Working together for clean air

Puget Sound Clean Air Agency

pscleanair.org

Air Toxics Grant Project Discussion

Seasonal and Spatial Characterization

Methods Development – Source Apportionment incorporating traffic and meteorological data

Matt Harper

Two Take Home Messages

If these Toxics Grant opportunities were not available, there is no way that our agency could undertake or fund such a Monitoring Plan – Thank you EPA!

If we did not have the ability collaborate with the University of Washington, there is no way these Monitoring plans could have been designed or executed – Thank you UW!

UNIVERSITY of WASHINGTON

Puget Sound Clean Air Agency

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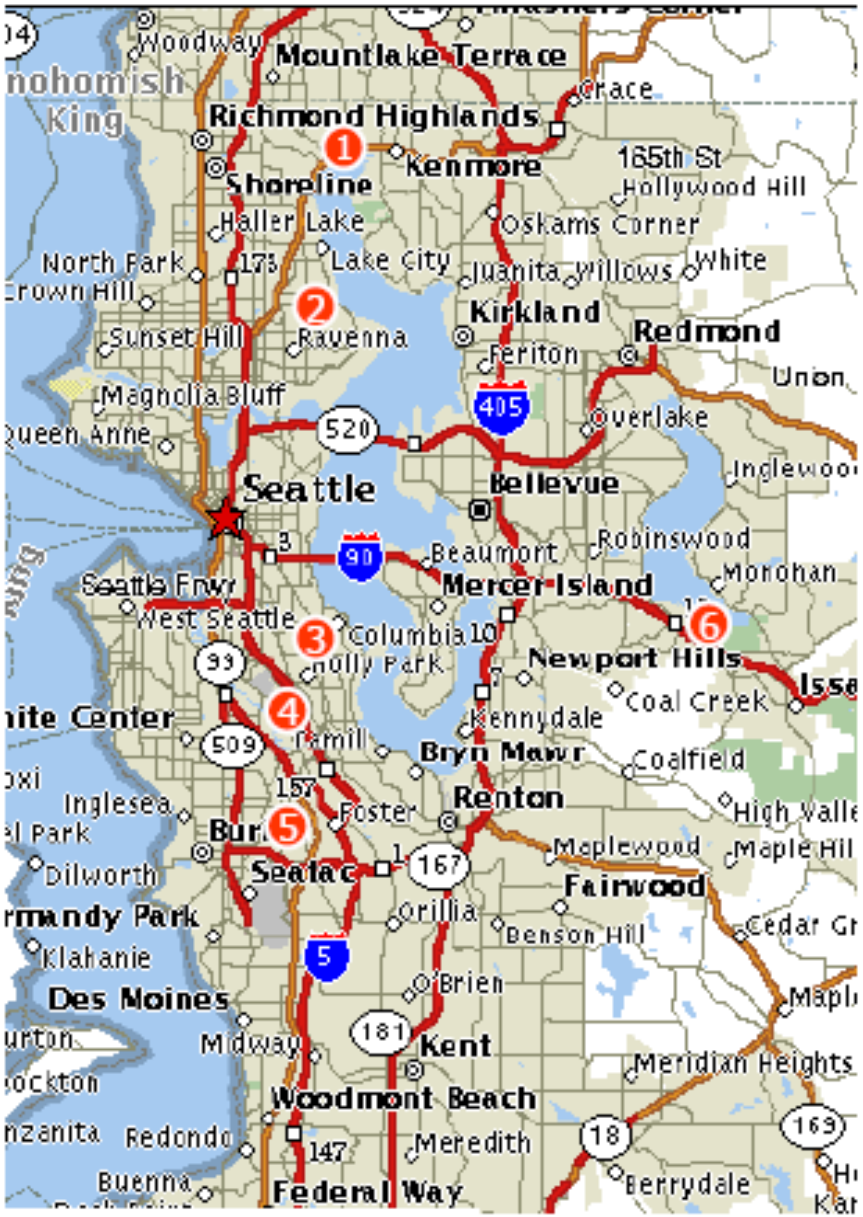
Objectives of the Presentation

- **Describe EPA Grant Monitoring Experience**
- **Discuss Air Toxics Monitoring Plans**
- **Discuss important shared lessons learned**
  - **If I could do this over again, what would I do differently?**
- **Show and Discuss some preliminary results**

