DRAFT PROPOSAL
Effectiveness of Sound Wall-Vegetation Combination Barriers as Near-Roadway Pollutant Mitigation Strategies

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Check if applicable:
Animal subjects___
Human subjects___

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Abstract

We propose to perform upwind and downwind measurements of freeway pollutants and sound in the presence or absence of sound walls and vegetative barriers. The sampling will include the following real-time field measurement data on multiple days, and during different commute periods for:

(1) Traffic-related pollutants: fine particular matter (PM2.5), ultrafine particles, black carbon, oxides of nitrogen, carbon dioxide, and carbon monoxide;
(2) Meteorology data: wind speed and direction, temperature, and humidity;
(3) Traffic activity patterns: traffic volume and speed, and fleet mix; and
(4) Noise measurements to ensure that the sound walls are achieving their intended purpose.

An additional option is the real-time measurement of polycyclic aromatic hydrocarbons (PAHs), elemental carbon and organic carbon, and PM10. Integrated PAHs will also be made for speciated PAHs versus size, as was done at the Roseville rail yard, since these measurements are key to establish lung capture of carcinogens like benzo[*a*]pyrene.

We propose development of a detailed sampling approach that includes one site upwind and 4 sites downwind sampling continuously. The downwind sampling must cover a range of distances from the freeway. In this matter, the question of freeway profile (at grade, raised, depressed) must be addressed, since order of magnitude differences in impacts have been documented at distances out to 500 meters.

For traffic-related pollutants: in addition to fine particulate matter (PM2.5), measurements will be made at three separate transect sites every 3 hours for 4 days in 9 size modes, 35 to 10, 10 to 2.5, 2.5 to 1.15, 1.15 to 0.75, 0.75 to 0.56, 0.56 to 0.34, 0.34 to 0.26, 0.26 to 0.09, and 0.09 to 0.0 µm aerodynamic diameter. In addition to mass, optical absorption (soot), and 42 elements, silicon through lead, will be measured. These elements are critically important to measure since they are closely tied to several health impacts, including ischemic heart disease, mortality and loss of lung function in children.

Traffic volume and conditions will be gathered from CalTrans sensors and video cameras in order to assess the amount of braking and acceleration.

Finally, using an artificial tracer technique first used in the US EPA NEXUS study in Detroit, and now (2011) in Sacramento, artificial tracers will be used to make numerous quantitative profiles of ultra-fine and very fine aerosols to cover vegetation and freeway configuration conditions beyond those in the three major transects. These measurements are strictly quantitative measurements of ultra-fine particles, with maximum relevance to removal onto vegetation for some of the most dangerous freeway derived pollutants (i.e. metals, PAHs). The measurements are also inexpensive and quick, with 2 transects/day, 6 downwind sites each.

These tracers will also be sampled in leaf transects to directly measure removal of ultra-fine toxics onto vegetation. These data will also be used to compare vegetation removal rates in western leaf structures against literature values in Eastern US studies.

Objectives

The ability to provide the Air Resources Board (ARB) and local agencies quantitative data on the mitigation efficiency of sound walls and vegetation will enhance the ability to use energy efficient near transport infill development. However, any attempt to measure the impact of sound walls and vegetation based on 3 paired transects will provide very limited support for the diversity of real life situations. Far more measurements are needed than are possible with the standard methodologies. The solution we propose to overcome this is manifold: target measurements where the model predictions breakdown, provide new definition to vegetation parameters to correct models and utilize new measurement approaches that provide more extensive definition to the concentration profiles that must be predicted.

Technical Plan

The Technical Plan builds on the need for detailed measurements over extended periods for sites both upwind and downwind of freeways with varying sound wall/vegetation configurations. We propose to enhance the complete, but limited, Full Array studies with inexpensive tracer studies using ultra-fine tracer aerosols, allowing for more conditions of freeway traffic, meteorology, vegetation, and seasonal variabilities to be examined. By doing this, we propose to develop robust technical guidance on how much mitigation these techniques can deliver in realistic conditions. Note that we propose winter studies, shown to have the most severe near roadway impacts.

Our approach is to do an extended experimental matrix, but populate a large portion of it with a simpler tracer study which we'll define later. This is a method we have developed, tested, and are presently using in the US EPA NEXUS study in Detroit. The tracer transect will provide the ground truthing concentration profile required for modeling parameter adjustments, but is more easily propagated across the large experimental parameter space.

	Traffic braking?	Vegetation Barrier + sound wall	Vegetation Downwind canopy	Summer	Fall	Winter	Spring
At Grade	No	No	No	Yes		Full array	
Depressed	No	No	No	Yes		Yes	
Raised	No	No	No	Yes		Yes	
At Grade	No	Yes	No	Yes	Yes	Full array	Yes
Depressed	No	Yes	No	Yes	Yes	Yes	Yes
Raised	No	Yes	No	Yes	Yes	Yes	Yes
At Grade	No	Yes	Yes	Yes		Yes	
Depressed	No	Yes	Yes	Yes		Yes	
Raised	No	Yes	Yes	Yes		Yes	
At Grade	Yes	Yes	No	Yes		Full array	
Depressed	Yes	Yes	No	Yes		Yes	
Raised	Yes	Yes	No	Yes		Yes	

Table 1. Proposed full transect array and limited tracer studies. The full array studies are the ARB requested measurements, plus the DELTA Group enhancements. Each limited tracer study will be supported by local meteorology, traffic definition data, including video, and standard gasses.

We propose 30 tracer transects, each with upwind, on-freeway, and typically 6 downwind sites.

Reasons for the Technical Plan

The health impacts attributed to pollutants associated with roadways on downwind populations must be addressed at all levels:

1. Reduction of emission from the roadway
   a. Pollutants/km, and
   b. Traffic types and density
2. Mitigation from roadway to right-of-way fence,
3. Mitigation from right-of-way fence to receptors, and
4. Reduction of roadway pollutants at receptor sites
   a. Outdoor
   b. Indoor

Clearly, one of the most effective mitigation strategies is distance, but this is in conflict with both existing urban patterns and the goals of SB375 to encourage infill. Thus, we must examine what can be done under present conditions, and in this regard, sound walls and vegetation provide potentially significant reductions, and vegetation can also mitigate from the right of way fence to the receptors.

