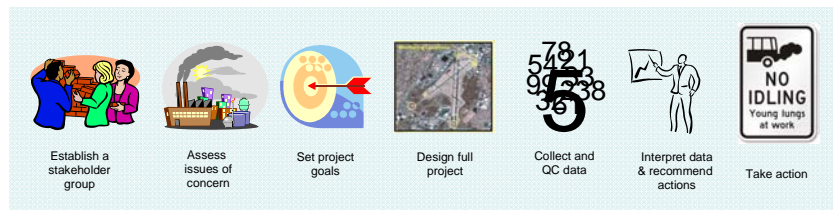


Summary: US 95 MSAT Project Example

- US 95 mobile source air toxics (MSAT) project (Nevada Dept. of Transportation, NDOT)
- Review each of the steps and how they influenced the final results and mitigation actions

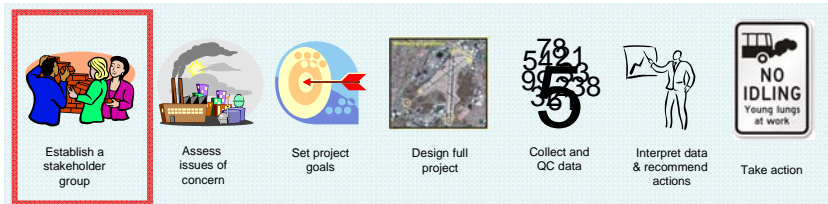


Session 7: Summary

1

Establish a Stakeholder Group

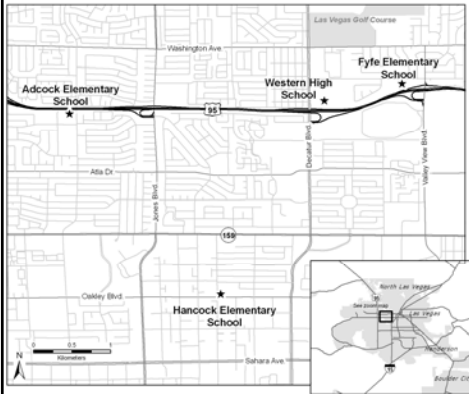
- A Court Settlement Agreement was reached between the Sierra Club and NDOT/FHWA regarding urban freeway expansion where three schools are adjacent to the roadway.
- Both mitigation and monitoring were required to reduce and assess student exposure.
 - MSAT monitoring study at schools (this study)
 - Filtration added to HVAC systems at schools
 - Bus retrofit program
 - Bus idling education
 - FHWA gradient study (with EPA)



Session 7: Summary

2

Assess Issues of Concern



Expansion of US 95 in Las Vegas, Nevada, where three adjacent schools were located within a few hundred meters of the roadway.

Issue: Student exposures to MSATs

Establish a stakeholder group

Assess issues of concern

Set project goals

Design full project

Collect and QC data

Interpret data & recommend actions

Take action

Session 7: Summary

3

Assess Issues of Concern (cont.)

Western High School

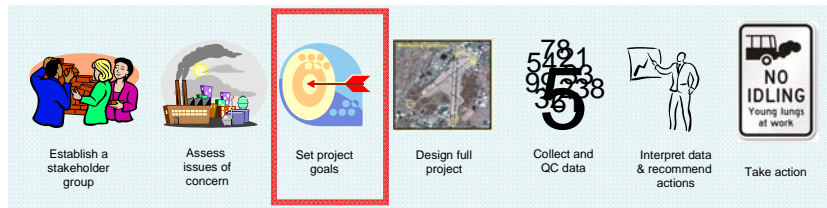
Fyfe Elementary School



4

Set Project Goals

- Characterize outdoor and indoor concentrations of MSATs at three schools, and thus characterize students' exposure to MSATs at the schools.
- Determine the contribution of vehicle traffic on US 95 to students' exposure.
- Determine the effectiveness and MSAT removal efficiencies of air management systems to be installed at each school.