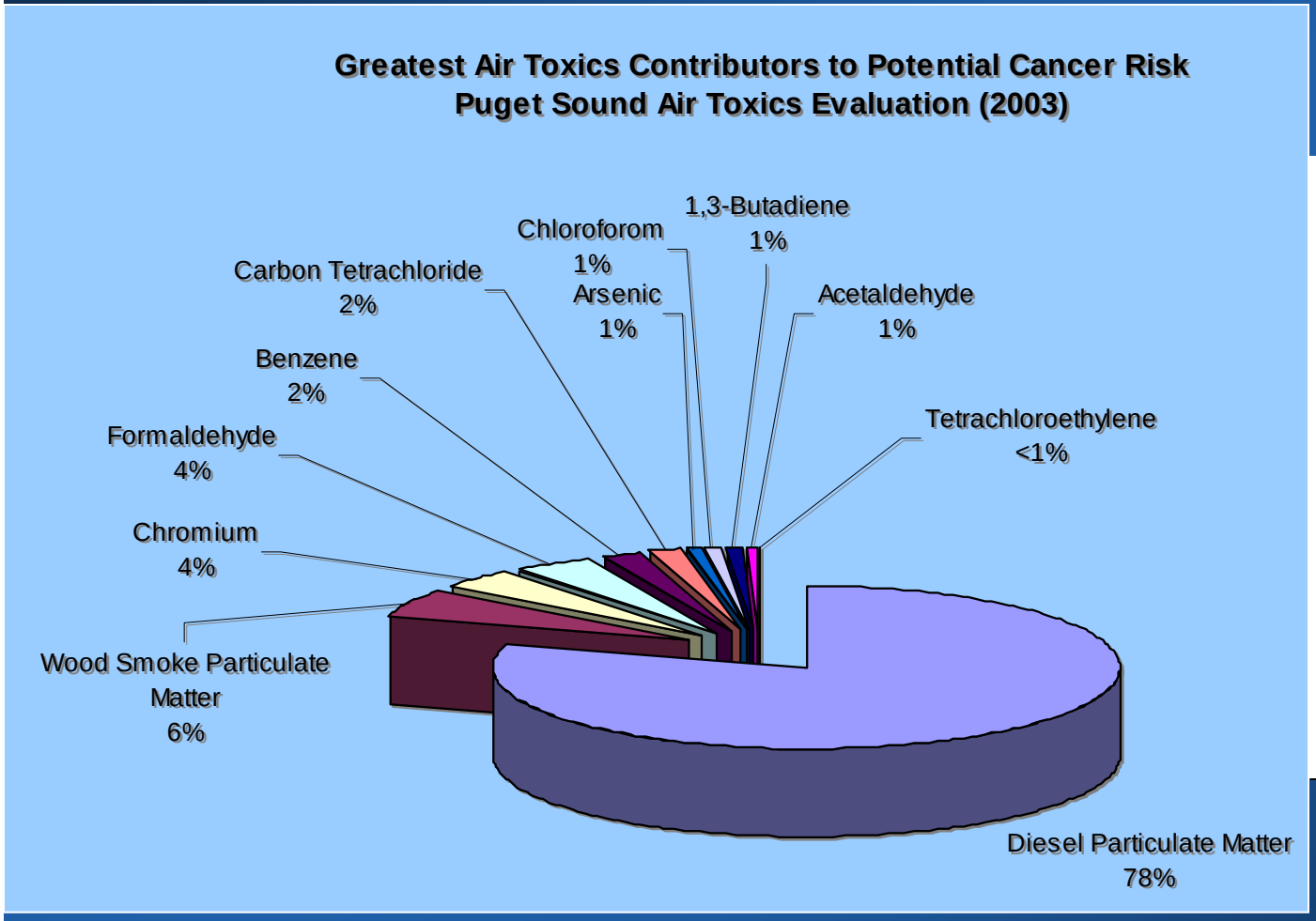
Background Information

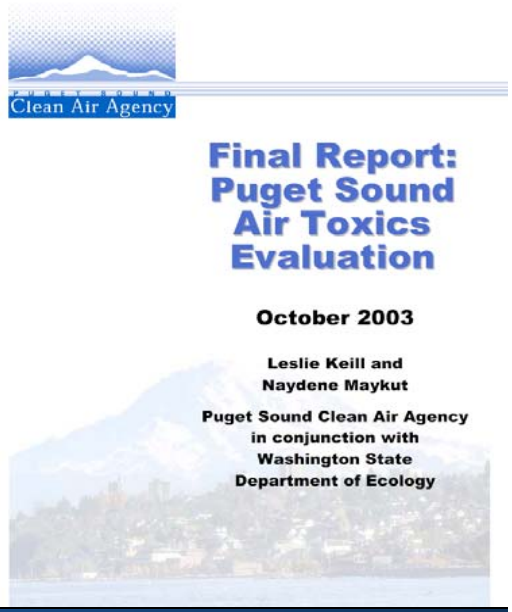
What do we already know about air toxics in the Puget Sound area?

- **NATTS site Seattle Beacon Hill**
  - Data since about 2000
  - Various grants and programs
  - VOC's and Metals information
  - More parameters since since NATTS program was implemented
- **2001 Seattle 5 site EPA grant**
  - WA Dept of Ecology
  - Final grant report available
  - Good coverage of a variety of Seattle neighborhoods
- **Speciation sites operating since about 2003 – most of the data collection has been limited to Seattle.**



What do we already know about air toxics in the Puget Sound area?