The ARB-proposed SCOPE OF WORK is sound in concept and reasonably efficient in execution, the goals are to provide data from measurements that can form a basis to more accurately represent the processes that occur in varying circumstances. When process definition is determined, it allows improvements in guidelines, rules of thumb for designs, and to improve the analytical models to allow easy assessment with improved accuracy. The problem is that using standard methods, the number of sites and conditions of observations, will require a large experiment matrix and much larger expense.

Figures 1 and 2 below represent the simple solution, where fall-off is as predicted and concentrations downwind of the roadway return to the prior levels as expected.

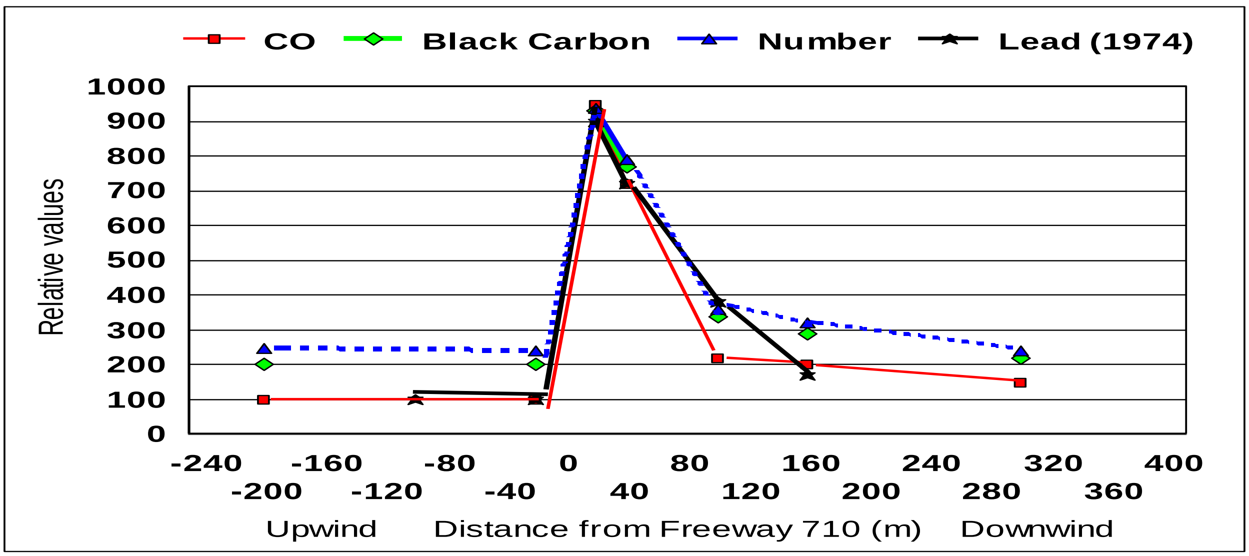


Figure 1. Highway transect of Zhu et al. 2002 with added data from Cahill et al. 1973 for lead.

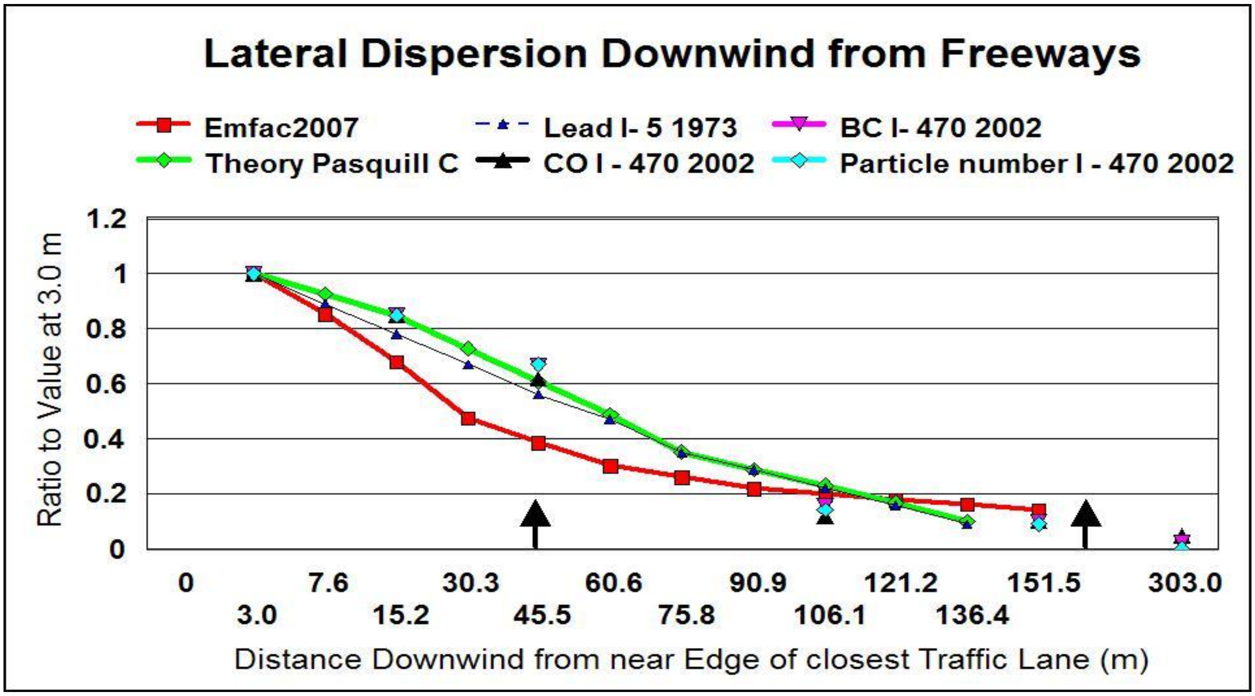


Figure 2. Downwind fall-off of pollutants for an at-grade roadway, including Zhu's results 2002 and the 1973 lead data.

The problem arises because of the complexity of near-highway dispersion in all but the simplest conditions. It is instructive to examine a few of the confounding parameters which can completely change the expected profile of pollutant concentrations. These complexities include but are not limited to:

1. Freeway configuration
    a. At grade
    b. Depressed
    c. Raised
2. Seasonal meteorology
    a. inversions, diurnal wind cycles, rain, temperature differences
    b. vegetation changes
3. Traffic behavior
    a. Freely flowing
    b. Stop and Go

1. Freeway Configuration

The most extensive set of measurements of near freeway dispersion were made under the lead-dispersion studies of ARB Contract # 502, Cahill et al., 1973, some of which appeared in the peer reviewed summaries, most notably Feeney et al. 1975. The advantage of this work was the use of a unique ultra-fine tracer of cars, lead (Pb), whose on-highway emission rate was precisely known. In addition, by performing elemental analysis for upwards of 30 species, the unique signature of automotive lead, PbBrCl, could be separated from all other potential sources. Lack of such capability lead the US EPA into a grave error, in which they assigned sulfur to freeway sources.