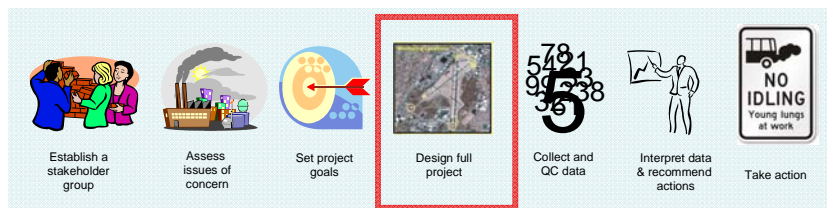


Session 7: Summary

5

Design Project: Pollutants of Interest

- Six MSATs from Settlement Agreement
 - Diesel particulate matter (DPM)
 - Diesel exhaust organic gases (DEOG), specifically benzene, 1,3-butadiene, acrolein
 - formaldehyde, acetaldehyde
- Other pollutants to help determine US 95 contributions:
 - CO, NO, NO₂



Session 7: Summary

6

Design Project: Critical Issues

- Measurement methods
- Measurement siting issues
- Meteorological data issues
- Informational and logistical needs (Clark County School District)
- Traffic data needs (NDOT)
- Measurement strategy issues
- Additional critical issues

Session 7: Summary

7

Design Project: Monitoring for DPM

- No current reference or standard method for DPM
- Two potential surrogate methods:
 - Particulate-PAH (polycyclic aromatic hydrocarbons); correlates with 4- & 5-ring PAHs
 - Black carbon (at 2 wavelengths, BC and UV)
 - Both methods can operate at about 10-minute and 1-hr frequency.
- Also use species ratios (to CO, NO, and NO₂, but at fewer sites?)



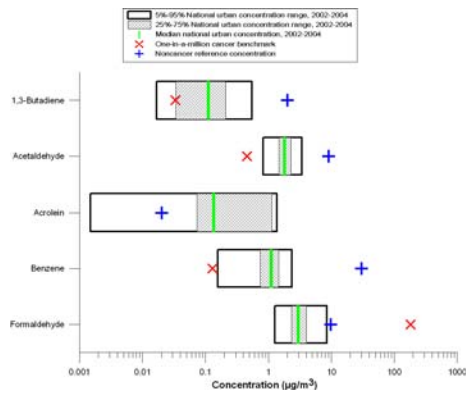
Example of Collected Filter

PM collected on 1" wide filter tape; note different degrees of black

Session 7: Summary

8

Monitoring for Gaseous MSATs



- Background concentrations
- Method detection limit
- Range of expected concentrations

- Benzene, 1,3-butadiene, and acrolein can be measured using canister sampling and analysis (EPA method TO-15).
- Formaldehyde and acetaldehyde can be measured using DNPH cartridge samples and HPLC/UV absorption analysis (EPA method TO-11).
- These methods and expected concentrations away from roadway likely require 1-hr or longer samples.

Session 7: Summary

9

Design Project: Monitoring Locations

- How many are needed outdoors at each school?
 - Cost will restrict this.
- Where should they be placed?
 - Likely at playground/sports fields plus near air inlets of classrooms.
- What is the influence of sound walls?

