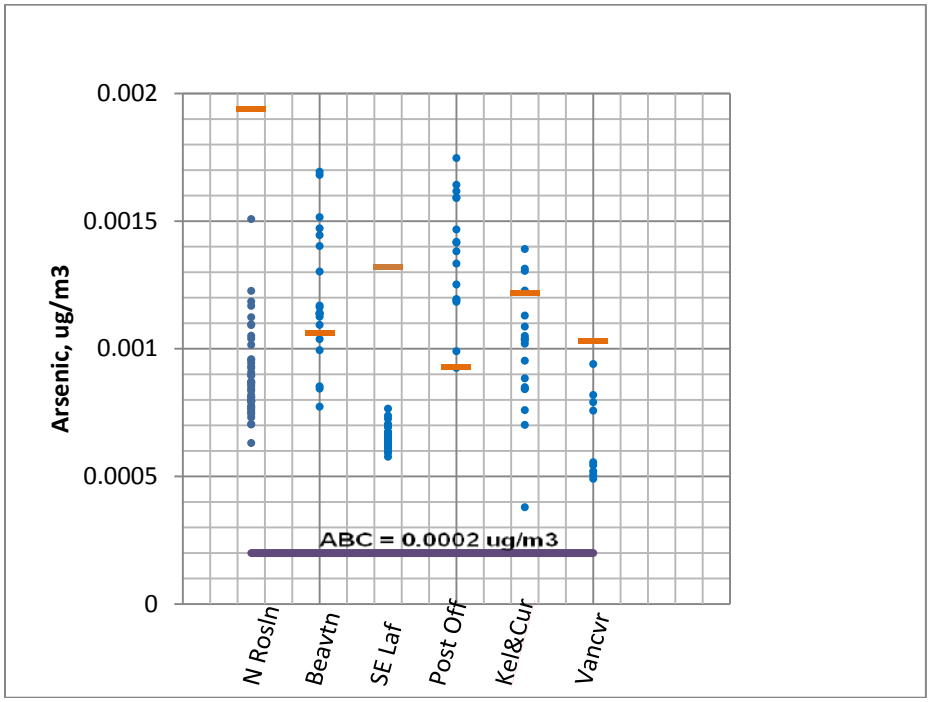


Figure 108: 2005 Cadmium Model to Monitor Results

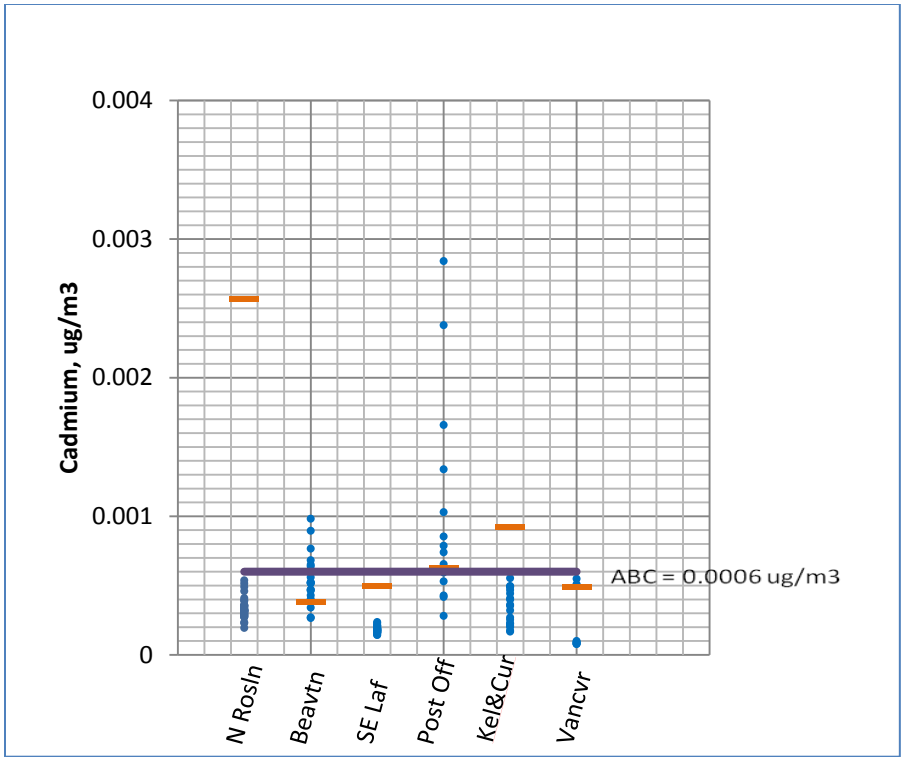


Figure 109: 2005 Lead Model to Monitor Results

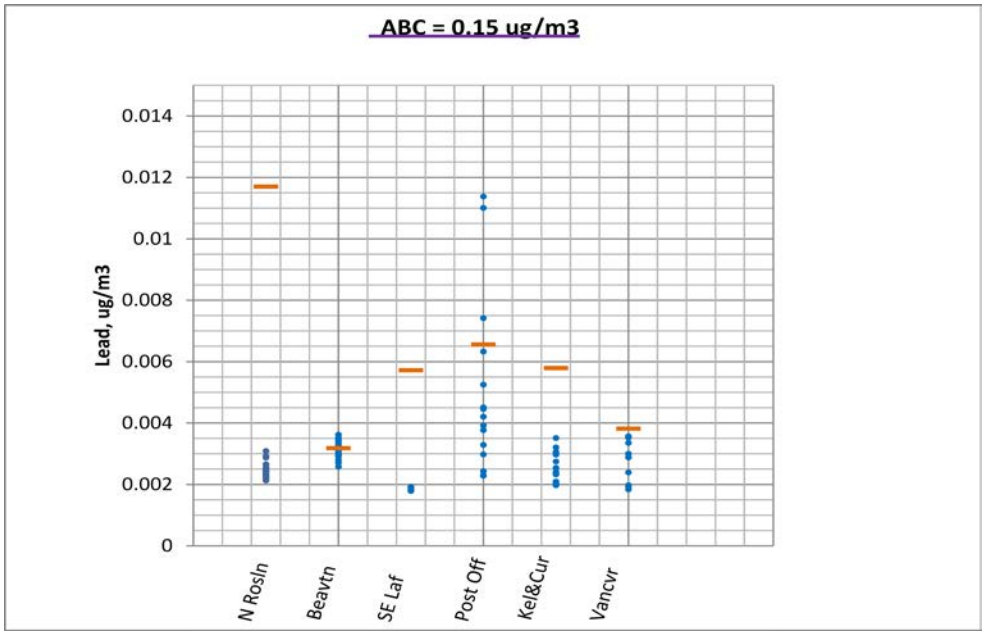


Figure 110: 2005 Manganese Model to Monitor Results

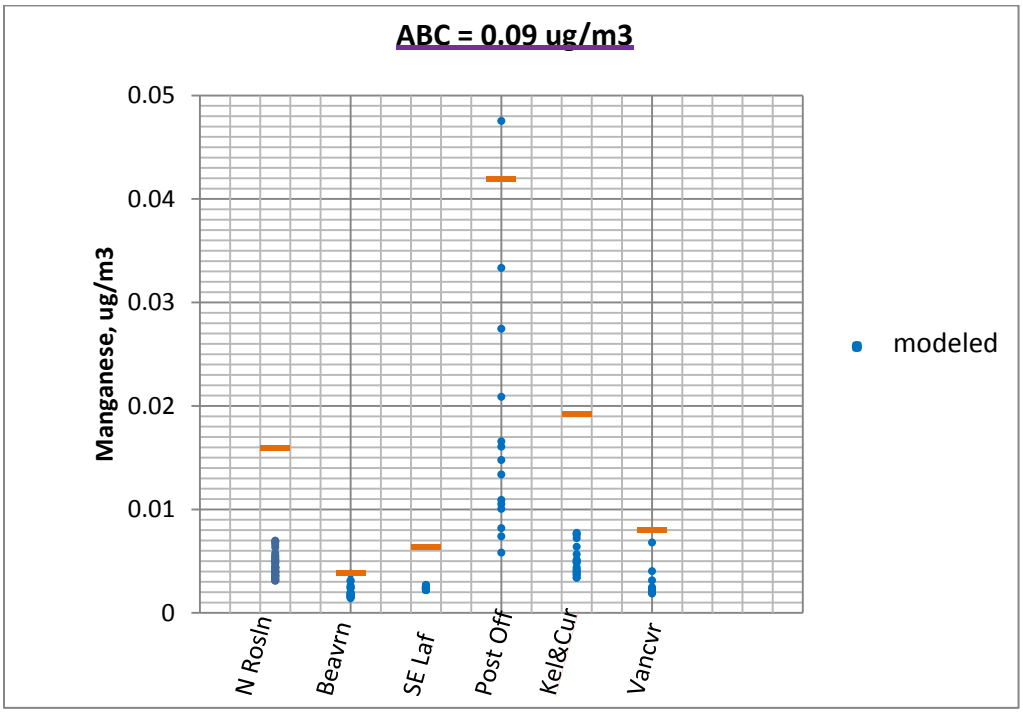
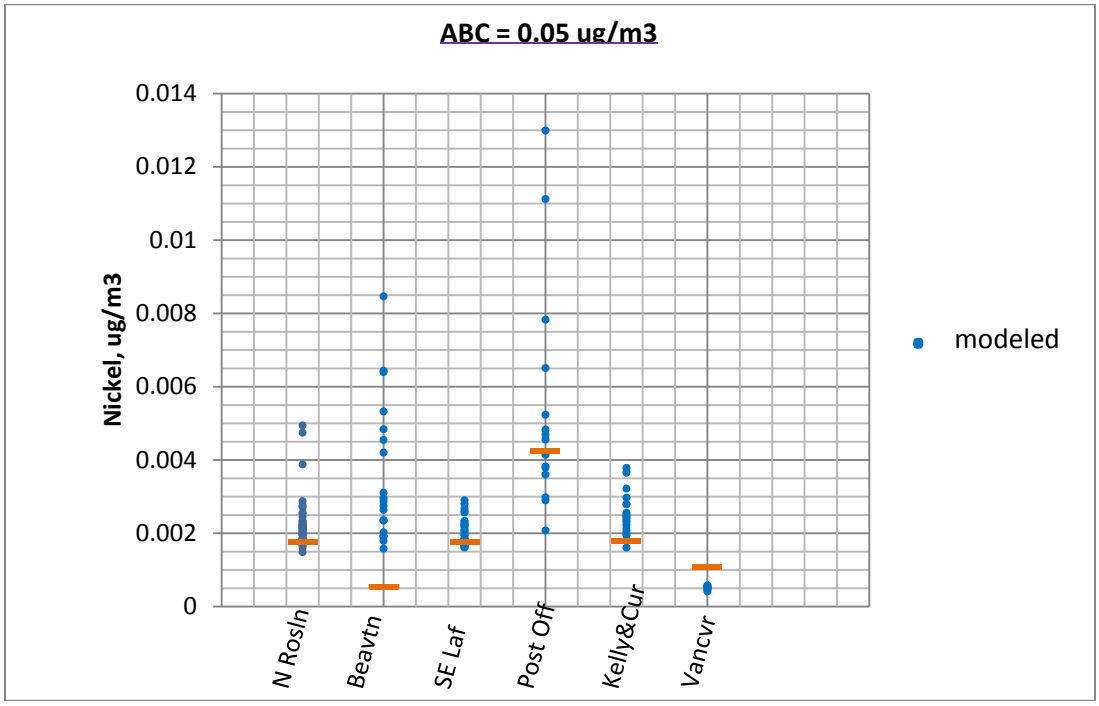


Figure 111: 2005 Nickel Model to Monitor Results



10.6.6 Monitor to Model Comparison Conclusions

According to US EPA (2201), studies of the performance of long-term air Quality models suggest that 90% of the estimated concentrations should be within a factor of two of those observed. This should be the case if the emissions are well characterized, chemical reactions that may form or remove pollutants do not occur, and the meteorological data are representative. In general, the results suggest that the CALPUFF model does a credible job of predicting ambient concentrations.

http://www.epa.gov/ttn/atw/sab/03-sab-nata-modeling.pdf

10.6.7 Cadmium Memo

- ***Document Title: North Portland Cadmium Source Investigation.*** As a follow-up to the modeling and monitoring comparison discussion of last meeting, this memo summarizes the history of DEQ's investigation into ambient air cadmium measurements in North Portland. http://www.deq.state.or.us/aq/toxics/docs/pats/cadmium.pdf

10.6.8 Additional Applications for Monitoring Information

- Reports on Oregon's air quality (http://www.deq.state.or.us/aq/forms/annrpt.htm);
- Air quality forecasting, wood stove burning advisories and air quality health alerts (http://www.deq.state.or.us/aq/advisories/index.htm);
- The Air Quality Index (http://www.deq.state.or.us/aqi/index.aspx);
- Forest fire smoke health alerts (http://www.deq.state.or.us/aq/burning/wildfires/neap.htm);
- The Wildfire Air Quality Rating (http://www.deq.state.or.us/aqi/wildfire/index.htm); and

- EPA's AIRNow nationwide website (http://www.airnow.gov/index.cfm?action=airnow.fcsummary&stateid=43).

10.7 Air Toxics Pollutant Summary

Document Title: Air toxics Pollutant Summaries. This document provides summaries of the best information DEQ has at this time. This document contains a general description of the pollutant, human-caused sources, health effects, the Oregon ambient benchmark concentration and whether each pollutant in Portland is above or below the benchmark based on modeling projections for 2017. The benchmark is the concentration of an air toxic in outdoor air that would result in an excess lifetime cancer risk level of one in a million or a non-cancer hazard quotient of one as established by the Air Toxics Science Advisory Committee. Each pollutant description includes a pie chart showing relative contributions from sources for each pollutant in the Portland area. http://www.deq.state.or.us/aq/factsheets/05-AQ-003_AirToxics.pdf