An example of one site is shown below, with 5 rotating drum Lundgren impactors used to give 2 hr data in 5 size modes, including < 0.5 µm, for periods as long as days. Over 100 such transects were made for freeways in,

a. At grade,
b. Depressed, and
c. Raised configurations (illustrated below)

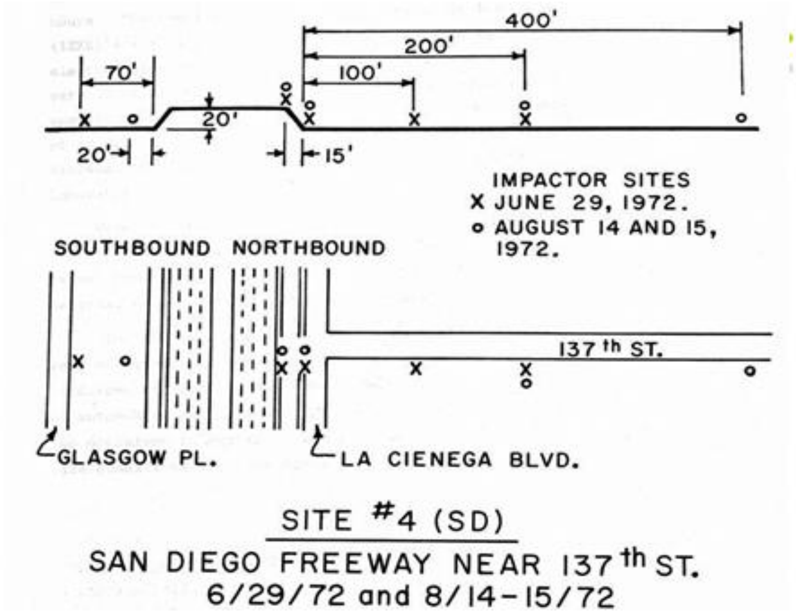


Figure 3. One of the 5 Freeway sites used in Cahill et al., 1973 for lead dispersion studies. Two transects of measurements were done at this site.

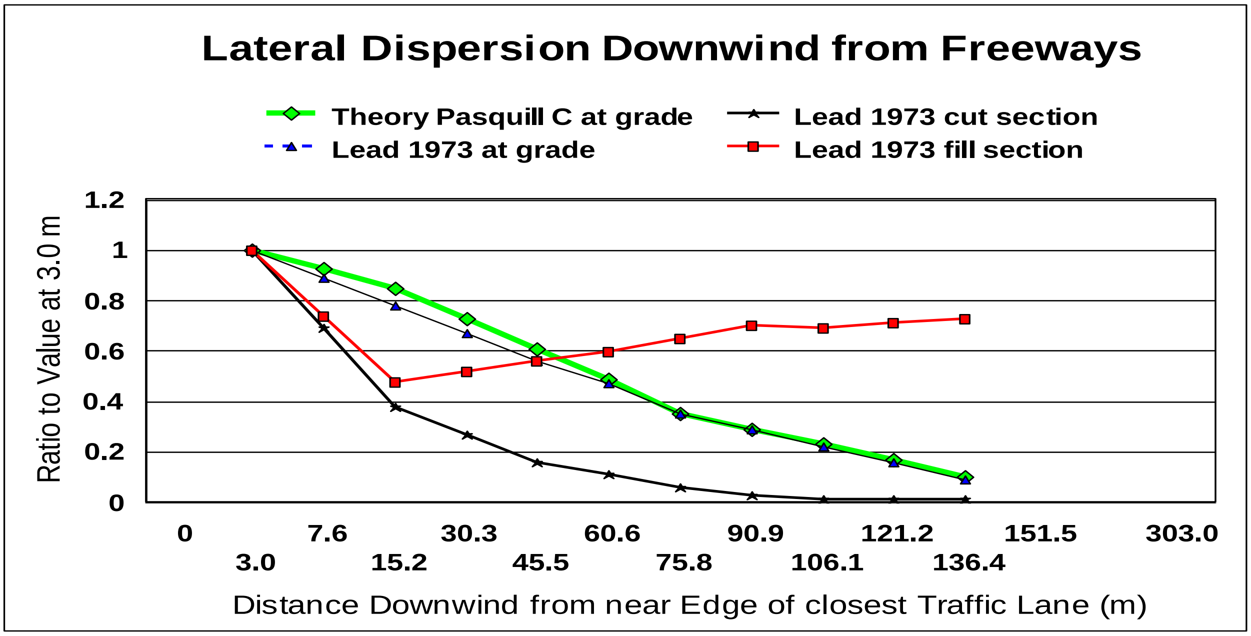


Figure 4. Downwind dispersion of lead from Cahill et al.,1973, Feeney et al.,1975.

First, the at-grade results were an exact match to emission rates using a sliding box model (Feeney et al. 1975). Second, these results are also plotted on the Zhu et al. graph, with a very good match (see above).

From these results, it can also be seen that freeway configuration has major impacts on downwind dispersion, with raised section freeways observed to have between 7 and 20 times as much ultra-fine aerosol as at-grade and depressed section freeways at 136 m (450 ft). The reasons for this are developed in the Final Report, but include wind direction and waste heat from cars, giving buoyant plumes in confined depressed freeways, and a vertical gyre lying downwind of elevated freeways.

2. Seasonal meteorology

a. inversions

b. vegetation changes

The impact of seasonal meteorology is well illustrated by a graph of $PM_{2.5}$ mass at Del Paso manor and the downtown 13^{th} and T sites. The impact of the typical winter inversions is evident, a result strengthened by the correlation of two sites 7 miles apart.