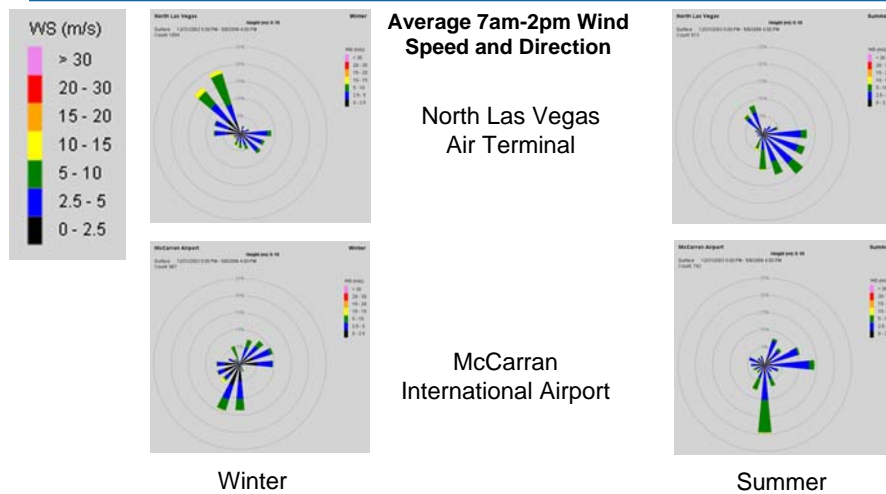


View from roof of science building at Western HS; monitoring trailer and US 95 in foreground

Session 7: Summary

10

Wind Directions Are Different at Existing Sites North and Southeast of Schools



So we'd better measure winds at the study sites!

Session 7: Summary

11

Design Project: School District Information and Logistics

- School calendar details, for 2006-2007 and 2007-2008 years
- When and where for installation of air management systems; also operational characteristics (on/off times, days, changes, etc.)
- Bus operations (location, timing, frequency, changes, etc.)
- Guidance on outdoor locations that would be acceptable (and not acceptable)
- Need for space, power, phone/Internet, safety, security, access
- Need to be creative for indoor locations (space, noise, classroom disruption)
- Opportunities for community education and outreach, and for science instruction in the classroom?

Session 7: Summary

12

Measurements Issues: Outdoor

- “Exposure” objective could be met with average samples (up to a complete school day).
- “Removal efficiency” objective could also be met with average samples.
- However, changes in atmospheric and traffic conditions and in student activities require shorter averaging times, in order to meet “contribution” objective.
- Thus, a combination of continuous and average samples are likely required.



Session 7: Summary

13

Measurements Issues: Indoor

- Need classrooms “in operation”
- Represent indoor concentrations before and after air management system installation and operation (if possible)
- Consider realistic ranges of ventilation, including seasonal variations
- Possibly deploy at one routine indoor location and perform multi-location indoor intensives, possibly rotating to the three schools
- Recognize difficult logistics inside classrooms (noise, space, disruption)



Session 7: Summary

14

Collect and QC Data

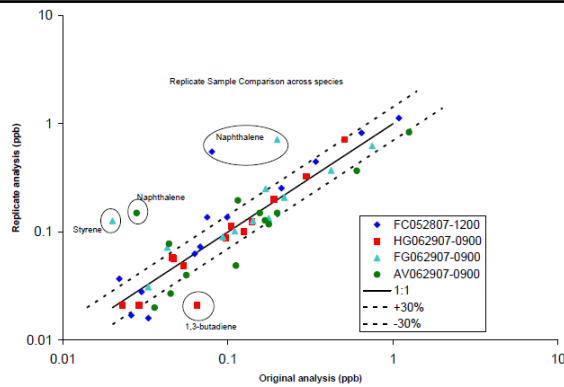
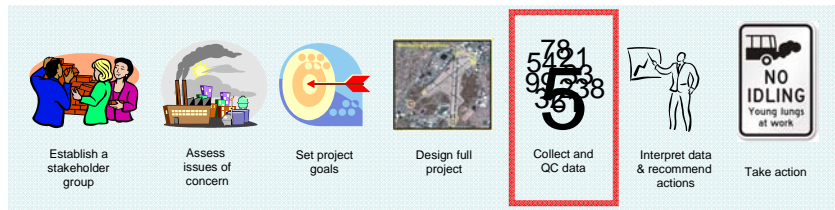