10.8 Emission Reduction Targets

The tables below provide additional emission reduction targets for mobile, area and point sources.

10.8.1 Mobile Sources

Table 47: On Road Mobile Potential Emission Reduction Targets

Impact around roadways: 500m	Average Concentration (ug/m3)	Benchmark (ug/m3)	Approximate Reduction Needed	Projected 2017 Emissions (tpy)	Potential Reduction Needed (tpy)
Acrolein	0.131	0.02	85%	4.12	3.5
1,3-Butadiene	0.249	0.03	88%	25.55	22.5
Formaldehyde	0.667	0.077	88%	80.82	71.1
Naphthalene	0.159	0.03	81%	9.15	7.4
Benzene	0.956	0.13	86%	205.98	177.1
Diesel PM	1.117	0.1	91%	81.72	74.4
Ethylbenzene	0.631	0.4	37%	85.61	31.7
Arsenic	0.000558	0.0002	64%	0.13	0.1
Chromium VI	0.000107	0.00008	25%	0.03	0.008
PAH - 15	0.018	0.0009	95%	1.04	0.98

Table 48: Non Road Mobile Construction Potential Emission Reduction Targets

Construction: analysis of the top 20% receptors					Area-Wide	
	All Source Categories				Construction Category	
	Average Concentration (ug/m3)	Benchmark (ug/m3)	Times> ABC	Approx Reduction needed	Projected 2017 Emissions (tpy)	Potential Reduction Needed (tpy)
Acrolein	0.1270	0.02	6.35	**84.1%**	1.1	0.95
1,3 Butadiene	0.2812	0.03	9.37	**90.5%**	1.3	1.1
Formaldehyde	0.6616	0.077	8.59	**88.9%**	42.6	37.9
Naphthalene	0.2105	0.03	7.02	**84.3%**	0.2	0.2
Benzene	0.9551	0.13	7.35	**87.4%**	11.7	10.2
Dichlorobenzene	0.1493	0.09	1.66	**48.4%**	0	0
Diesel PM	1.2209	0.1	12.21	**92.5%**	247.3	228.7
Ethylbenzene	0.6557	0.40	1.64	**46.7%**	4.2	2.0
Arsenic	0.0005	0.0002	2.40	**61.5%**	0.011	0.007
Chromium VI	0.0001	0.00008	1.11	**14.7%**	5.9E-05	8.7E-06
PAH-15	0.0219	0.0009	24.33	**96.3%**	0.19	0.18

Table 49: Non Road Mobile Rail Potential Emission Reduction Targets

Rail: analysis of the top 20 % of receptors					Rail Category	
	All Source Categories					
	Average Concentration (ug/m3)	Benchmark (ug/m3)	Times> ABC	Approx. Reduction needed	Projected 2017 Emissions (tpy)	Potential Reduction Needed (tpy)
Acrolein	0.1415	0.02	7.08	**84.2%**	0.20	0.17
1,3 Butadiene	0.2175	0.03	7.25	**89.3%**	0.21	0.18
Formaldehyde	0.5467	0.077	7.10	**88.4%**	2.8	2.5
Naphthalene	0.1806	0.03	6.02	**85.7%**	0.11	0.09
Benzene	0.7515	0.13	5.78	**86.4%**	0.20	0.17
Dichlorobenzene	0.0769	0.09	0.85	**39.7%**	0	0
Diesel PM	0.9545	0.1	9.54	**91.8%**	38.8	35.6
Ethylbenzene	0.4288	0.40	1.07	**39.0%**	0.16	0.06
Arsenic	0.0004	0.0002	2.05	**58.3%**	4.7E-05	2.7E-05
Chromium	0.0001	0.00008	1.00	**9.7%**	1.1E-07	1.1E-08
PAH-15	0.0152	0.0009	16.89	**95.9%**	0.06	0.06