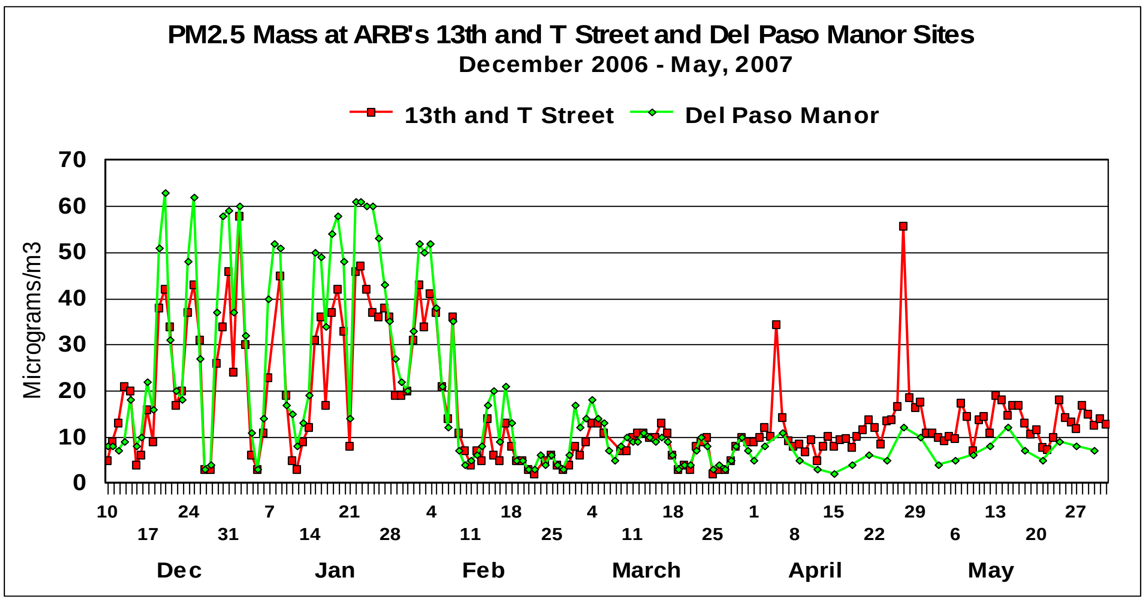


Figure 5. Comparison of $PM_{2.5}$ mass data from the 13^{th} and T Street and Del Paso manor sites, 2007.

As part of a long standing study of Arden Middle School by the Health Effects Task Force, measurements were made of ultra-fine metals directly downwind of Watt Avenue close to the major intersection at Arden Way. An upwind site at 500 m showed essentially zero ultra- fines. The plot extends from Feb 7 (Winter) to June 20 (Spring C).

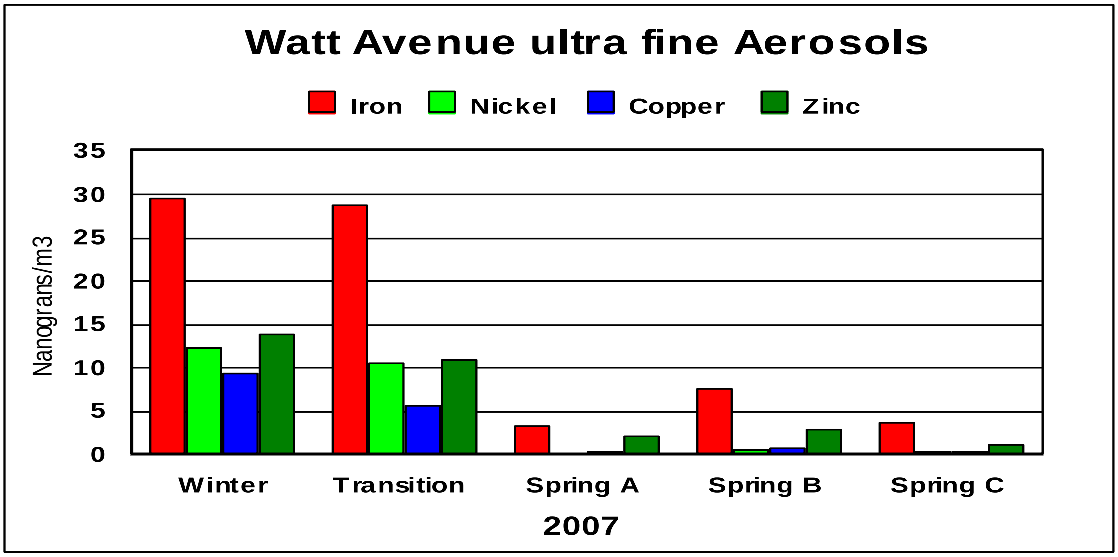


Figure 6. Ultra-fine (< 0.09 µm) metals directly (15 m) downwind of Watt Avenue at Arden Middle School, just south of a stop light on a busy (65,000 v/day) road. These particles have been traced to brake pads, brake drums, and zinc in lube oil.

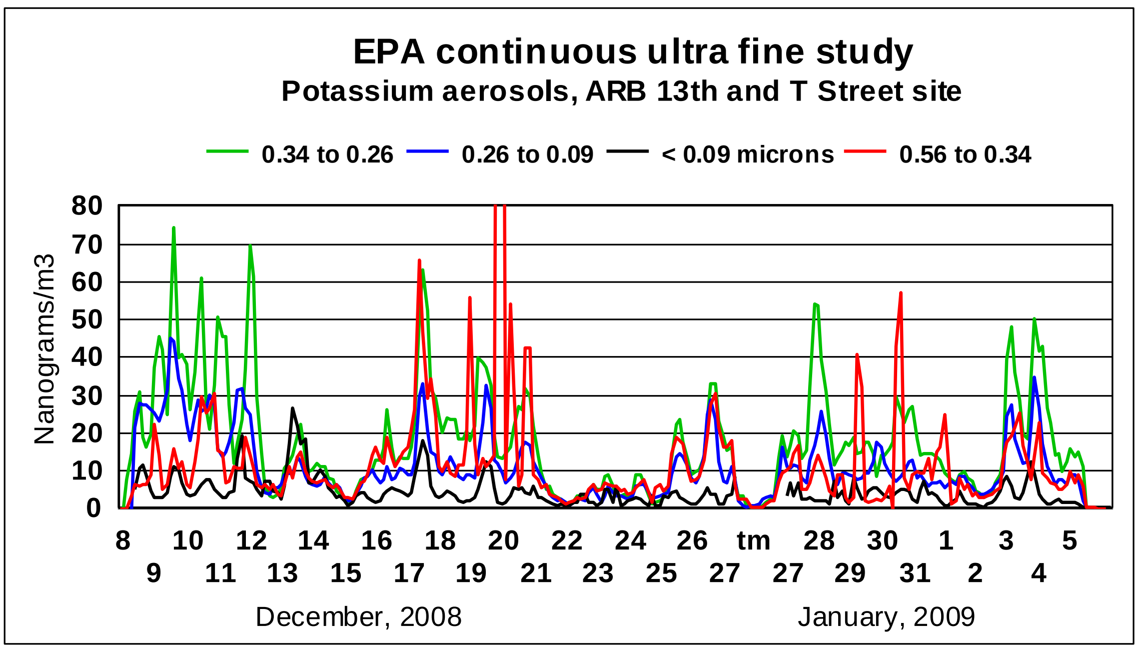


Figure 7. Very fine and ultra-fine aerosols at 13th and T Street. Note the lack of correlation that often occurs between ultra-fine (black) and coarser (red) potassium aerosols, isolating different sources.