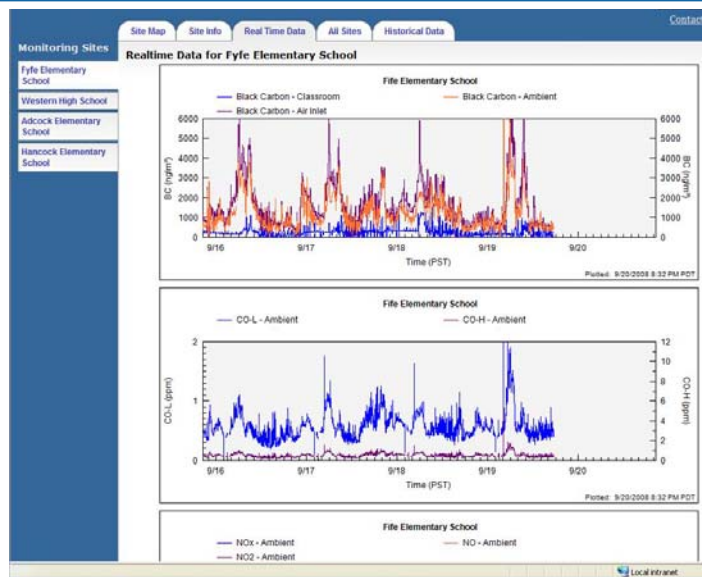
Figure H-2. Scatter plot comparison of four collocated samples from the summer IOP. Large outliers are circled and the pollutant identified. The lines indicate the 1:1 ratio (solid) and the 30% uncertainty (dotted) range.



Session 7: Summary

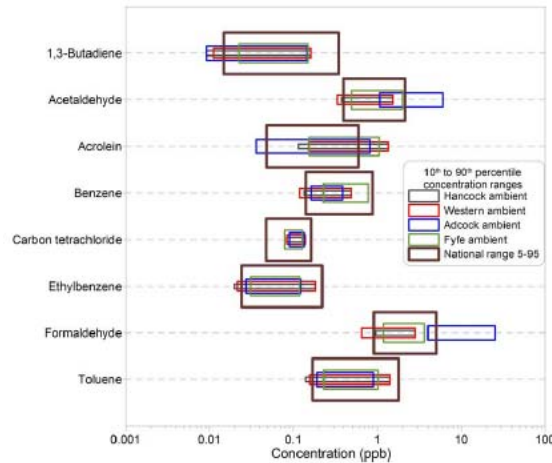
15

Collect and QC Data (cont.)



16

Collect and QC Data (cont.)



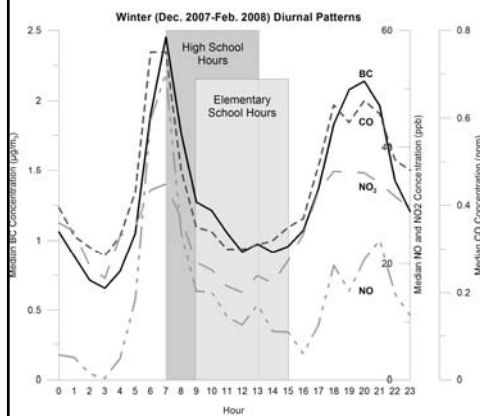
Level 3 validation –
Comparisons with
national data
ranges

Selected MSAT concentration ranges at each school during both IOPs and the national ranges during 2003-2005 (5th to 95th percentiles) (McCarthy et al., 2009).