Table 50: Non Road Mobile Marine Potential Emission Reduction Targets

Commercial & Recreational Marine: analysis of the top 20 % of receptors					Marine Category	
	All Source Categories					
	Average Concentration (ug/m3)	Benchmark (ug/m3)	Times> ABC	Approx. Reduction needed	Projected 2017 Emissions (tpy)	Potential Reduction Needed (tpy)
Acrolein	0.1180	0.02	5.90	**85.9%**	0.10	0.08
1,3, Butadiene	0.1893	0.03	6.31	**86.2%**	0.37	0.32
Formaldehyde	0.4712	0.077	6.12	**85.9%**	4.1	3.5
Naphthalene	0.1524	0.03	5.08	**83.4%**	0.54	0.45
Benzene	0.6374	0.13	4.90	**82.7%**	4.8	4.0
Diesel PM	0.8191	0.1	8.19	**89.5%**	8.0	7.2
Ethylbenzene	0.3752	0.40	0.94	**6.7%**	3.0	0.2
Arsenic	0.0003	0.0002	1.69	**51.3%**	0.0007	0.0004
PAH-15	0.0126	0.0009	14.04	**94.1%**	0.012	0.012

10.8.2 Area Sources

Table 51: Residential Wood Combustion Potential Emission Reduction Targets

RWC: analysis of the of the top 20% receptors					RWC Category	
All Source Categories						
	Average Concentration (ug/m3)	Benchmark (ug/m3)	Times> ABC	Approx. Reduction needed	Projected 2017 Emissions (tpy)	Potential Reduction Needed (tpy)
Acrolein	0.1273	0.02	6.36	**84.3%**	8.17	6.9
1,3 Butadiene	0.2872	0.03	9.57	**89.6%**	23.75	21.3
Formaldehyde	0.6576	0.077	8.54	**88.3%**	159.77	141.1
Naphthalene	0.1721	0.03	5.74	**82.6%**	25.20	20.8
Benzene	0.8335	0.13	6.41	**84.4%**	130.34	110.0
Dichlorobenzene	0.1304	0.09	1.45	**31.0%**	0	0
Diesel PM	0.9910	0.1	9.91	**89.9%**	0	0
Ethylbenzene	0.5463	0.40	1.37	**26.8%**	0	0
Arsenic	0.0004	0.0002	1.91	**47.6%**	0	0
PAH-15	0.0280	0.0009	31.11	**96.8%**	12.59	12.18

Table 52: Lawn and Garden Potential Emission Reduction Targets

Lawn & Garden: analysis of the the top 20% receptors					Lawn and Garden Category	
	All Source Categories					
	Average Concentration (ug/m3)	Benchmark (ug/m3)	Times> ABC	Approx. Reduction needed	Projected 2017 Emissions (tpy)	Potential Reduction Needed (tpy)
Acrolein	0.1261	0.02	6.30	**89.9%**	1.1	0.97
1,3 Butadiene	0.3163	0.03	10.54	**90.0%**	10.5	9.4
Formaldehyde	0.6940	0.077	9.01	**89.5%**	21.9	19.6
Naphthalene	0.1912	0.03	6.37	**88.3%**	2.5	2.2
Benzene	1.0311	0.13	7.93	**87.5%**	70.8	62.0
Dichlorobenzene	0.1744	0.09	1.94	**37.1%**	0	0
Diesel PM	1.3334	0.1	13.33	**92.3%**	15.1	14.0
Ethylbenzene	0.7506	0.40	1.88	**39.9%**	47.9	19.1
Arsenic	0.0005	0.0002	2.60	**63.3%**	0.009	0.006
Chromium	0.0001	0.00008	1.17	**17.7%**	0.0008	0.0001
PAH-15	0.0241	0.0009	26.81	**96.0%**	0.61	0.58

Table 53: Solvent Use Potential Emission Reduction Targets

Solvent Use: analysis of the of the top 20% receptors					Solvent Use Category	
	All Source Categories					
	Average Concentration (ug/m3)	Benchmark (ug/m3)	Times> ABC	Approx. Reduction needed	Projected 2017 Emissions (tpy)	Potential Reduction Needed (tpy)
Formaldehyde	0.7655	0.077	9.94	**89.9%**	1.4	1.3
Naphthalene	0.2580	0.03	8.60	**88.4%**	43.3	38.3
Benzene	1.1450	0.13	8.81	**88.6%**	20.4	18.1
Dichlorobenzene	0.1615	0.09	1.79	**44.3%**	80.7	35.7
Ethylbenzene	0.7489	0.40	1.87	**46.6%**	85.0	39.6

10.8.3 Point Source Emission Reduction Targets

10.8.3.1 Cadmium

The map in Figure 112 below shows pie charts for each industrial facility with significant cadmium emissions. Each pie chart shows relative contributions for the highest impact receptor near those facilities. The map also shows facility source numbers that correspond to the approximate reductions needed list in Table 48 below. Emission inventory and modeling refinements are needed to refine the approximate

reductions listed in Table 48. Model to monitor comparisons for cadmium suggest that there are additional cadmium sources in North Portland that are not included in the model. (See section 3.6) The elevated cadmium levels modeled in the Beaverton area are related to natural gas use.

Figure 112: Total Risk from Cadmium From All Sources (Point, Area, Mobile) with Pie Charts for Point Source Cadmium Emissions

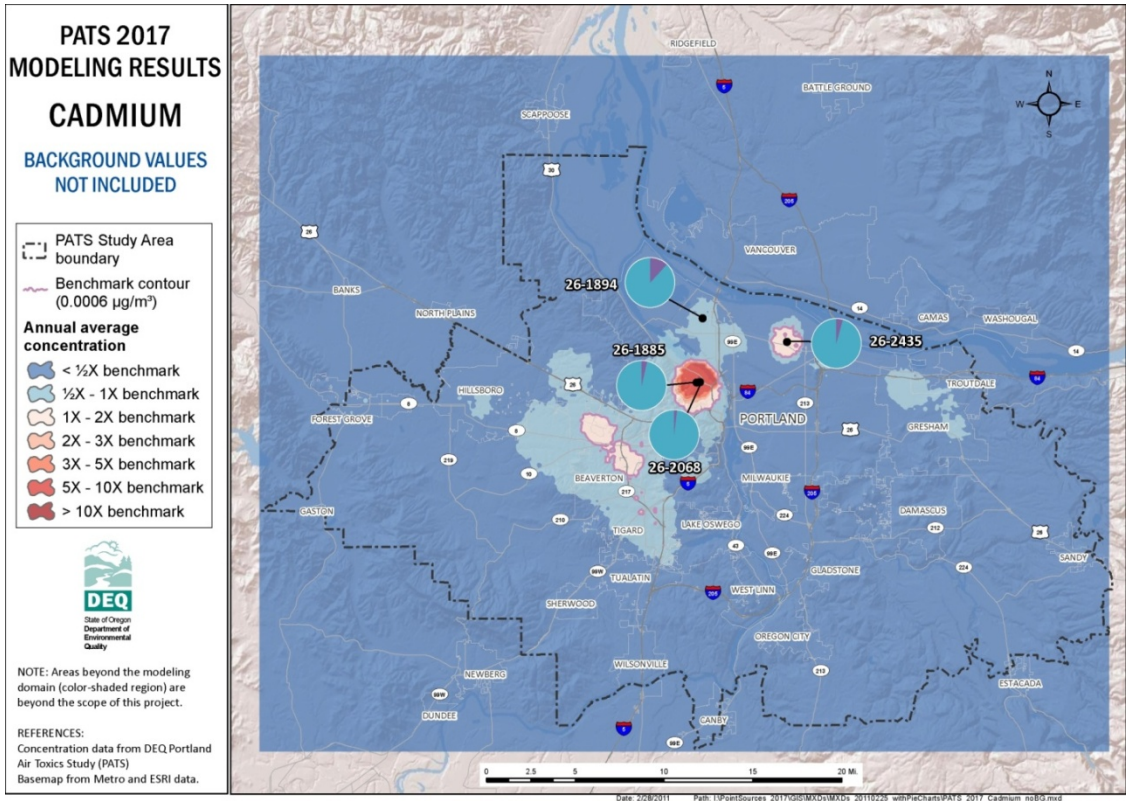


Table 54: Approximate Reduction Needed at Highest Impacted Receptor for Cadmium Point Sources

Source No.	Source Name	Source Category Description	Approximate Reduction Needed at Highest Impacted Receptor	Projected 2017 Emissions (lbs)	Potential Reduction (lbs)
26-2068	ESCO Corporation	Steel Foundries	96%	27	26
26-2435	Cardinal Aluminum	Heating Equipment Manufacturing	84%	11	9
26-1885	Galvanizers Co	Metal Coating, Engraving, and Allied Services to Manufacturers	94%	4	4
26-1894	Malarkey Roofing Company	Asphalt Shingle and Coating Materials Manufacturing	66%	3	2

10.8.3.2 Manganese

The map in Figure 113 below shows pie charts for each industrial facility with significant manganese emissions. Each pie chart shows relative contributions for the highest impact receptor near those facilities. The map also shows facility source numbers that correspond to the approximate reductions needed list in Table 55 below. Emission inventory and modeling refinements are needed to refine the approximate reductions.