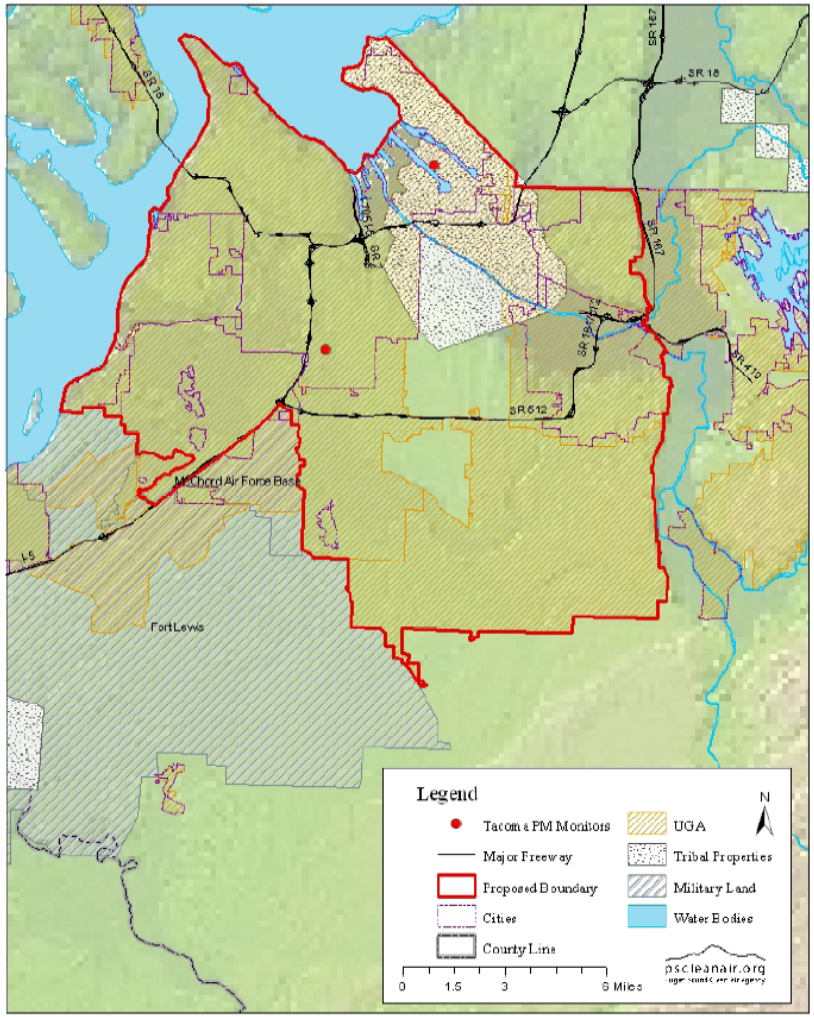


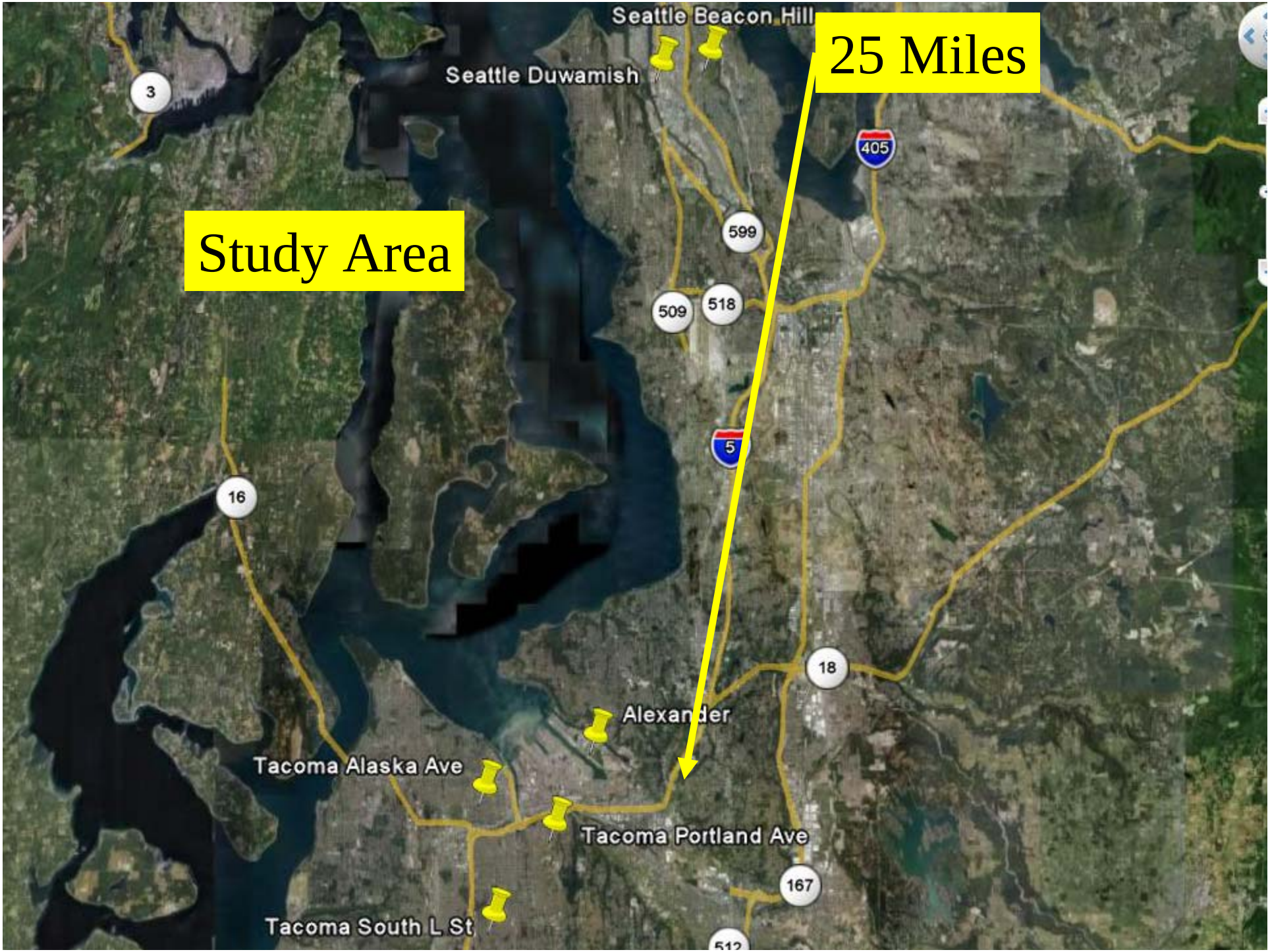
PM Non-Attainment

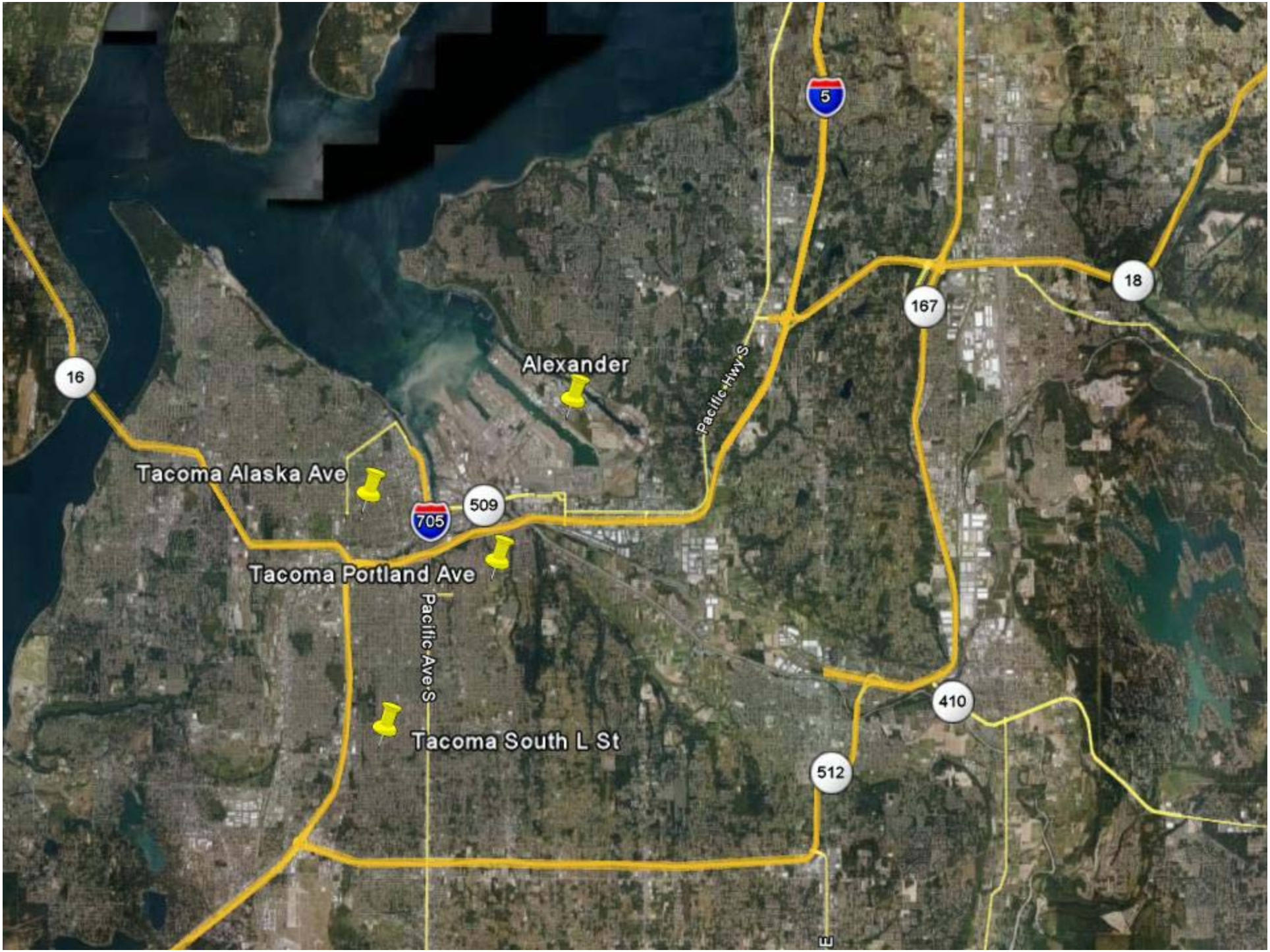
- **PM 2.5 Non-Attainment Area for Tacoma and part of Pierce County**
  - **Politically charged**
- **Public Health Concerns, Community Concerns, Environmental Justice Concerns**
- **Tacoma Air Toxics – Is Seattle data representative of Tacoma?**

Figure 1:

Proposed Boundary for Tacoma Non-Attainment Area




Seattle Beacon Hill
Seattle Duwamish
25 Miles
Study Area
3
405
599
509
518
5
16
18
Alexander
Tacoma Alaska Ave
Tacoma Portland Ave
167
Tacoma South L St
512

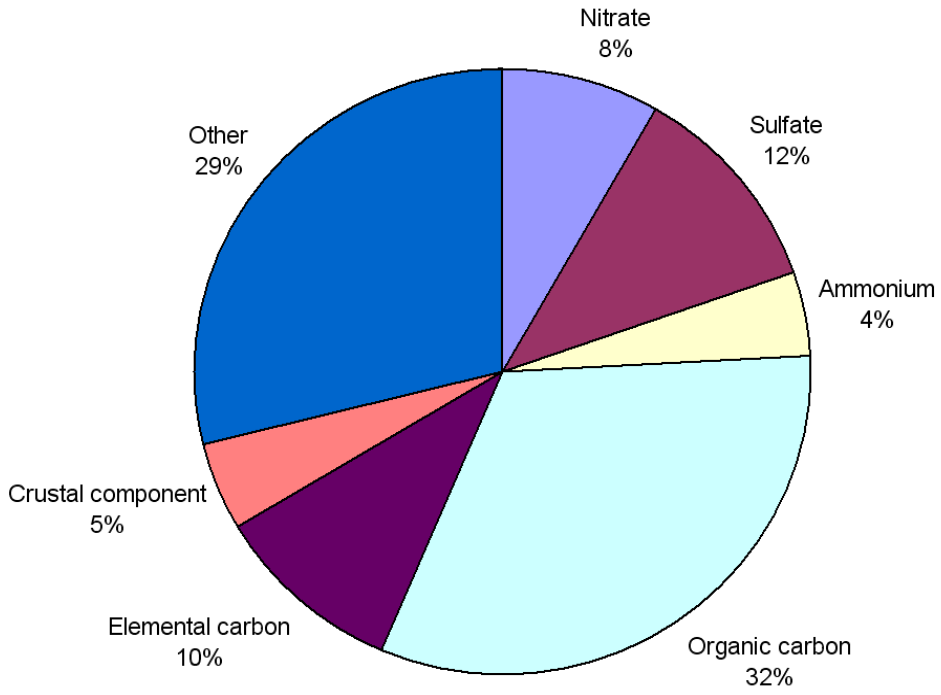

5
18
167
16
Alexander
Pacific Hwy S
Tacoma Alaska Ave
509
705
Tacoma Portland Ave
Pacific Ave S
410
Tacoma South L St
512