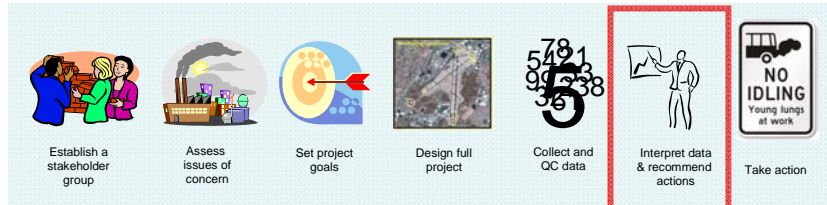
Session 7: Summary

17

Interpret Data and Recommend Actions



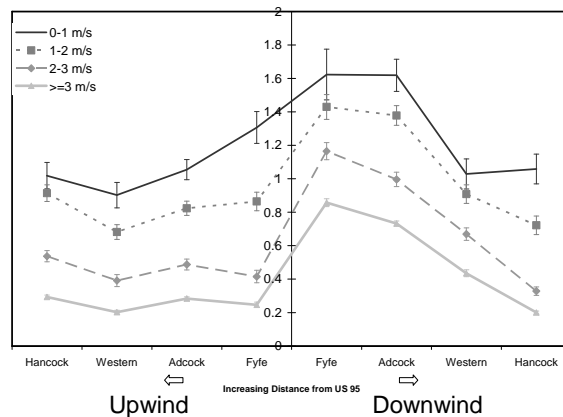
- Diurnal pattern is important for school day exposures
- Potential option for mitigation of exposure is to change hours of operation for high school



Session 7: Summary

18

Gradient in Concentrations Is Influenced by Wind Speeds

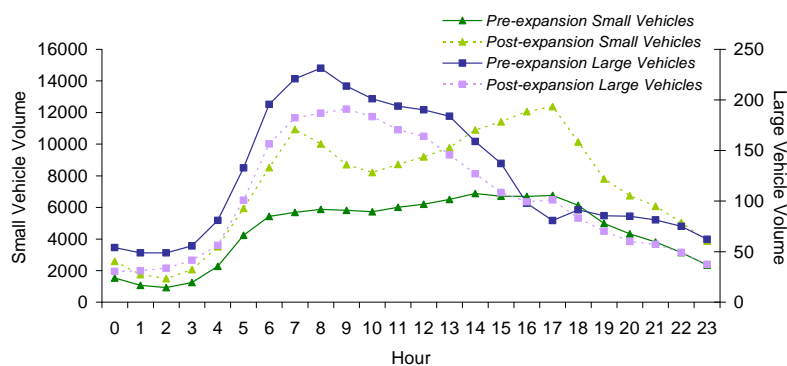


- Near-road school concentrations were higher when winds were from the road
- Near-road school concentrations were 2-3 times higher than upwind school concentrations
- Concentrations are greatest when winds are lowest

Session 7: Summary

19

Small Vehicle Traffic Up ~62% and Large Vehicle Traffic Down ~17% After Expansion

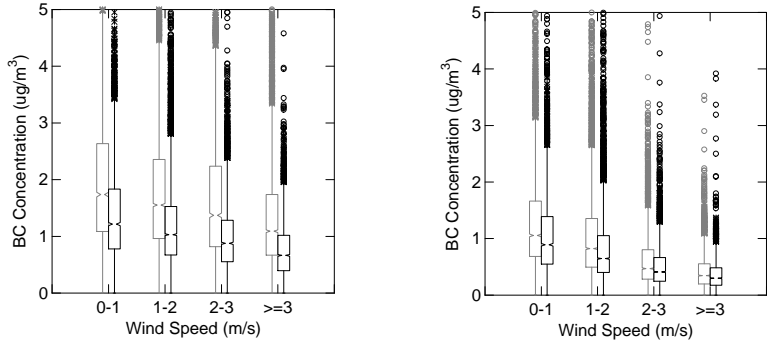


Average hourly small-vehicle (less than 21 feet in length) and large-vehicle (greater than 40 feet in length) volume pre-expansion (June-August 2007) and post-expansion (June-August 2008) on weekdays.