Figure 113: Total Manganese Emissions From All Sources (Point, Area, Mobile) with Pie Charts for Point Source Manganese Emissions

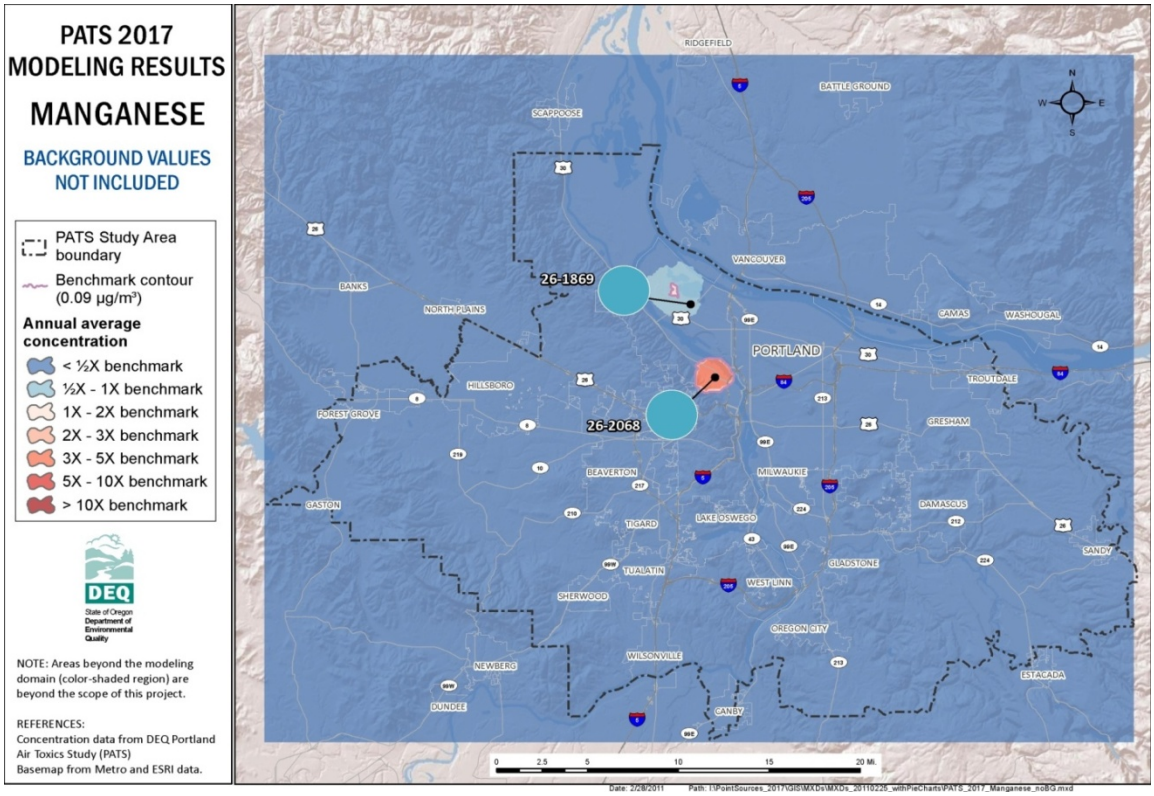


Table 55: Approximate Reduction Needed at Highest Impacted Receptor for Manganese Point Sources

Source No.	Source Name	Primary NAICS description	Approximate Reduction Needed at Highest Impacted Receptor	Projected 2017 Emissions (lbs)	Potential Reduction (lbs)
26-1869	Columbia Steel Casting Co Inc	Steel Foundries	39%	1,951	753
26-2068	ESCO Corporation	Steel Foundries	91%	816	743

10.8.3.3 Nickel

The map in Figure 114 below shows pie charts for each industrial facility with significant nickel emissions. Each pie chart shows relative contributions for the highest impact receptor near those facilities. The map also shows facility source numbers that correspond to the approximate reductions needed list in Table 56 below. Emission inventory and modeling refinements are needed to refine the approximate reductions.

Figure 114: Total Nickel Emissions From All Sources (Point, Area, Mobile) with Pie Charts for Point Source Nickel Emissions

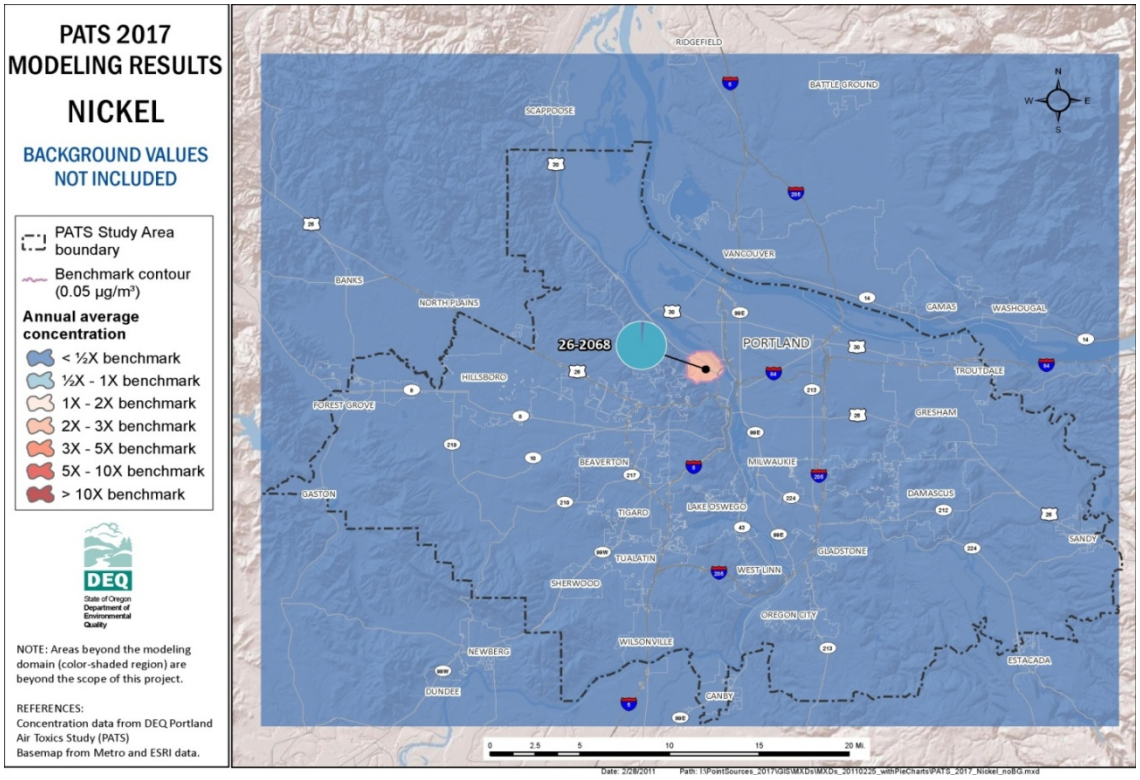


Table 56: Approximate Reduction Needed at Highest Impacted Receptor for Nickel Point Sources

Source No.	Source Name	Source Category Description	Approximate Reduction Needed at Highest Impacted Receptor	Projected 2017 Emissions (lbs)	Potential Reduction Needed (lbs)
26-2068	ESCO Corporation	Steel Foundries	72%	85	62

10.8.3.4 Lead

The map in Figure 115 below shows pie charts for the one industrial facility with lead emissions. There was only one receptor showing a level above the lead benchmark. The map also shows the facility source number that corresponds to the approximate reductions needed list in Table 57 below. Emission inventory and modeling refinements are needed to refine the approximate reductions.