PM Speciation Sampling

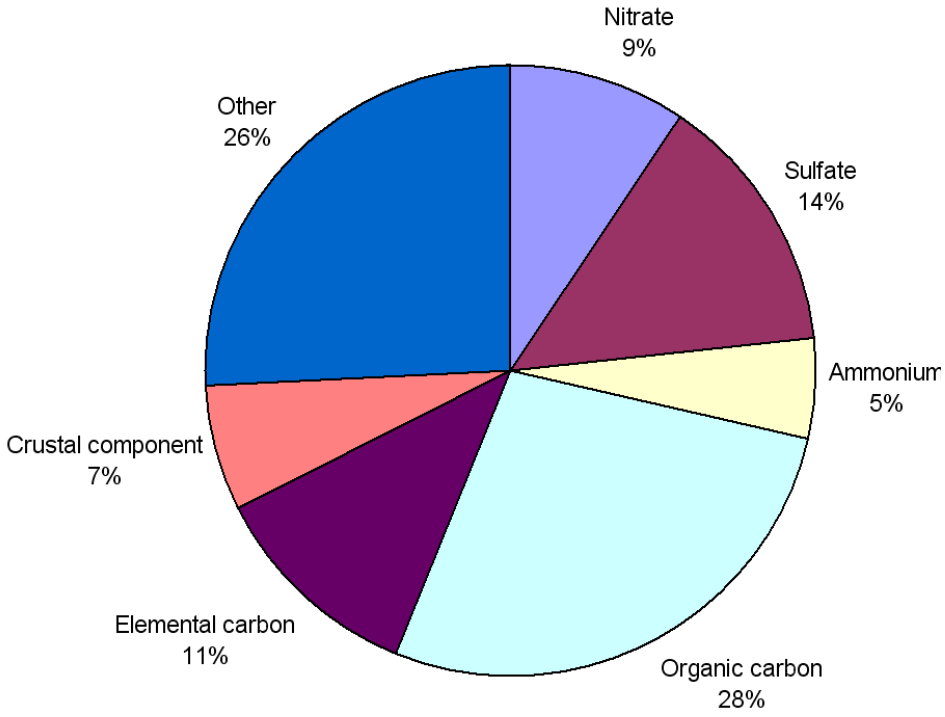
- **STN network sites integrated from the WA State Department of Ecology (2 sites)**
- **2 Additional Speciation sites were added by PSCAA to Complement our Air Toxics Grant Projects**
- **Funding is independent of any EPA Grants.**

Preliminary Speciation Results

Alexander
Date(s): 11/14/2008 - 6/12/2009
Average Concentration (µg/m³)



Duwamish
Date(s): 11/14/2008 - 6/12/2009
Average Concentration (µg/m³)



Community Scale EPA Grant Parameters

- **Projects to begin Fall 2008**
- **Most monitoring/data collection to be completed in 2009**
- **Data validation and report write-up Early 2010 to be completed before June**
- **Community-scale report will include ranking and discussion of priority air toxics**

Seasonal Spatial Characterization Purpose

- **(NATA) places PSCAA jurisdiction in the top 5th percentile of the country for potential health (cancer) risk from air toxics.**

- **Tacoma is not Seattle !!**

1. **Determine base-line (fixed site) air toxics concentrations for the Tacoma area and Seattle area for comparison.**
2. **Characterize seasonal and spatial patterns**
3. **Use data to assess health risks from exposure to air toxics, and communicate them clearly to the community.**

What will we gain?

Community Scale Monitoring

- **"Baseline" Tacoma data**
- **Inter-City Comparison between Tacoma and Seattle**
- **Intra-City Comparison within Tacoma**
- **Spatial resolution**
- **Temporal resolution**
- **Internal Data products**
- **Information for Resource Groups – Public health partners, Community Groups**

QAPP Development

Very Challenging Process

Good News – Many State approved procedures that we could utilize as resources.

Considerable Workload Factor at the Beginning.

Lesson #1 -- Think About a Phasing Plan

Phase 1 – Use new methods with draft SOP, but without QAPP

Phase 2 – QAPP required and this is when the formal data is under full QA validation.

Principle: Don't underestimate time/effort needed for a good QAPP

Community Scale Monitoring Plan

- **Fixed Site Sampling**
- **Mobile Sampling Component**

Community Scale Fixed Site Monitoring Parameters

- TO-15 Volatile Organic Compounds
- TO-13 Polycyclic Aromatic Hydrocarbons using a PUF sampler
- TO-11 Aldehydes (Carbonyl) using DNPH tube syst.

- PM 2.5 Speciation Sampling
- Aethalometer Black Carbon and UV Absorbing Carbon
- Continuous PM 2.5 devices (Nephs, Teoms)
- PM 2.5 filters to be analyzed for BioMarkers (Levoglucosan)

- Meteorology
- Including Vertical Temperature Measurements
  - Recently added but not as part of the grant budget

VOC Canister Leak Problems

Good Run = Results Reported to PSCAA
Failed Run = (Reason, if any)

	Duwamish			Alexander			South Tacoma			Portland Ave Reservoir	
Sampling Date	Carbonyls	VOCs	PAHs	Carbonyls	VOCs	PAHs	Carbonyls	VOCs	PAHs	Carbonyls	VOCs
11/2/2008										No Power	No Power
11/8/2008	Lab Ship Error	Lab Ship Error		Lab Ship Error	Lab Ship Error		Lab Ship Error	Lab Ship Error	Ran on 11/9/08	Operator Error	
11/14/2008											
11/20/2008											
11/26/2008											
12/2/2008											
12/8/2008											Canister Leak
12/14/2008		Canister Leak									
12/20/2008											
12/26/2008								Canister Leak			
1/1/2009											
1/7/2009											Canister Leak