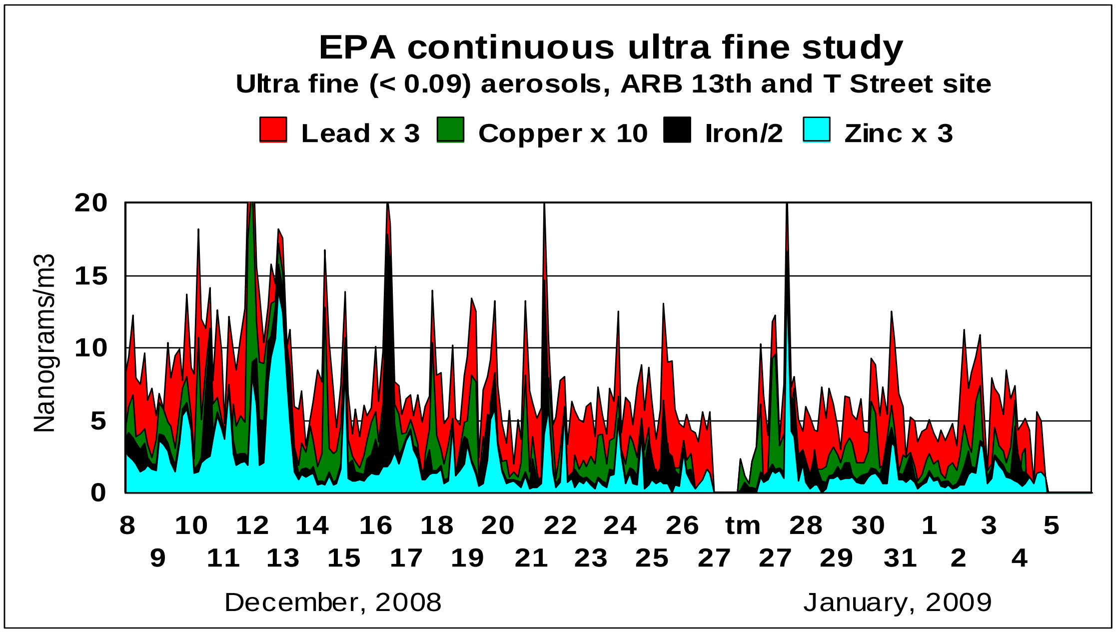


Figure 8. Ultra-fine metals that come from brake pads and drums and lube oil as seen at 13th and T Street. Note that these same aerosols were almost completely absent at the suburban background site 500 m SW of Watt at Arden.

In addition to the effect of inversions, the effect of changing vegetation must also be included.

3. **Traffic behavior**
   a. **Freely flowing**
   b. **Stop and Go**

The graph (above) was used to identify the sources of the ultra-fine metals as brake drum and pads, plus zinc from lubrication oil. Note that in a recent study of **freely flowing** traffic in Detroit with the US EPA NEXUS program, levels were much lower than seen on Watt Avenue at the stoplight. The correlation of these metals in Bakersfield and the tie to braking on I-5 Grapevine grade and the Tehachapi grade (Cahill et al., 2011 a) shows that the toxicity of freeways for ischemic heart disease is closely tied to traffic behavior.

Stop and go behavior has been shown to be critically important to the health effects downwind of freeways, as braking produces very fine and ultra-fine particles associated with both loss of lung function (transition metals and the Fenton free radical problem) and ischemic heart disease (ultra-fine insolubles), and increased carcinogens associated with acceleration, especially in trucks (benzo[*a*]pyrene, etc.).

Response to ARB requirements – 3 major paired sites

1. The sampling must include, at a minimum, the following real-time field measurement data on multiple days, and during different commute periods for traffic-related pollutants:
   a. fine particular matter (PM2.5),
   b. ultrafine particles,
   c. black carbon,
   d. oxides of nitrogen, carbon dioxide, and carbon monoxide;

2. Meteorology data: wind speed and direction, temperature, and humidity;
3. Traffic activity patterns: traffic volume and speed, and fleet mix; and
4. Noise measurements to ensure that the sound walls are achieving their intended purpose.

These measurements must be made at an upwind site well beyond the range of freeway turbulence, as well as one directly downwind of the roadway, for 3 days at each site.

Proposed addition to ARB requirements – 3 major paired sites

In order to better tie freeway aerosols to health impacts, we also propose:

1. Size and time resolved aerosols, especially transition metals (Fenton free radicals)
    a. 1/1/2 hr time resolution
    b. 3 days duration
    c. Continuous ultra-fine metals and soot, < 0.09 µm, 3 hr time resolution (ischemic heart disease)
    d. Size resolved soot (and wood smoke, other sources) by optics
2. Size and time integrated speciated heavy PAHs (carcinogens) and *n*-alkanes

The accuracy and precision of the DELTA Group 8 DRUM versus standard 24 hr $PM_{2.5}$ FRM samplers for mass is shown below in a side by side comparison at the ARB 13th and T Street test site. For the entire study of almost a year the mean precision was ± 10%, well within the ± 15 % allowed by US EPA Protocols for equivalency. (see below, Figure 9, and Cahill et al. 2011a) Operationally, the full array suite will include 3 vans – 2 fixed at the upwind and near downwind site, the third able to measure along the transect. The fixed site vans will include:

1. Meteorology
2. Particle numbers
3. PM2.5 24 hr filters – mass, elements, optics
4. PM2.5 24 hr filter - EC
5. Ultra-fine filters, 24 hr, S-XRF elements
6. Gasses – CO, CO_2 NO
7. Continuous PAHs
8. 3 day integrated filter – PAH speciated PAHs and *n*-alkanes, in 9 size modes
9. Continuous aerosols in 9 size modes, including ultrafine – 3 hr resolution, for mass, S-XRF elements, and optics 350 – 820 nm.