Figure 115: Total Lead Emissions From All Sources (Point, Area, Mobile) with Pie Charts for Point Source Lead Emissions

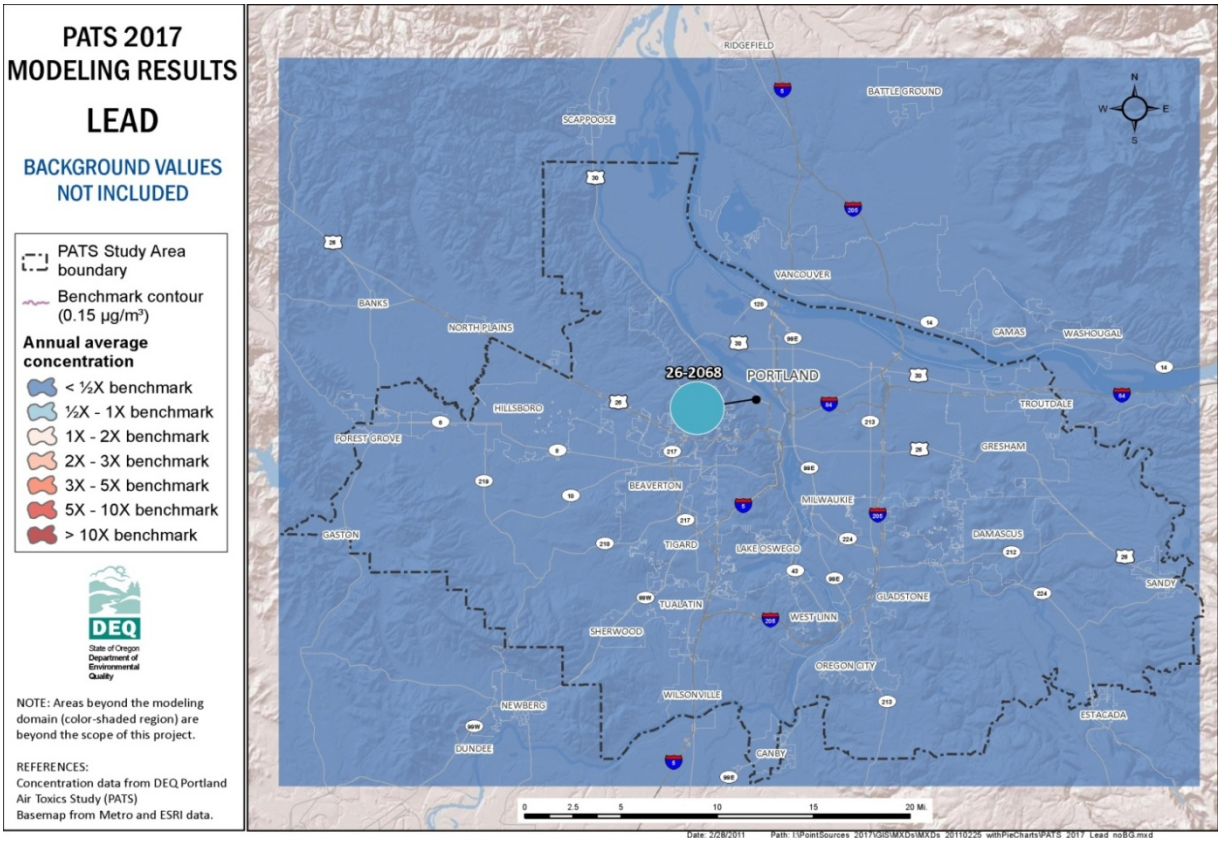


Table 57: Approximate Reduction Needed at Highest Impacted Receptor for Lead Point Sources

Source No.	Source Name	Source Category Description	Approximate Reduction Needed at Highest Impacted Receptor	Projected 2017 Emissions (lbs)	Potential Reduction (lbs)
26-2068	ESCO Corporation	Steel Foundries	49%	167	82

10.8.3.5 Benzene

The map in Figure 116 below shows pie charts for each industrial facility with significant benzene emissions. Each pie chart shows relative contributions for the highest impact receptor near those facilities. The map also shows facility source numbers that correspond to the approximate reductions needed list in Table 58 below. Emission inventory and modeling refinements are needed to refine the approximate reductions.

Figure 116: Total Benzene Emissions From All Sources (Point, Area, Mobile) with Pie Charts for Point Source Benzene Emissions

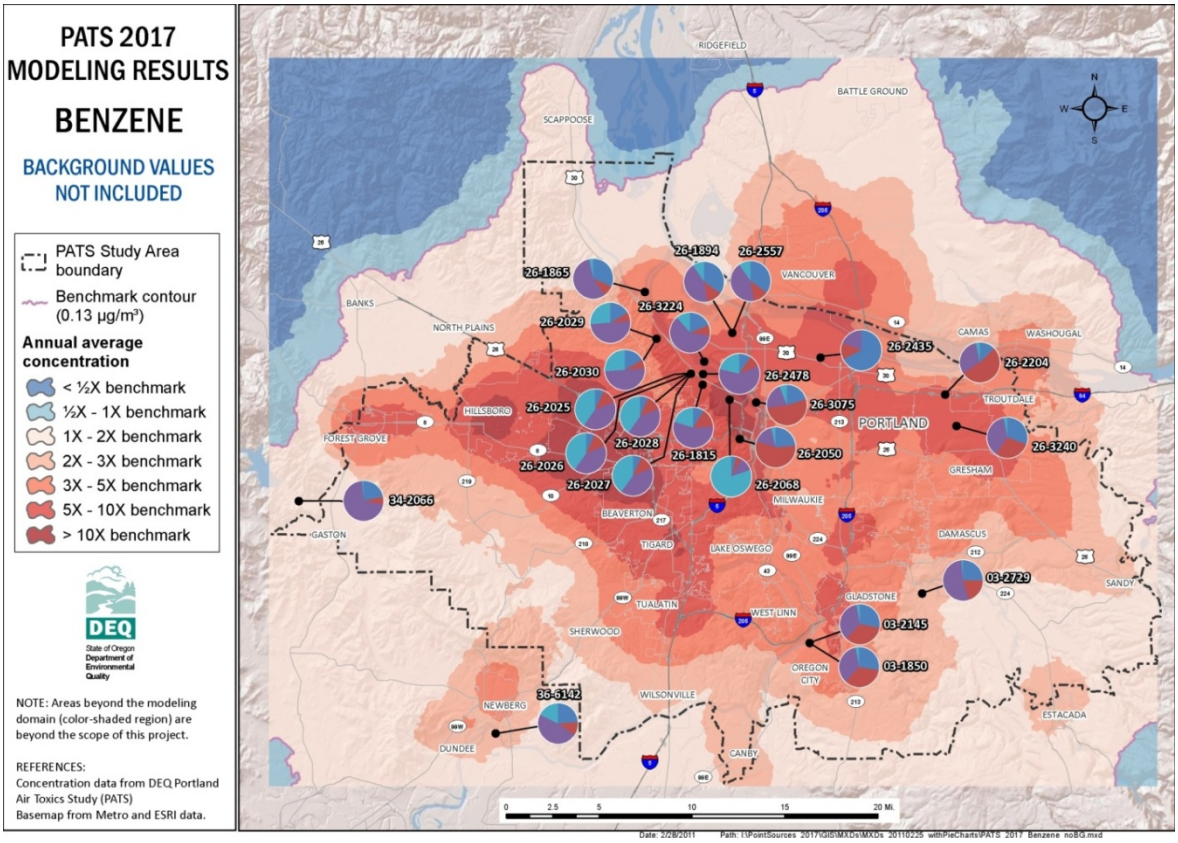


Table 58: Approximate Reduction Needed at Highest Impacted Receptor for Benzene Point Sources

Source No.	Source Name	Source Category Description	Approximate Reduction Needed at Highest Impacted Receptor	Projected 2017 Emissions (lbs)	Potential Reduction (lbs)
26-2068	ESCO Corporation	Steel Foundries	98%	5,269	5,156
36-6142	SP Newsprint Co.	Newsprint Mills	61%	7,517	4,559
26-2030	BP West Coast Products, LLC	Petroleum Bulk Stations and Terminals	84%	1,567	1,309
26-2025	Paramount Petroleum, Willbridge Refinery	Petroleum Refineries	93%	1,020	945
26-2027	Chevron Products Company	Petroleum Bulk Stations and Terminals	93%	1,018	943
26-2028	Kinder Morgan Energy Partners, L.P	General Warehousing and Storage	93%	677	627
26-2029	Shore Terminals LLC	Petroleum Bulk Stations and Terminals	84%	737	616
26-1815	Owens-Corning Corporation	Asphalt Shingle and Coating Materials Manufacturing	91%	505	457
26-2204	Boeing Company (The)	Other Aircraft Parts and Auxiliary Equipment Manufacturing	85%	208	178
03-1850	Blue Heron Paper Company	Pulp Mills	69%	221	152
26-2478	Equilon Enterprises LLC	Petroleum Bulk Stations and Terminals	88%	144	126
26-3224	Vigor Industrial, LLC	Ship Building and Repairing	78%	143	111
26-1894	Malarkey Roofing Company	Asphalt Shingle and Coating Materials Manufacturing	84%	122	102
26-2026	ConocoPhillips	Petroleum Bulk Stations and Terminals	93%	79	73
26-2557	Blasen Blasen Lumber	Sawmills	84%	65	54
03-2729	Northwest Pipeline Corporation	Pipeline Transportation of Natural Gas	48%	113	54
34-2066	Stimson Lumber Company	Sawmills	29%	160	47
26-3075	TARR ACQUISITION LLC	Petroleum Bulk Stations and Terminals	82%	44	35
26-2435	Cardinal Aluminum	Heating Equipment (except Warm Air Furnaces) Manufacturing	88%	21	19
26-1865	Oregon Steel Mills, Inc.	Iron and Steel Mills	48%	5	2
03-2145	West Linn Paper Company	Paper (except Newsprint) Mills	69%	3	2
26-3240	Microchip Technology, Inc.	Semiconductor and Related Device Manufacturing	79%	2	2
26-2050	Oregon Health Sciences University	Hazardous Waste Treatment and Disposal	90%	1	1
26-1876	Owens-Brockway Glass Container Inc.		84%	1	<1

10.9 White Paper Strategy Development

The white papers provide information to inform future committees in post-PATSAC efforts. The White Papers contain:

- A description of the emission source category
- Modeling results
- A summary of existing emission reduction measures
- A brainstorm list of potential new emission reduction measures, evaluated on the following PATSAC considerations: magnitude of emission reductions, timeframe to reduce emissions, technical feasibility, and a cost summary. See section 2.3.3 for the full list of PATSAC considerations.
- Details for each potential new emission reduction measure. There are a host of other PATSAC considerations that were utilized in the selection process for the recommendation framework. The additional considerations include, but not limited to, implementation, funding, non-regulatory approaches, effect on exposure, cost effectiveness, health benefits, and risk distribution. See section 2.3.3 for the full list of PATSAC considerations.