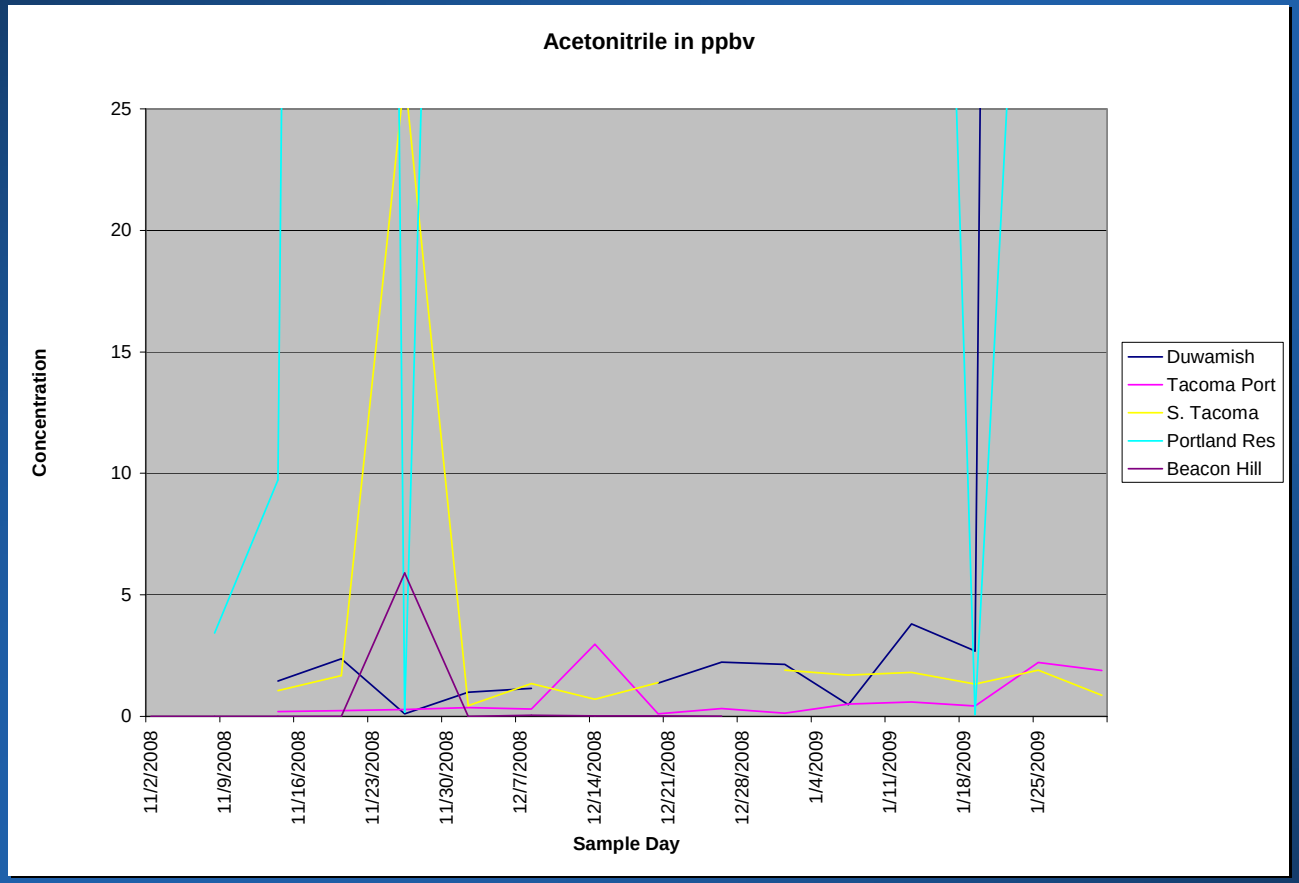
Lesson #2 – VOC Canister Procedures

- **UW Grad Students were operators. We learned that even very smart people needed a solid training process.**
- **There are always some Canister Problems.**
- **TO-15 Sample Collection could be more consistent**

Some Preliminary Data

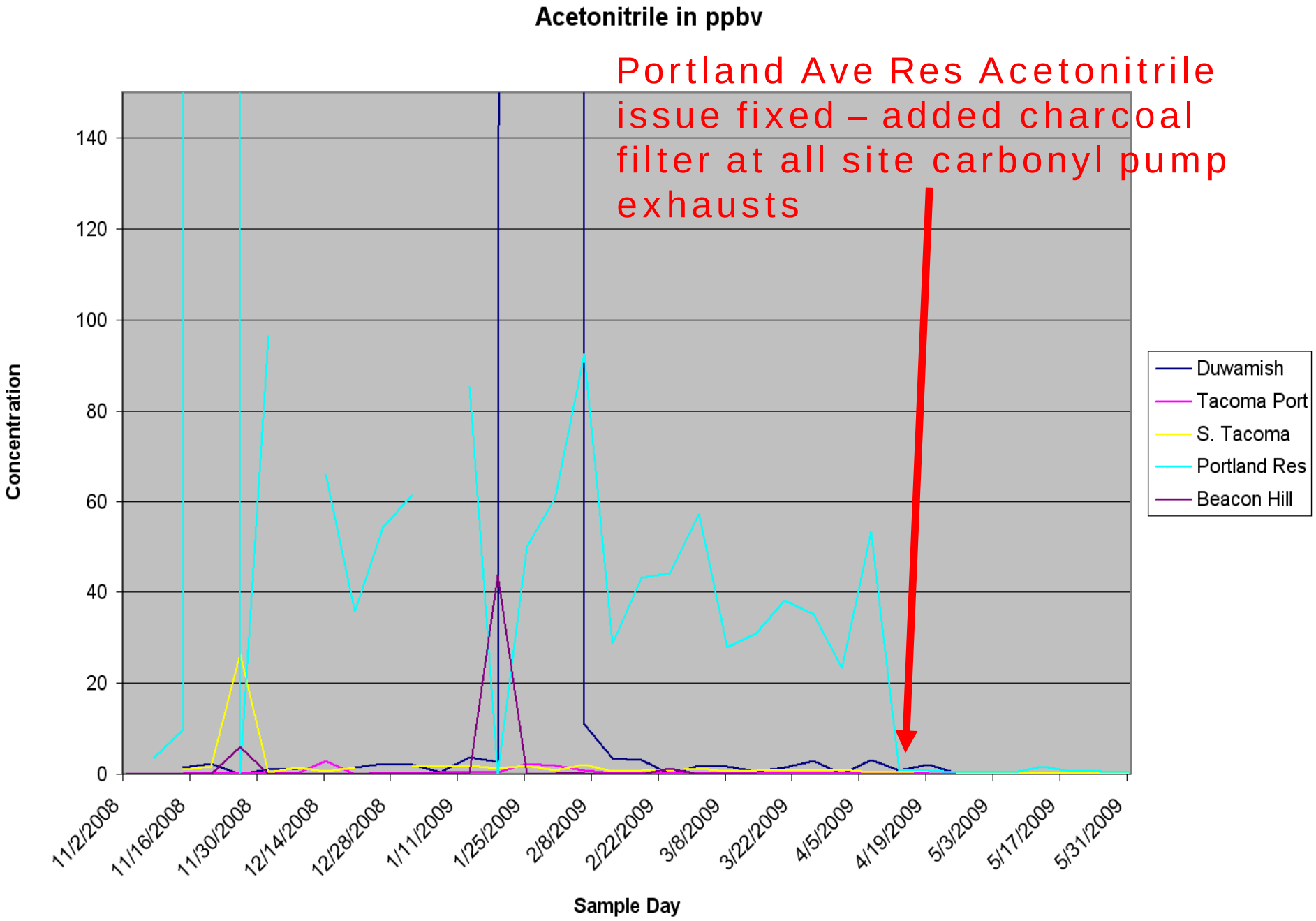
Lesson #3 - Acetonitrile and Interferences

- **VOC Results for Acetonitrile and Others OFF THE CHART**



Cross Contamination Problem and Solution

- **DNPH Tube Sampler pump was venting too close to the sampling inlet of the Canister Sampler.**
- **Solution – Use activated charcoal filter to vent pump exhaust, and then tubing to get the exhaust away from the shelter.**


Acetonitrile in ppbv
Portland Ave Res Acetonitrile issue fixed – added charcoal filter at all site carbonyl pump exhausts
Concentration
0
20
40
60
80
100
120
140
11/2/2008
11/16/2008
11/30/2008
12/14/2008
12/28/2008
1/11/2009
1/25/2009
2/8/2009
2/22/2009
3/8/2009
3/22/2009
4/5/2009
4/19/2009
5/3/2009
5/17/2009
5/31/2009
Sample Day
Duwamish
Tacoma Port
S. Tacoma
Portland Res
Beacon Hill