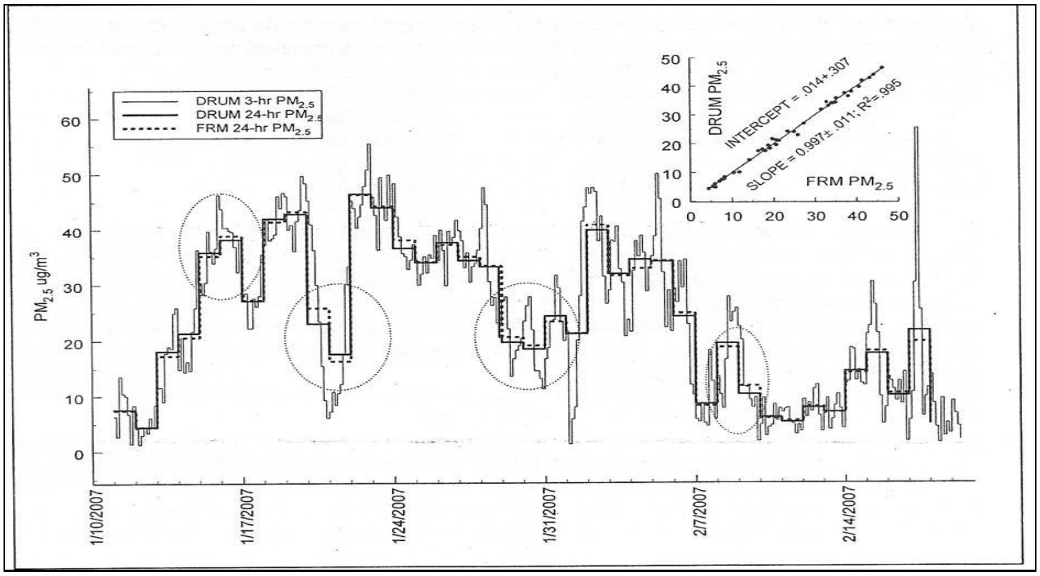


Figure 9. Comparison between mass from a DELA Group 8 DRUM impactor and an FRM filter at the ARB 13th and T Street site.

As part of our proposed enhancement, we now have developed, under a US EPA ORD contract, the ability to measure ultra-fine mass, soot, and metals continuously. Below we show ultra-fine sulfur versus time for the downwind 10 m and 100 m sites, and the very fine – ultra-fine comparison at 10 m, from the ongoing Detroit NEXUS program. (Also see Figures 7 and 8.)

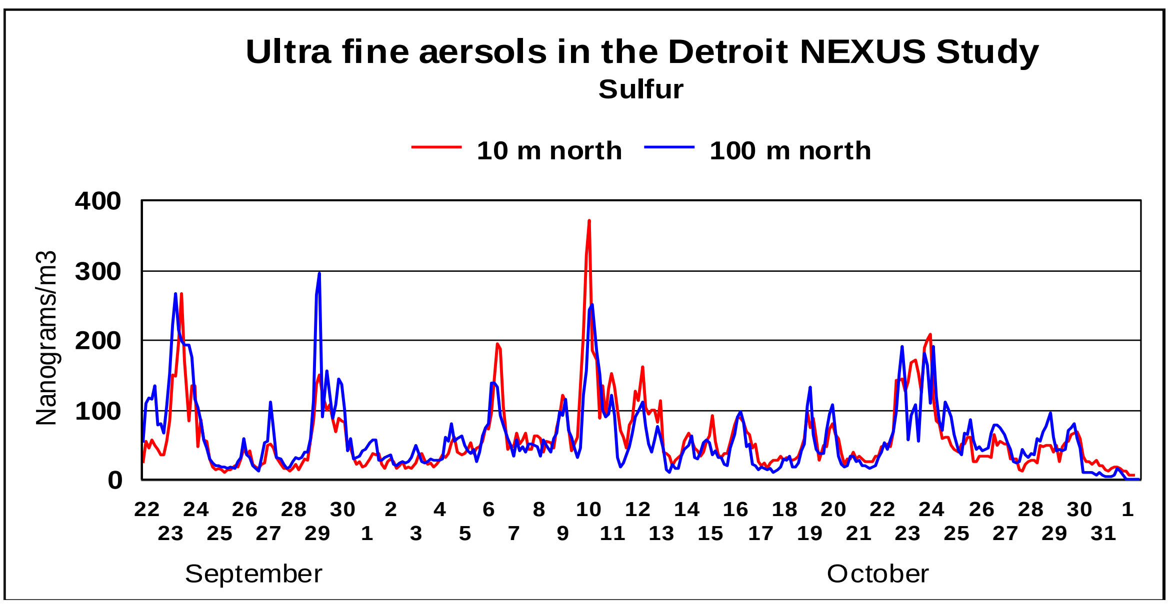


Figure 10. Ultra-fine sulfur from the NEXUS study, Detroit, at 2 distances.

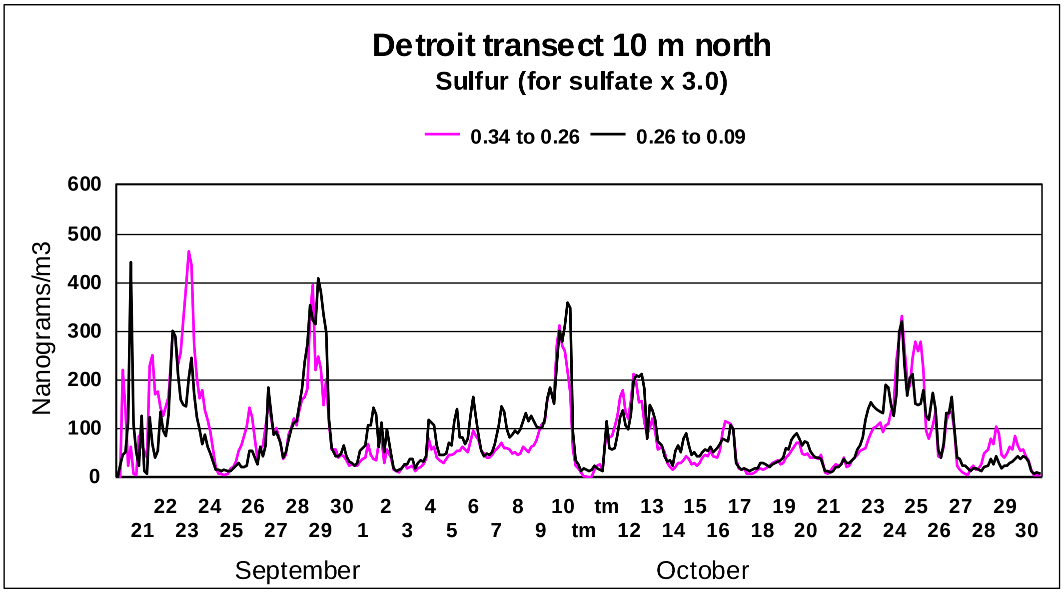


Figure 11. Comparison between very fine and ultra-fine sulfur from NEXUS.