These White Papers are intended solely to provide initial background and survey-level findings for potential emissions reduction measures for the specific source category. The White Papers may contain prepared written statements in the Attachments that represent those group or individual positions only. Not

all participants in the PATSAC process submitted comments to the White Papers. The content included in this White Paper was developed to inform future stakeholder work and may be further investigated and refined.

10.9.1 Area and Mobile Emission Source Categories

- ***Document Title:*** Residential Wood Combustion and Heating
- ***Document Title:*** On-Road Gasoline.
- ***Document Title:*** Nonroad Diesel.
- ***Document Title:*** On-Road Diesel.
- ***Document Title:*** Nonroad Gasoline.
- ***Document Title:*** Solvent/Coating Use-Paint Strippers & Architectural.
- ***Document Title:*** Consumer Products.
- ***Document Title:*** Railroads.
- ***Document Title:*** Unpermitted Industrial Fuel Use.
- ***Document Title:*** Asphalt Use (non-permitted).
- ***Document Title:*** Miscellaneous (Publicly Owned Treatment Works, Landfills, and Restaurants).

10.9.2 Point Source Emission Source Categories

- ***Document Title:*** Asphalt Roofing Manufacturing.
- ***Document Title:*** Bulk Terminals
- ***Document Title:*** Glass Manufacturing.
- ***Document Title:*** Metals Facilities.
- ***Document Title:*** Permitted Industrial Fuel Use.
- ***Document Title:*** Surface Coating.

10.10 Gaps and Growth Documents

10.10.1 PEAC Proposal PEAC Point Source Recommendation.pdf
10.10.2 PEAC Proposal Letter of SupportPEAC Point Source Letter of Support.pdf
10.10.3 Gaps and Growth Matrix Gaps and Growth Matrix 51911.pdf
10.10.4 AOI and OMIC comments on Gaps and Growth Matrix AOI and OMIC.pdf

10.11 Meeting Summaries

1. **August 13, 2009:** http://www.deq.state.or.us/aq/toxics/docs/pats/SummaryMtg1.pdf
2. **April 20, 2010:** http://www.deq.state.or.us/aq/toxics/docs/pats/pATSACactionItems.pdf
3. **June 3, 2010:** http://www.deq.state.or.us/aq/toxics/docs/pats/actionItems6_3_10Meeting.pdf
4. **July 20, 2010:** http://www.deq.state.or.us/aq/toxics/docs/pats/kearnsWest.pdf
5. **October 27, 2010:** http://www.deq.state.or.us/aq/toxics/docs/pats/octoberActionItems.pdf
6. **December 1, 2010:** http://www.deq.state.or.us/aq/toxics/docs/pats/actionItemsMeeting%20Summary12_10.pdf
7. **January 25, 2011:** http://www.deq.state.or.us/aq/toxics/docs/pats/1_25_11ActionItems.pdf
8. **February 10, 2011 (work session, no notes)**
9. **March 2, 2011:** http://www.deq.state.or.us/aq/toxics/docs/pats/march2ActionItems.pdf

10. **April 6, 2011:** http://www.deq.state.or.us/aq/toxics/docs/pats/5_19_11memorandum.pdf
11. **April 14, 2011:** http://www.deq.state.or.us/aq/toxics/docs/pats/5_19_11memorandum2.pdf
12. **May 19, 2011:** http://www.deq.state.or.us/aq/toxics/docs/pats/5_19_11summary%20.pdf
13. **June 21, 2011:** http://www.deq.state.or.us/aq/toxics/docs/pats/6_21_11summary.pdf
14. **October 17, 2011:** http://www.deq.state.or.us/aq/toxics/docs/pats/10_17_11summary.pdf

10.11 Resources for Comparing Emissions from Alternative Fuels

- California has evaluated energy use, criteria pollutants, some air toxics and greenhouse gas emissions for alternative fuels, which covers on-road vehicles. http://www.energy.ca.gov/2007publications/CEC-600-2007-004/CEC-600-2007-004-REV.PDF
- Oregon fuels and alternative fuels would differ slightly for many reasons, including, but not limited to: different electricity sources, Oregon does not have reformulated gas, Oregon has more high carbon intensity crudes than California (which take more energy to refine) in our petroleum mix.
- There is also general info on this US Dept. of Energy website, which covers on-road vehicles: http://www.afdc.energy.gov/afdc/vehicles/emissions.html
- This Argonne National Laboratory study evaluated air toxics emissions of the following fuels and vehicle technologies: conventional gasoline, conventional diesel, federal reformulated gasoline, California reformulated gasoline, compressed natural gas, liquefied natural gas, methanol, ethanol, battery-powered electric vehicles, and hybrid electric vehicles. http://www.transportation.anl.gov/pdfs/TA/137.pdf

- EPA currently has a research project investigating alternative fuel emissions. Vehicles that use alternative fuels such as ethanol blend gasoline and biodiesel are the subject of ongoing research by air quality scientists in EPA's National Risk Management Research Laboratory. Emissions from these two most commonly available fuels are being examined for their potential impacts on environmental and human health. http://www.epa.gov/nrmrl/news/112010/news112010.html

10.12 Recommendations Section Supporting Documentation

10.12.1 Additional Ongoing and Imminent Strategies that will Reduce Air Toxics in the Portland Area

1. Additional Metro actions that will decrease air toxics

   - Since adoption in 1995, Metro, TriMet and local governments have implemented the 2040 Growth Concept, targeting development in those areas with access to local goods and services and transit connections to regional destinations. Among other desired outcomes, the 2040 Growth Concept and implementing regional and local plans aim to reduce and shorten vehicle trips, thereby decreasing VMT and their related emissions.

   - Since the late-90's, Metro's Regional Travel Options program has worked with large employers in the region to help them comply with the Employee Commute Options (ECO) rules by implementing transportation demand management (TDM) strategies. The RTO program also provided technical assistance to Transportation Management Associations (TMAs) in the region, including the Lloyd District TMA, Westside Transportation Alliance and Swan Island TMA; operated the Metro VanPool program and RideshareOnline (via Drive Less/Save More) in addition to partnering with cities to implement individualized marketing residential outreach along high capacity transit corridors in the region.

- Since 1998, Metro's Transit Oriented Development (TOD) program has worked with public and private partners to purchase land located near bus and light-rail stations to create high-density, mixed-use developments to help reduce the amount people drive in the region.

- Since 2006, the Oregon Department of Transportation (ODOT), Metro, TriMet, and other public and private partners have implemented the Drive Less/Save More Campaign to reduce drive-alone car trips in the region.

- Metro is responsible for conducting air quality conformity of regionally-significant transportation projects and programs as part of each RTP update and demonstrates compliance with Transportation Control Measures (TCM) that are included in the Carbon Monoxide Maintenance Plan in coordination with the DEQ and other partners. Air toxics began being reported in the 2035 RTP.

- Under the joint Metro-DEQ Region Clean Refuse Fleet Project, 40 garbage trucks have been tested for compatibility and 98% will be fitted with either a diesel particulate filter or a diesel oxidation catalyst. Testing on eighty additional trucks is pending, with a goal of 120 to 160 trucks eventually having a device installed.

2. Additional Multnomah County actions that will decrease air toxics

- Multnomah County has maintained an active energy program since 1994. This includes authorizing development of solar energy generation projects on County facilities, continuing investigation of the potential for water, wind, and additional solar energy generation projects, efficiency improvements through the retrofit and replacement of energy-using equipment in County facilities and optimizing the operation and control of existing building equipment. In 2001, Multnomah County joined the City of Portland in adopting a revised plan, the Local Action Plan on Global Warming, outlining 150 short- and long-term actions to reduce community-wide greenhouse gas emissions to 10 percent below 1990 levels by 2010.

- Sustainable transportation options are an essential part of our region's strategy to prevent pollution and reduce greenhouse gas emissions. Multnomah County supports the work of regional public transportation agency, Tri-Met and regional transportation planning agency, Metro to reduce greenhouse gases and other air pollutants, including air toxics. Multnomah County's Transportation Planning office manages the development of plans to address all modes of transportation at both the local and regional level.