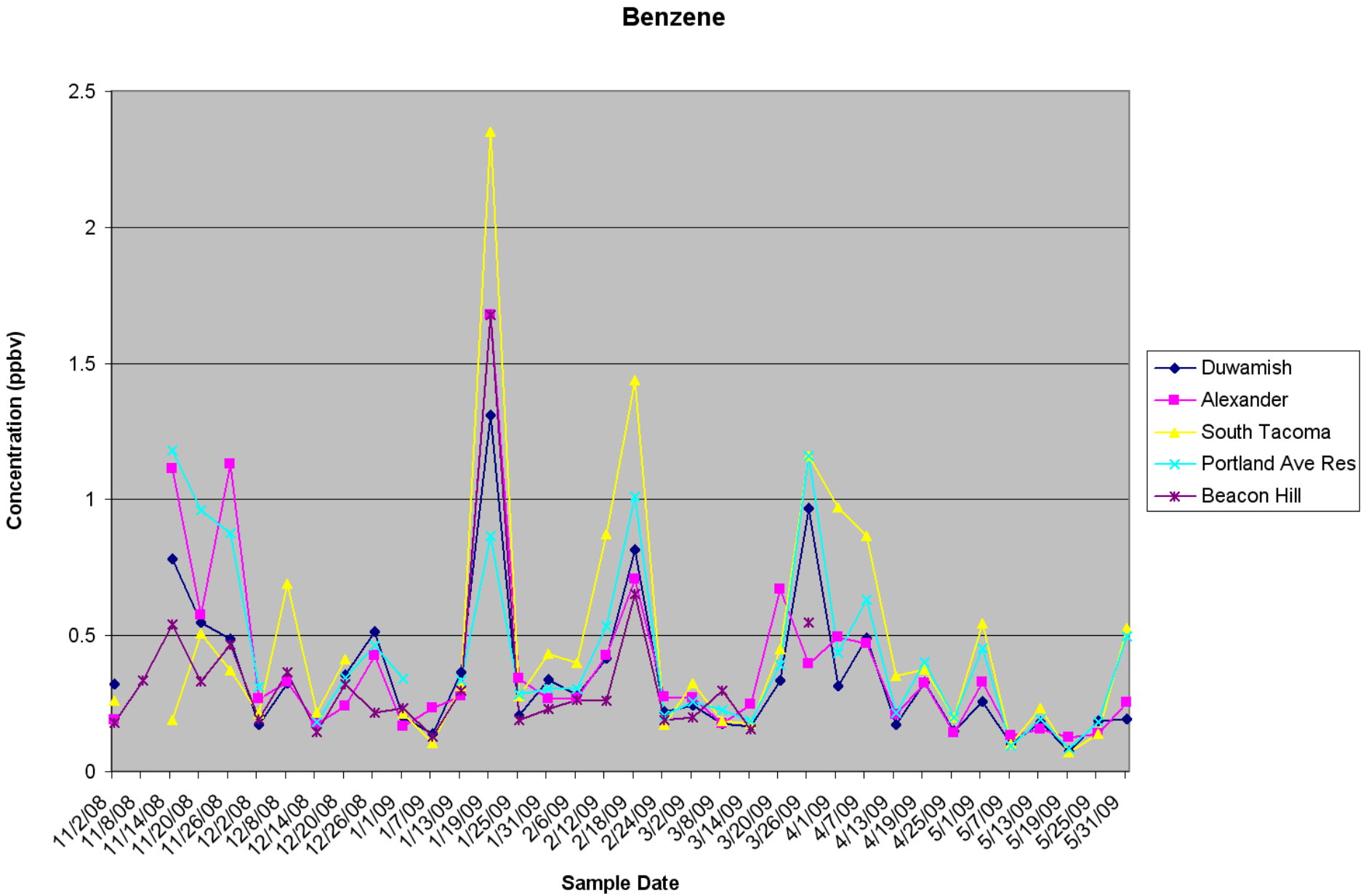
Lesson #4 – Shelter Design and observations

- **For VOC, Carbonyl, and PUF sampling, the problems that we ran into were from the site that had the smallest shelter – Would recommend that if we did a study like this again, our fixed sites would have more space**
- **Try to design your systems to avoid cross contamination**

Basic Monitoring Principle Reminder

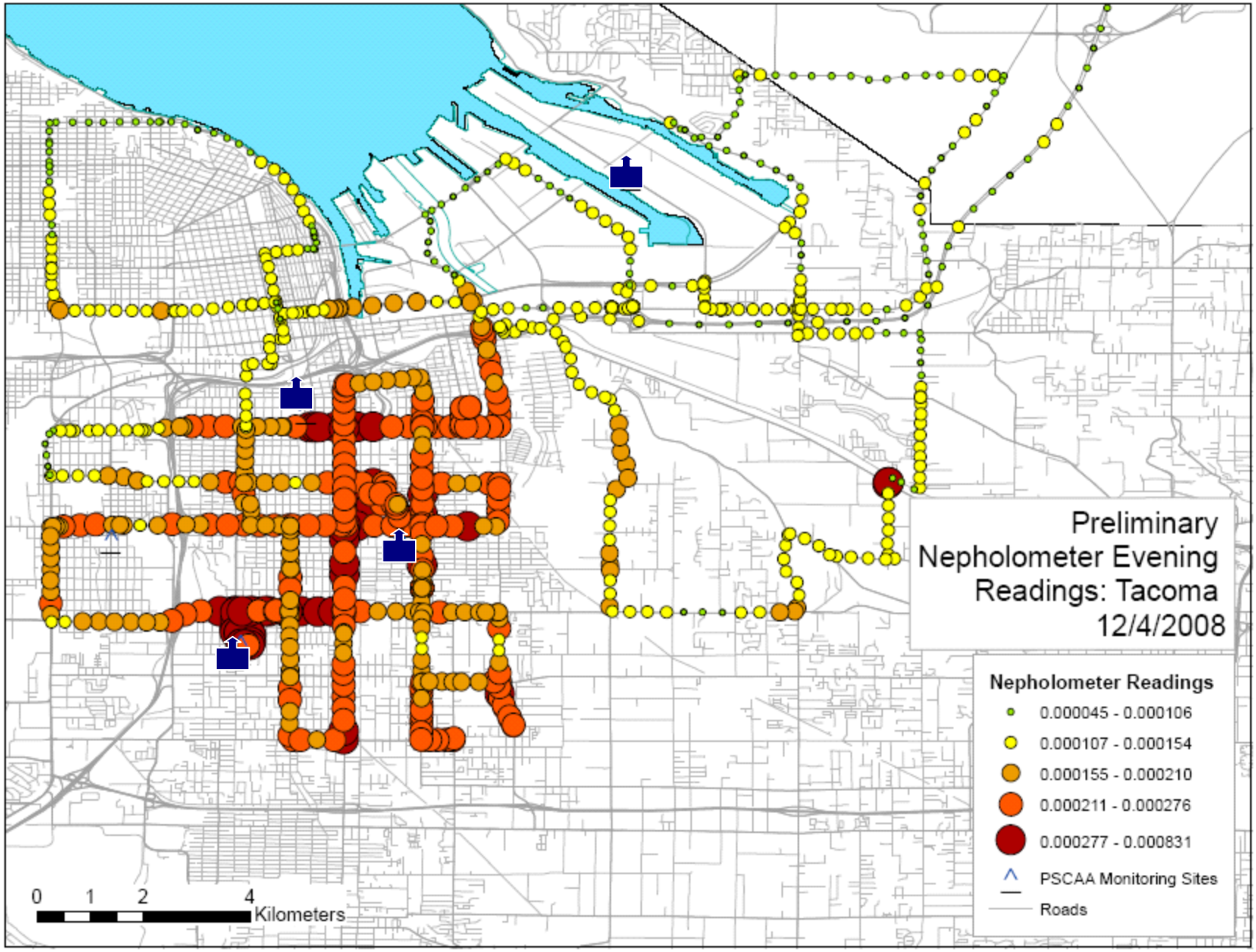
- **Always have your team exhibit due diligence with understanding and interpreting monitoring data**
- **Toxics projects are particularly tricky when it comes to interferences and problems with consistent sampling methods**