Continuous Measurements—Available Capabilities

Multiple continuous measurements will be coupled with the transect and other near-road measurements. Both pollutant and meteorology will be extensively captured both at near-road locations as well as at points representative of local conditions. Fast (>10 Hz) measurements are possible in order to more fully characterize micro-environmental conditions, including turbulence and friction velocity, etc. These measurements will be useful in the CFD modeling of transport through and around the plant barriers and canopy (see Study Enhancement #3). These measurements will also assist in understanding the relative importance of advective vs. diffusive mechanisms for transport of pollutants from the highway to the downwind receptors, including through and/or around barriers, both solid and vegetative.

Standard gaseous pollutant analyzers will be used to assess their impact at various points in the test setup. In addition to the DRUM aerosol samplers, various continuous particle analyzers, both size fractions and particle-counting, are available for direct measurements as well as cross-calibration and comparison with other instruments.

Other important pollutant parameters relevant to vehicle emissions are particle-bound PAH and Black Carbon. Both are useful for tracking emissions, including the capability of the 7-wavelength aethalometer to distinguish black carbon from 'brown' carbon.

Available capabilities include the following:

1. Mesoscale Meteorology--Standard parameters at 10 meters: wind speed/direction (sonic and mechanical), ambient temperature, relative humidity, barometric pressure, sigma theta
2. Delta-T Stability—Fine Wire Temperature sensors at 2 m and 10 m.
3. Local sub-Mesoscale Meteorology/Micrometeorology—fast 3D sonic for turbulence measurements
4. Pollutant Gases: CO, CO2, NO—both standard and fast analyzers

5. Continuous particulate (PM10/PM2.5/PM1, at 5 to 60 min)—BAM, EBAM, Optical Sensors
6. Fast Particulate Measurement (>1 Hz): Optical sensors
7. Fast Particulate Counting (Four particle sizes at 1 Hz)—DRX particle counter/nephelometer
8. Toxics—Particulate Bound PAH (1 sec resolution); Black carbon (7 wavelength/2 wavelength)
9. Tracer Gases (>10 Hz): CH4, CO2, H2O

Proposal for use of artificial tracers

Returning to the very successful work on lead in 1973-1974, the key was the availability of a unique tracer that also happened to be the primary toxic material of concern, Happily; lead is now gone, but toxics remain. They are, however, hard and expensive to measure.

One technique in current use for roadway studies is the use of artificial tracers. Inert gaseous tracers, such as SF_6 can provide a quantitative measure of roadway impacts well downwind (Barzyk et al., 2012). However, the role of vegetation in collecting ultra-fine particles by diffusion cannot be modeled with gaseous SF_6 but requires an ultra-fine particle tracer surrogate.

For this work, we propose to use artificial ultra-fine tracers of unique composition, namely highway safety flares, giving very fine and ultra-fine aerosols capable of inexpensive sampling and analysis. This allows us to make numerous transects as a function of vegetation, highway configuration and season.

These will be calibrated to co-located complete transect sites as in the call for proposals, as well as using the EPA NEXUS comparisons.

This technique was developed in conjunction with the Health Effects Task Force, Breathe California of Sacramento Emigrant Trails, and utilized for the first time in the US EPA Detroit Nexus studies (on going). The concept is simple. Freeway flares are placed directly upwind of the freeway section in a linear array long enough to meet the linear dispersion assumption of the models. They are allowed to emit for 1 hour, while up to 10 or more measurements are being made by simple battery power aerosol samplers. This simple array provides concentration ground truthing for model predictions along the profile. Analysis is then done using synchrotron-induced x-ray fluorescence that has the sensitivity to identify the unique ultra-fine strontium peak on the filters.

Figure 12. Highway flare used for the vegetation tunnel and NEXUS Detroit studies.

Figure 13. Placement of the transect samplers at 35 Ave. Note the heavy redwood barrier at the downwind freeway edge.

Transect set	Dates, Day	Duration	Site #	Distance (m)	Vegetation; Sound Wall	Tracer aerosol source	Other
Transect #1: 35 avenue			Upwind freeway (UW)	UW	Barrier, Yes, Heavy, tall redwoods		
Elevated Freeway 10 m	Summer, Thursday, Aug. 18				Downwind: sparse ~ 30% cover	Truck on roadway I mile shuttle	
Sound Wall	Winter, yy, Jan xx	1 hr	1	50			
		1 hr	2 a	115			QA pair
		1 hr	2 b	115			QA pair
		1 hr	3 a	206			QA pair
		1 hr	3 b	206			QA pair
		1 hr	4	280			
		1 hr	5	380			
Transect #2: 10th Ave	Summer, Tuesday, Aug 23;		Upwind; bike path	UW	Barrier: Yes, Sparse	Emitters on bike path	
Elevated freeway, 5 m	Fall, Nov. 13	1 hr	SDW1	5	Downwind: Sparse	Shuttle	
Sound Wall	Winter, Jan xx	1 hr	SDW2 a	65			QA pair
		1 hr	SDW2 b	65			QA pair
		1 hr	SDW 3	115			
		1 hr	SDW 4	210			
Transect #3; 13 Ave	Summer, Tuesday, Aug 23		Upwind; Bike path	UW	Barrier; moderate	Emitters on bike path	
Slightly elevated, 2m	Fall, Nov. 13	1 hr	PDW 1 , up, down	5	Downwind: Heavy canopy ~ 70%	Shuttle	Vertical pair
		1 hr	PDW 2 a	50			QA pair
		1 hr	PDW 2 b	50			QA pair
		1 hr	PDW 3	140			
		1 hr	PDW 4	215			

Table 2. Transects study and placement. Distances are from downwind edge of freeway.