- Multnomah County has an active Employee Commute Options program. Goals of the program are to reduce the need to drive, promote biking, promote walking, use transit, support carpooling, provide education, create incentives, manage parking, pursue funding, and measure progress. (Source: Multnomah County website: http://web.multco.us/sustainability)

3. Additional Washington County actions that will decrease air toxics

- Washington County's Fleet Services participated in DEQ's ARRA-funded State Clean Diesel grant and retrofitted 16 qualified vehicles with Diesel Particulate Filter Technology.

- Washington County participates in DEQ's Employee Commute Options program and fully subsidizes employees' annual TriMet passes in order to support alternative commute options

4. Additional TriMet actions that will decrease air toxics

- TriMet is the largest biodiesel user in Oregon. TriMet uses a B5 blend of five percent biodiesel and 95 percent petroleum-based diesel in all fixed route LIFT buses. TriMet also uses ultra-low sulfur

diesel (ULSD), which is a cleaner petroleum-based diesel that reduces sulfur content by 97 percent. Combined, the biodiesel/ULSD blend reduces particulate emissions from buses up to 30 percent.

- TriMet is working to further improve its fuel economy by being the nation's first transit agency to test and operate buses cooled by a NASCAR-inspired system. Traditional systems draw up to 50 horsepower off the engine, draining power and consuming fuel. The system's electric fans use less engine power, resulting in five percent better fuel economy. The system also significantly cuts maintenance time and costs, and is safer to maintain. A drive train computer in the engine compartment of each bus saves fuel and improves driving safety. It monitors the engine, transmission, and braking system, and uses the data to adjust acceleration, braking, traction control and fuel injection. This technology can also be retrofitted to the existing fleet rather than waiting for a new bus purchase.

- TriMet is ordering four next-generation diesel-electric hybrid buses as part of the FY2012 bus order. With the new order, TriMet will be able to test and assess efficiency of these new generation hybrids and determine whether they could represent a cost savings in the future.

10.12.2 Greenhouse Gas Reduction Planning Information

The Land Conservation and Development Commission adopted new rules, codified as OAR 660-044,setting targets to guide long range planning by Oregon's largest urban areas to reduce greenhouse gas emissions from auto travel. The rule calls for local planners to explore ways to reduce emissions from auto and light truck travel by 17 percent to 21 percent per person by the year 2035.
http://www.oregon.gov/LCD/CLIMATECHANGE/metropolitan_greenhouse_gas_reduction_targets.shtml#LCDC_Adopts_GHG_Targets_to_Guide_Metropolitan_Planning

10.13 PATSAC Member Comments and Letters

PATSAC members provided oral and written input to the PATS process throughout the course of advisory committee meetings. After DEQ drafted the committee report, it requested that members submit any additional comments between September and November 2011. Those letters and comments are included below in alphabetical order by commenter and date received. Redline/strikeout editing to various versions of the draft report is not included because of length, but is available from DEQ.

10.13.1 Associated Oregon Industries

http://www.deq.state.or.us/aq/planning/report/appendix/aoi6-20-11.pdf
http://www.deq.state.or.us/aq/planning/report/appendix/aoi9-15-11.pdf
http://www.deq.state.or.us/aq/planning/report/appendix/aoiOMIC11-3-11.pdf

10.13.2 Daniela Cargill

http://www.deq.state.or.us/aq/planning/report/appendix/Cargill9-15-11.pdf

10.13.3. Metro

http://www.deq.state.or.us/aq/planning/report/appendix/mETRO1-5-12.pdf

10.13.4 Multnomah County Health Department

http://www.deq.state.or.us/aq/planning/report/appendix/MultCoHealth4-13-11.pdf
http://www.deq.state.or.us/aq/planning/report/appendix/MultCoHealth10-14-11.pdf
http://www.deq.state.or.us/aq/planning/report/appendix/MultCoHealth11-3-11.pdf

10.13.5 Oregon Health Authority
http://www.deq.state.or.us/aq/planning/report/appendix/OHA12-5-11.pdf

10.13.6 Oregon Metals Industry Council
http://www.deq.state.or.us/aq/planning/report/appendix/OMIC6-20-11.pdf
http://www.deq.state.or.us/aq/planning/report/appendix/OMIC9-14-11.pdf

10.13.7 OPAL
http://www.deq.state.or.us/aq/planning/report/appendix/OPAL10-13-11.pdf

10.13.8 Oregon Trucking Association
http://www.deq.state.or.us/aq/planning/report/appendix/OTA9-15-11.pdf
http://www.deq.state.or.us/aq/planning/report/appendix/ota7-18-11.pdf

10.13.9 Pacific Environmental Advocacy Center
http://www.deq.state.or.us/aq/planning/report/appendix/PEAC4-13-11.pdf

10.13.10 Port of Portland
http://www.deq.state.or.us/aq/planning/report/appendix/port11-4-11.pdf

10.13.11 Sierra Club (ex officio)
http://www.deq.state.or.us/aq/planning/report/appendix/SierraClub9-13-11.pdf

10.13.12 TriMet
http://www.deq.state.or.us/aq/planning/report/appendix/TriMet11-4-11.pdf

10.13.13 Washington County
http://www.deq.state.or.us/aq/planning/report/appendix/waCountyintro11-15-11.pdf
http://www.deq.state.or.us/aq/planning/report/appendix/waCounty11-15-11.pdf

10.14 Portland Air Toxics Solutions Environmental Justice Analysis

10.14.1 Introduction

DEQ used quantitative environmental justice analysis to explore statistical evidence of any air toxics inequity among people of different race or income level within the Portland Air Toxics Solutions (PATS) study area. With the help of the PATS advisory committee, DEQ conducted its first analysis of environmental justice. This appendix includes more technical details to supplement the primary environmental justice discussion in Chapter 8 of the PATS Report and Recommendations.

10.14.2 Background

DEQ reviewed the approaches that others have taken in assessing environmental justice issues from air pollution. A number of environmental justice studies have been limited by methods focusing on spatial proximity to pollution as a risk. This method ignores the quantity, toxicity, meteorological conditions and other factors that influence direction and distance traveled by pollutants. Environmental justice research also has a tendency to study a single pollution source, focusing primarily on industrial facilities. Previous studies have showed that pollution from other sources is equally important to consider, even if these sources emit fewer quantities of air toxics than large industrial facilities, they cumulatively contribute significant health risks. DEQ found this to be true in the PATS study area as well. Statistical methods such as multivariate regression have been used to examine the disparity by evaluating the association between magnitude of pollution and sociodemographics variables. Some critics highlight the challenges with

conventional regression techniques, especially their inability to distinguish local variations in the relationships between dependent and independent variables. These critics promote the use of geographically weighted regression when assessing environmental justice on national, regional, or state level. The lack of geographic specificity can obscure underlying patterns when evaluating environmental justice over large areas. The PATS study area is relatively small, and DEQ thought that applying conventional regression techniques was an appropriate methodology. DEQ evaluated environmental justice on a census block group level which provides exceptional spatial resolution. One drawback of using block group level data is the fact that income data, obtained from the American Community Survey (ACS) 5-year average dataset, has relatively high margins of error. Therefore, DEQ's findings related to environmental justice and poverty intrinsically carry higher uncertainty than findings related to race and ethnicity for which data comes from the U.S. Census.

10.14.3 Study Area

The analysis focuses on the Portland Air Toxics Solutions study area, which represents a wide range of demographic and socioeconomic indicators, and variety of air toxics sources. Figure 4 in Chapter 3.3 shows the location and extent of the PATS study area.

10.14.4 Demographic Data

The regression analysis is based on 2010 ethnicity and race data from the U.S. Census Bureau and 2005-2009 five-year population below poverty data from the American Community Survey (ACS). ACS is part of the assessment conducted by the U.S. Census Bureau. Demographic data is provided at the block group level. There are 982 block groups within the PATS study area in 2010. PATSAC and DEQ discussed what would be the best dataset to use in the regression analysis to adequately represent the low income population. It is believed that federal poverty level is well below poverty level for the PATS study area, therefore use of the ACS below poverty data can neglect a number of people that are above the federal threshold but considered low income for this area. Low income guidelines for Portland Metro area are available from Portland Housing Authority and they are provided by a household size. ACS offers average household income data by block group but the link to the household size is not readily available. DEQ repeated the regression analysis using the ACS 2005-2009 median income data and found no significant differences in the final results (from ACS below poverty data), however there were fewer significant factors. DEQ selected the medium household income dataset to conduct comparison between the impacts on lowest ten (and fifty) block groups by income vs. average impact in the PATS study area.

The National Guidance explains that a minority population may be present if the minority population percentage of the affected area is "meaningfully greater" than the minority population percentage in the general population or other "appropriate unit of geographic analysis" (EPA 1998). The unit of geographic analysis was the PATS study area for which DEQ calculated an average percent minority population by block group (25%). "Meaningfully greater" was interpreted as simply greater than this average and Figure 80 Chapter 8 shows block groups that have greater than 25% minority. Minority is defined as everyone not claiming single race non-Hispanic white. This definition of minority is used in the two steps of analysis: mapping and cumulative distribution function.