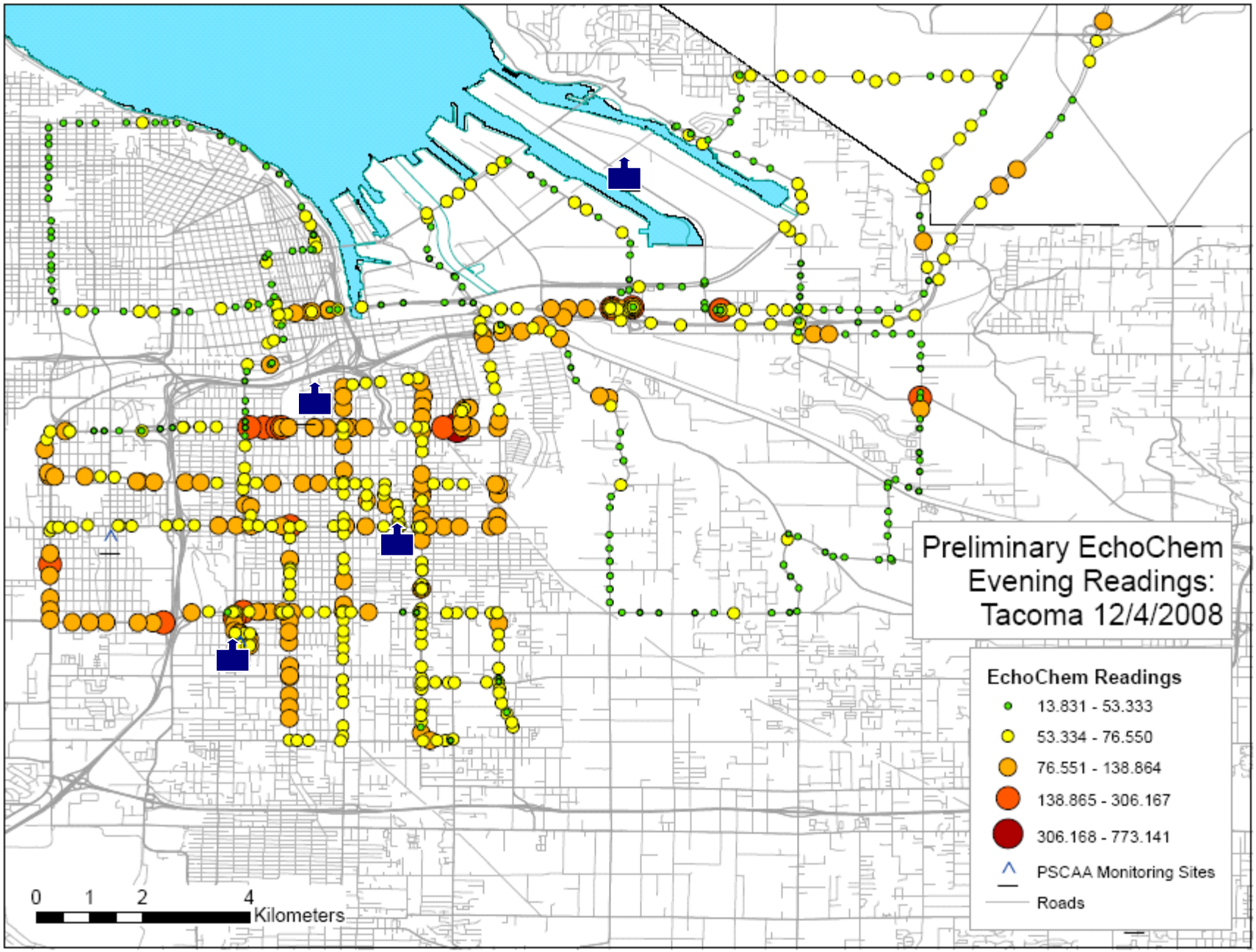
Initial Benzene Graph



Mobile Monitoring Component

- **Purpose: Evaluate spatial patterns**
- **We looked at Evening stagnations during the Winter heating season**
- **Continuous PM 2.5**
- **Continuous Soot (PSAP)**
- **MIMS Membrane Introduction Mass Spectrometry**
- **Ecochem PAS 2000 for Particle bound PAH**
  - **Examples of Toxic PAH's**
    - **Benzo(a)pyrene**
    - **Benzo(b)fluoranthene**
    - **Benzo(a)anthracene**
    - **Benzo(c)phenanthrene**


Preliminary
Nepholometer Evening
Readings: Tacoma
12/4/2008
Nepholometer Readings
0.000045 - 0.000106
0.000107 - 0.000154
0.000155 - 0.000210
0.000211 - 0.000276
0.000277 - 0.000831
PSCAA Monitoring Sites
Roads
0 1 2 4
Kilometers


Preliminary EchoChem
Evening Readings:
Tacoma 12/4/2008
EchoChem Readings
13.831 - 53.333
53.334 - 76.550
76.551 - 138.864
138.865 - 306.167
306.168 - 773.141
PSCAA Monitoring Sites
Roads
0 1 2 4
Kilometers

Methods Development Grant Purpose

- **Apply Positive Matrix Factorization to several types of data**
  - **NMHC data (C2-C12) from a GC-FID Instrument – same as what is commonly used in the PAMS network**
  - **FTIR hourly data**
  - **Speciation Data collected in addition to the grant monitoring, and in addition to the WA state STN participation**
- **Result will be a set of more resolved source related profiles – Attempting to resolve Diesel, Marine, and Gasoline Sources.**
- **Traffic monitoring data will be incorporated and will help evaluate the PMF model results.**
- **Shipping traffic data**
  - **Using the AIS Coast Guard system**
  - **LIDAR data will be incorporate and help evaluate model results.**

What will we gain?

- **Methods Development**
- **Potentially improved methods for estimating diesel and gasoline contributions to fine particles**
- **Potentially improved methods to detect emissions from ships**
- **Comprehensive Source Apportionment**
- **Gain additional perspective on PM continuous data tools**

Methods Development Monitoring Plan

- **Currently running and supplemented PM Continuous Data from various PM2.5 continuous monitors**
- **GC-FID**
- **Open Path FTIR – Fourier Transform Infra-Red Spectroscopy**
- **Traffic Monitoring using Counting tools**
- **LIDAR – Light Detection And Ranging – pulsed laser detects range of a plume**
- **Ship traffic monitoring using AIS and other surveillance tools**
- **Standard Met data (Winds, T, P, RH)**