Session 7: Summary

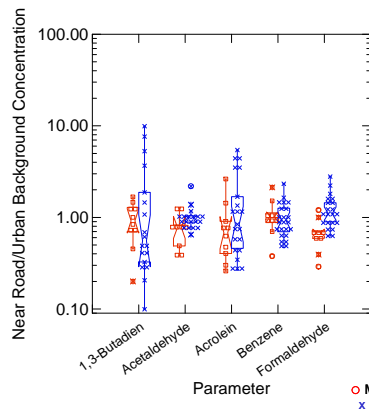
20

BC Concentrations Are Down After US 95 Expansion



Pre-expansion (Summer 2007, gray) and post-expansion (Summer 2008, black) concentrations for Fyfe (left) and Hancock (right) on weekdays.

Gaseous MSAT Concentrations Before and After US 95 Expansion

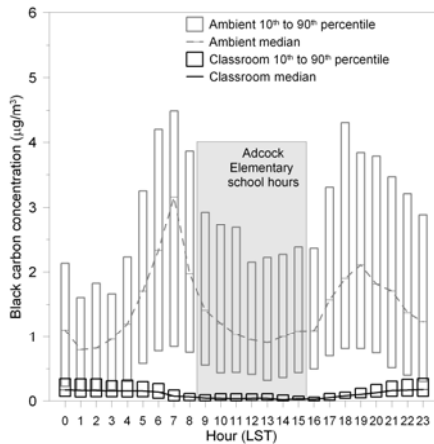


2-hr. integrated samples at 9-11 a.m. and 1-3 p.m. on 14 days in 2007 and 14 days in 2008.

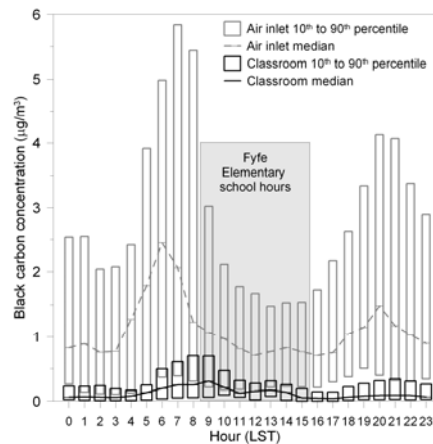
Too few samples to identify significant differences

Pre-expansion (May-June 2007, red) and post-expansion (January 2008, blue) concentration ratios for Fyfe/Hancock.

BC Distributions Outdoors and in a Classroom: Significant BC Removal



Effective filter efficiency: original system about 74%; improved system about 97%.



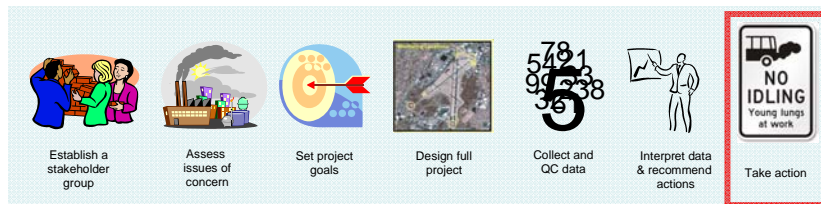
Effective filter efficiency: original system about 61%; improved system about 78%.

Session 7: Summary

23

Take Action

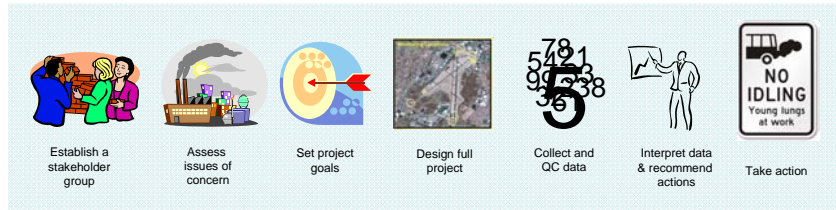
- Filtration system installation at near-road schools
- Behavior modification
 - Leave doors/windows closed in classrooms with doors to the outside
 - Avoid early morning recess/gym class near roads
 - Change timing of HVAC system operations to avoid early morning intake of air
 - Bus anti-idling measures



Session 7: Summary

24

Wrap Up



- References and resources
- Evaluation forms