10.14.5 Air Toxics Data

DEQ conducted comprehensive emission inventory and dispersion modeling of 19 air toxics of concern. DEQ has established a set of benchmarks for air toxics to serve as guidance for its programs. Modeled concentrations are divided by the benchmarks to get times above benchmark (TAB) value for each toxic. For each source category, these benchmark exceedances are accumulated into one value that represents the measure of pollution from a given source category. The results of the measure of pollution, or cumulative times above benchmark (CTAB) values, are provided at the block group centroids. Using the spatial analyst extension within GIS software, a smooth surface of CTAB values for each source category is created for the entire PATS study area. Although this interpolation step introduces an additional layer of

uncertainty, the smooth surface depicts an array of CTAB values that is easy to interpret, which is very important for neighborhood-level analyses and community outreach. More detailed description of emission inventory and modeling methodology and results can be found in Chapters 3 and 4 and in Appendices.

For EJ analysis, the following source categories are used: On-Road Mobile (e.g., cars and trucks), Non-Road Mobile (e.g., rail, lawn movers, construction equipment), RWC (residential wood combustion), Area (e.g. household cleaners, industrial and commercial solvent use, paving), Point Type (permitted industrial facilities, gas stations, dry cleaners).

10.14.6 Merging Datasets

Demographics data and CTAB values are available for the same geographic area, but are not in the same geographic format. Demographics data is provided by 2010 Census block groups while model receptors with CTAB values are based on centroids of 2000 Census block groups plus additional receptors as described in the modeling appendix. In order to merge these two datasets, DEQ overlaid a smooth surface of CTAB values on 2010 Census block groups using GIS software, and read the CTAB value for each Census block centroid. This step determined CTAB values and demographics data for each 2010 Census block group.

10.14.7 Cumulative Distribution Functions

Cumulative distribution function (CDF) is used to address disparate air toxics impacts on non-white (also referred to in this text as minority) populations. Non-white includes everyone who did not state single race non-Latino white on 2010 census. The CDFs are created using CTAB values at block group level for white and for non-white populations. Figures 84-86 in Chapter 8 show results of this analysis for all sources and examples for residential wood combustion and point sources. The y-axis represents CTAB values, and the x-axis represents the fraction of the population (from 0 to 1).

10.14.8 Descriptive Statistics

Table 59: Correlation Matrix

		Percent (%)						Times above Benchmark (TAB)					
	Correlation Matrix	***Hispanic/ Latino***	***African American/ Black***	***Asian***	***White***	***Below Poverty***	***Above Poverty***	***Total All Sources***	***Point Sources***	***On-Road Mobile***	***Non-Road Mobile***	***Area Sources***	***Residential Wood Comb.***
	Hispanic/Latino	1.00											
Percent (%)	***African American/Black***	0.08	1.00										
	Asian	-0.09	-0.01	1.00									
	White	-0.79	-0.50	-0.35	1.00								
	Below Poverty	0.35	0.33	-0.03	-0.43	1.00							
	Above Poverty	-0.35	-0.33	0.03	0.43	-1.00	1.00						
Times above Benchmark (TAB)	***Total All Sources***	0.39	0.11	0.13	-0.42	0.20	-0.20	1.00					
	Point Sources	-0.05	0.00	-0.03	0.05	0.04	-0.04	0.30	1.00				
	On-Road Mobile	0.21	0.00	0.16	-0.25	0.22	-0.22	0.77	0.08	1.00			
	Non-Road Mobile	0.36	0.11	0.14	-0.39	0.09	-0.09	0.85	0.03	0.69	1.00		
	Area Sources	0.18	0.35	0.04	-0.33	0.31	-0.31	0.75	0.20	0.58	0.57	1.00	
	Residential Wood Comb.	0.47	-0.03	0.05	-0.38	0.05	-0.05	0.56	-0.14	0.13	0.42	0.22	1.00

Table 60: Descriptive Statistics for Independent and Dependent Variables used in Multiple Linear Regression Analysis

	Percent of Population by 2010 Census Block Group					*Cumulative Times Above Benchmark*					
Descriptive Statistics	Latino	Black	Asian	White	Below Poverty	Total All Sources	Point Sources	On-Road Mobile	Non-Road Mobile	Area Sources	Residential Wood Comb.
Mean	11.3	3.5	6.0	0.7	12.6	71.0	1.3	18.4	17.2	16.8	17.0
Standard Error	0.3	0.2	0.2	0.0	0.3	0.8	0.2	0.3	0.3	0.2	0.3
Median	7.4	1.6	4.2	0.8	9.8	65.3	0.5	16.4	14.8	16.3	15.8
Standard Deviation	10.5	5.2	5.4	0.1	10.5	26.1	6.8	8.5	8.4	6.8	9.4
Range	83.0	38.2	45.1	0.8	59.8	155.9	89.9	48.8	64.0	33.7	60.0
Minimum	0.0	0.0	0.0	0.1	0.0	15.7	0.1	1.7	2.4	2.7	3.7
Maximum	83.0	38.2	45.1	1.0	59.8	171.6	89.9	50.5	66.4	36.4	63.7
Count	982	982	982	982	982	982	982	982	982	982	982

10.14.9 Multiple Regression Analysis

Using multiple linear regression models (MLR), DEQ examined whether the minority population and the population below poverty have a greater likelihood of living in areas with high levels of air toxics pollution. Instead of grouping all minorities together, as in the mapping and cumulative distribution function steps, here the analysis separated Hispanics, African American/Blacks, and Asians as independent variables. Dependent variables are CTAB values by block group. The analysis consisted of two MLR models. The first model (Model 1) uses three independent variables: % Hispanics/Latino, % African American/Black, and % Asians. The second model (Model 2), in addition to the three independent variables from Model 1, adds % Below Poverty (regardless of ethnicity/race) as the fourth independent variable. In general, MLR equation expresses the relationship between the dependent variable and a combination of independent variables simultaneously in a single model:

$$(1) \qquad y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ \dots \ + \beta_k X_k + \varepsilon.$$

Y is the dependent variable, $X_1, X_2, \dots X_k$ are the independent variables, and $\beta_0, \beta_1, \beta_2, \dots \beta_k$ are the model parameters. The model parameters indicate the nature and strength of the association between the particular independent variable and the dependent variable, negative or positive, when the effects of the other independent variables are also taken into account.

MLR produced six sets of models, one for each source category and one for total CTAB from all source categories. Results are shown in Table 55. For each model parameter, stars indicate the level of statistical significance. No stars indicate non-significant results.

MLR for all source models indicates that all of the examined independent variables have positive association with the CTAB values. In Model 2, % Below Poverty is a positive but not a statistically significant parameter. The R-squared for both models in this first set is 0.18.

MLR models associated with the different source categories indicate more variation in model parameters. The R-squared values range between 0.15 and 0.25 for all models except for Point Source and On-Road categories. Point Source models have the lowest R-squared values.

Comparison of Model 1 and Model 2 reveals no significant change in the sign or size of the parameters associated with Asian population in any of the model sets. However, there is some change for the Hispanic/Latino population and more significant change in parameters for the African American/Black population. This is likely due to higher correlation between these two population groups and poverty levels.

Table 61: Multiple Regression Analysis Results

Multiple Linear Regression ***Results***	All Sources		Major Source Categories									
			Residential Wood Combustion		Point Sources		On-road Mobile		Non-road Mobile		Area Other	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	Coefficients express the change in risk for 1% change in one of explanatory variables, e.g. the model predicts that 10% increase in Hispanic/Latino adds additional 9.7 times above the benchmark to the final risk value from all sources.											
Hispanic/Latino (percent)	**0.97 ***	**0.93 ***	**0.43 ***	**0.47 ***	**-0.04 *****	**-0.05 ** **	**0.19 ***	**0.14 ***	**0.29 ***	**0.31 ***	**0.10 ***	**0.06 ***
African American/Black (percent)	**0.41 ***	**0.33 ** **	**-0.13 ***	-0.07	0.01	-0.01	-0.02	**-0.11 ** **	**0.13 ***	**0.17 ***	**0.45 ***	**0.38 ***
Asian (percent)	**0.80 ***	**0.80 ***	**0.17 ***	**0.17 ***	-0.04	-0.04	**0.29 ***	**0.28 ***	**0.27 ***	**0.27 ***	**0.07 *****	**0.06 *****
Below Poverty (percent)		0.13		**-0.11 ***		**0.04 *****		**0.15 ***		**-0.06 ** **		**0.12 ***
*Sample size n = 982. Standard errors are in parentheses. Significance levels: *** p<0.1 ** p<0.05 * P<0.01 No stars indicate results are not significant.*												
Intercept (unit = times above benchmark)	54	53	12	12	2	2	15	14	12	12	14	13
R-squared	0.18	0.18	0.24	0.25	0.004	0.007	0.08	0.11	0.16	0.17	0.15	0.18

10.14.10 Caveats to Results

The results describe the pattern but do not imply causality.