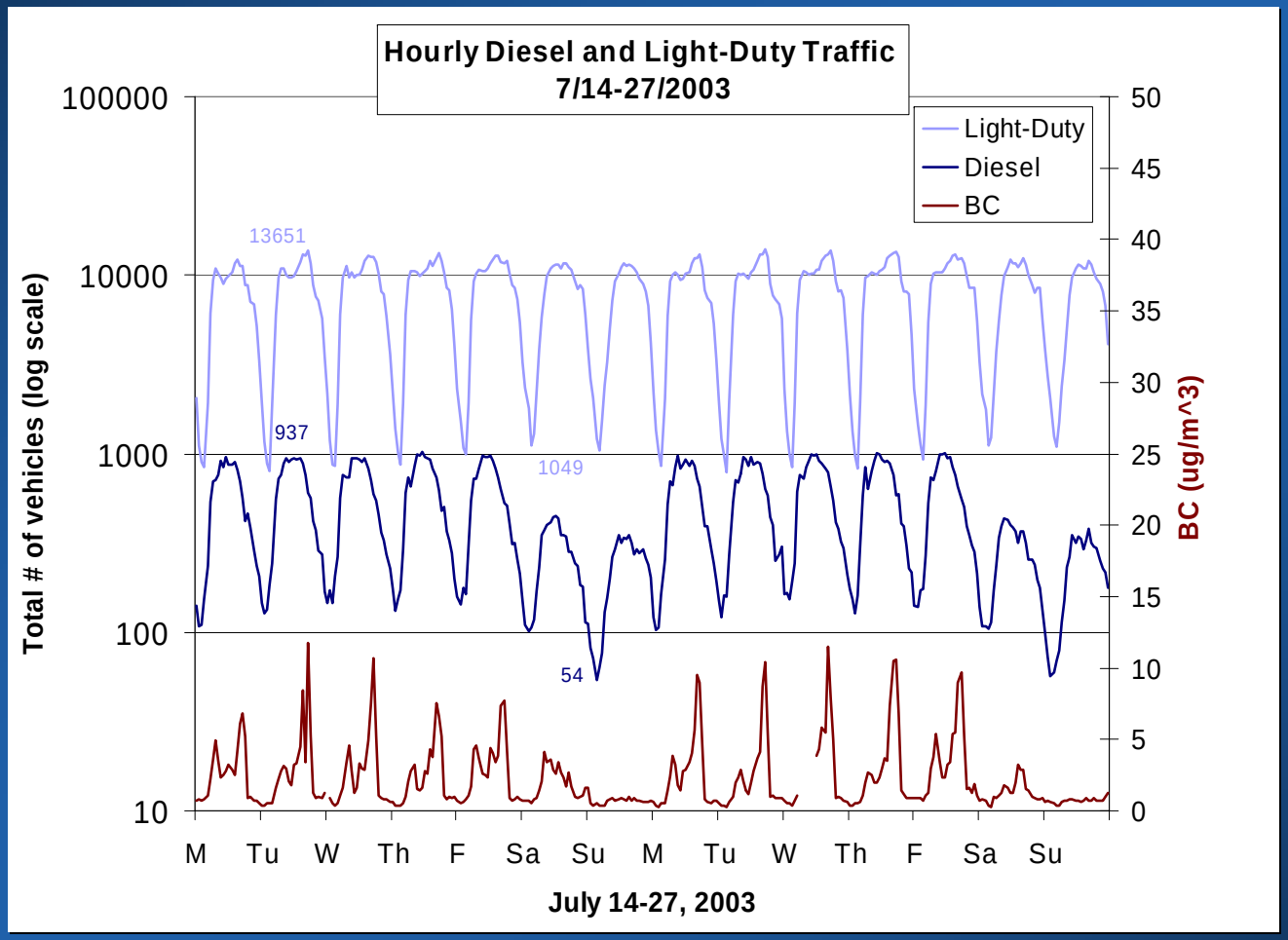
GC-FID Instrument Lessons

- Gas Chromatograph Flame Ionization Detector with Thermal Desorber System
- PAMS network – Thanks NY, NJ, CT, others.

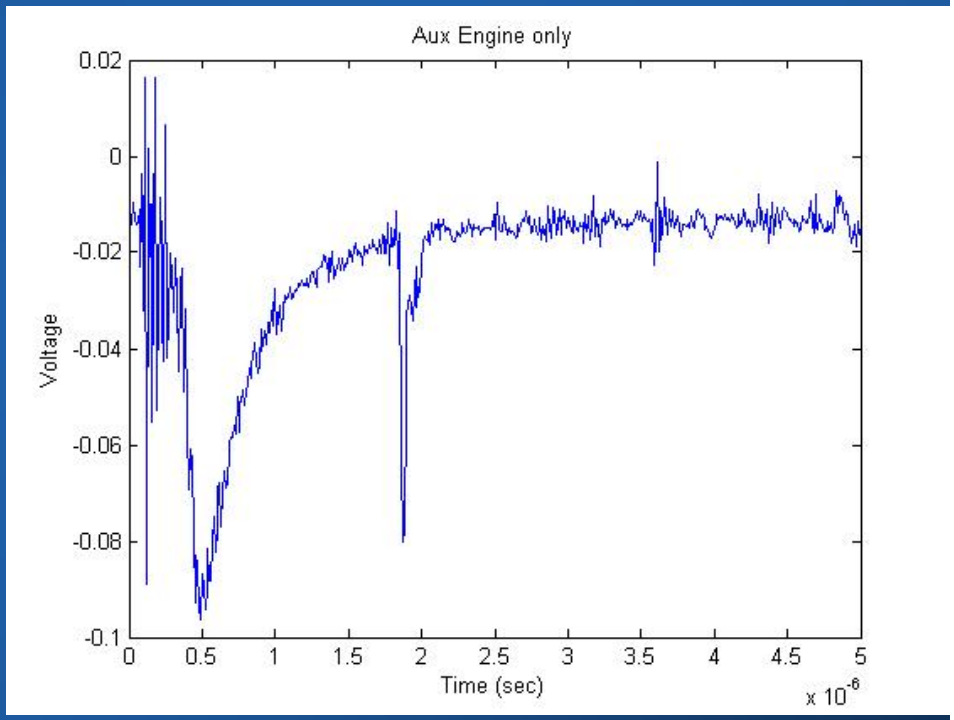
- Installation
- Operation and Maintenance
- Carrier Gas and Dry Zero Air Subsystems
- LineUp Software

FTIR – Fourier Transform Infra-Red Spectroscopy

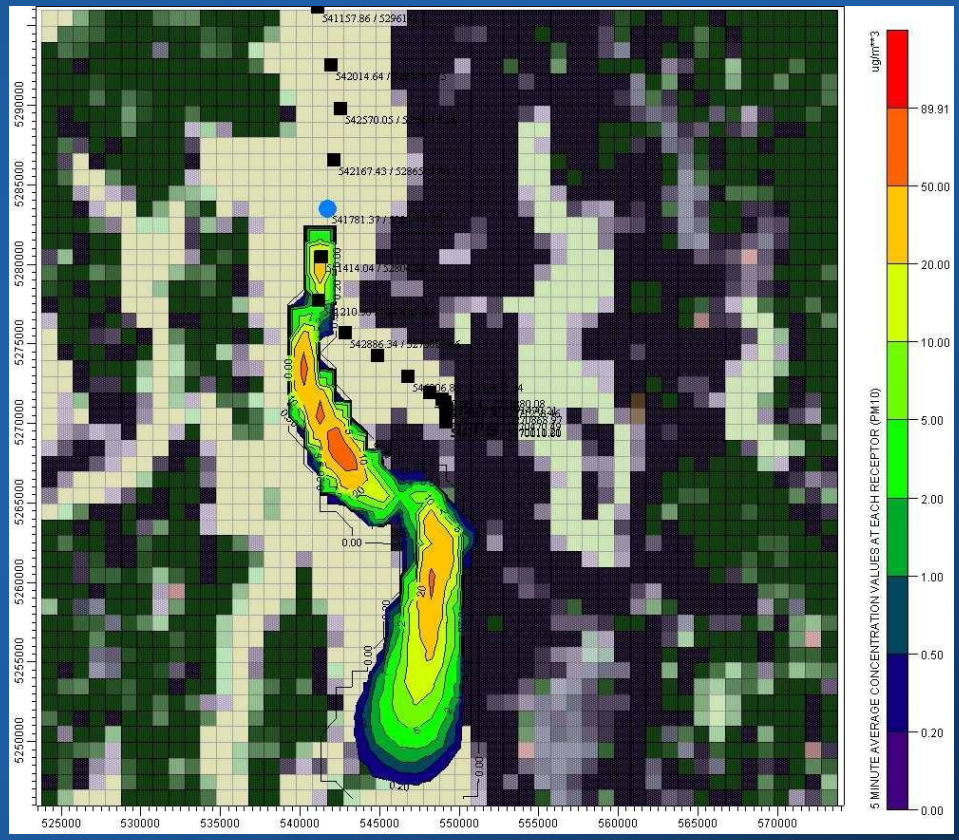
Traffic Data Historical Example



LIDAR Photo and Signal from auxiliary engine



Ship Surveillance via AIS



Summary Slide

- **Toxic Grants Planning**
  - QAPP
- **Monitoring Execution**
  - Interferences
  - Phasing of project
  - Fundamentals
- **Takeaway Messages from Preliminary Results**
  - Continuing to evaluate data quality
  - Experimental design should take into account several independent surveillance techniques. Examples:
    - Vehicle Counting and Emission inventory data to select sites
    - Port activity using ship surveillance and emissions plume detection