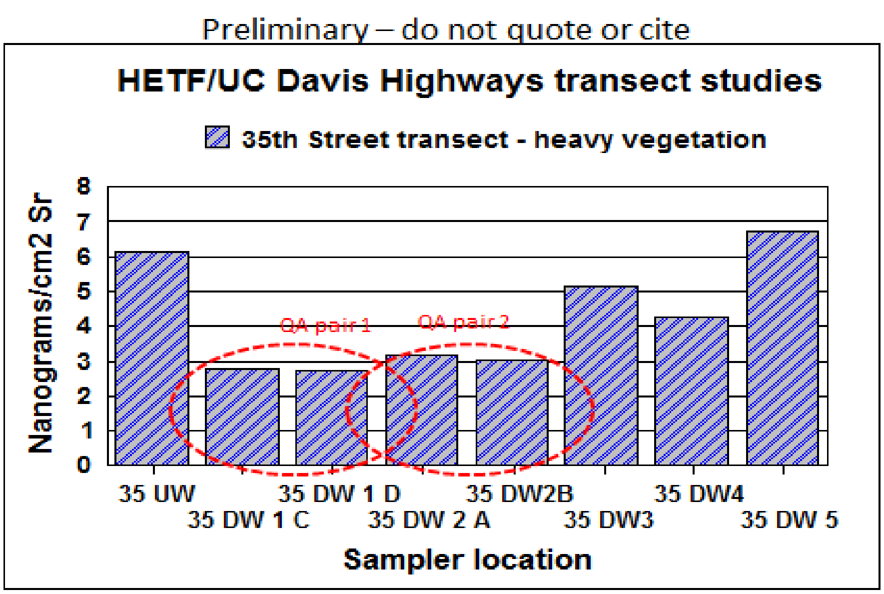


Figure 14. 35 Ave transect: The 35 UW was in the turbulence zone of the freeway, while there was a heavy redwood screen at freeway, light (30%) coverage downwind; raised section freeway (circa 30 feet), summer sampling The 35 DW 5 site was at 380 meters.

Note the excellent precision of the co-located samplers in all cases. Also note that the 35th Ave site and the School Transect site on 10th Ave. were both raised section freeways. The following two sites were also sampled in summer on the same day.

The “School Transect” on 10th Ave, had modest freeway vegetation (Eucalyptus) and modest downwind vegetation.

The 13th Ave transect went in to Land park, and had moderate freeway vegetation (Eucalyptus) and a heavy tree canopy downwind (circs 70%). The sharp reduction below the tree canopy was also seen in the North Carolina studies.

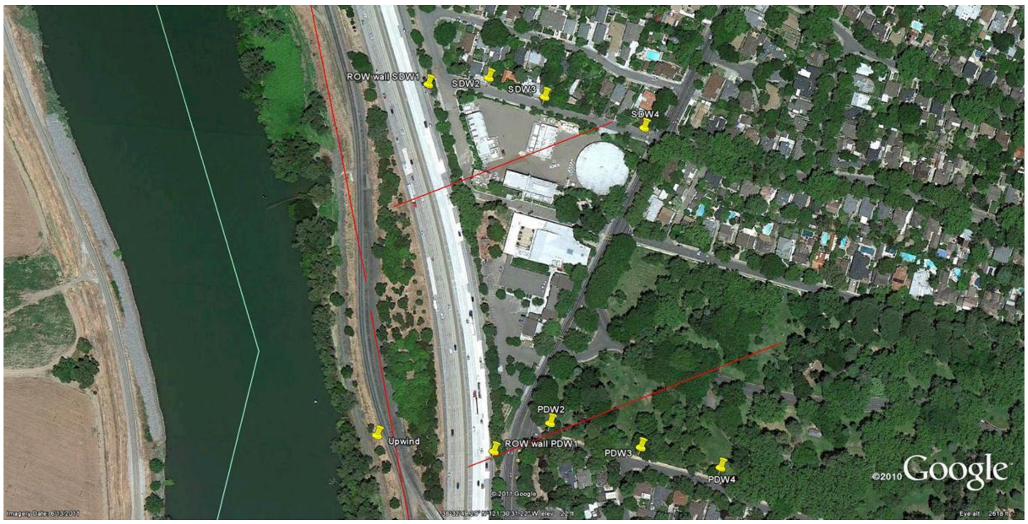


Figure 15. Transects # 2 and 3

Preliminary – do not quote or cite

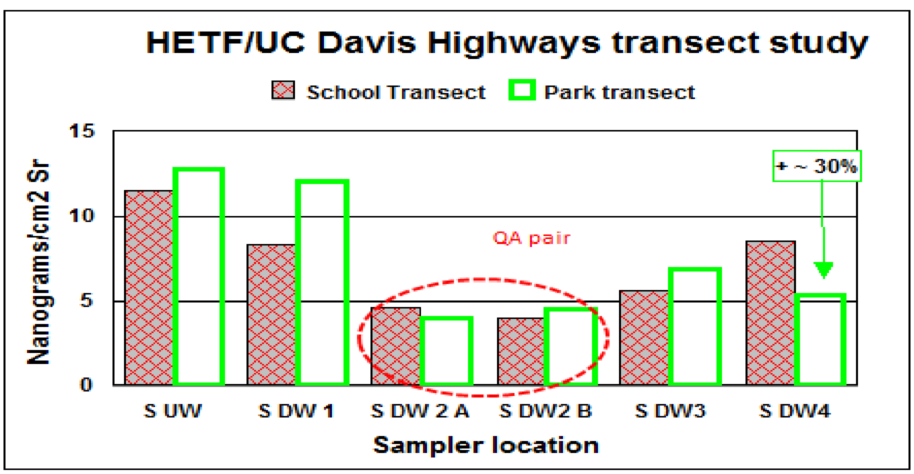


Figure 16. The summer school and park transects. SUW was within the freeway turbulence zone. Later upwind sites for fall and winter were moved farther upwind.

The S DW 4 site was at 210 meters, while the Park site 4 was 215 meters. Note that the SDW4 and PDW4 sites are at the same downwind distance, but PDW4 is under a heavy tree canopy, sharply reducing ultra-fine and very fine aerosols. This becomes a significant gain in predicted health benefit for ischemic heart disease.

Vegetation factors

The role of seasonal vegetation is also a key factor. This is especially true when it is realized that the greatest freeway impact occurs in winter. This favors perennial vegetation, such as red woods, deodar cedar, and for southern California, California pepper. The important point is that some of the particles proven to be the most dangerous are ultra-fine, and thus can be removed onto vegetation.

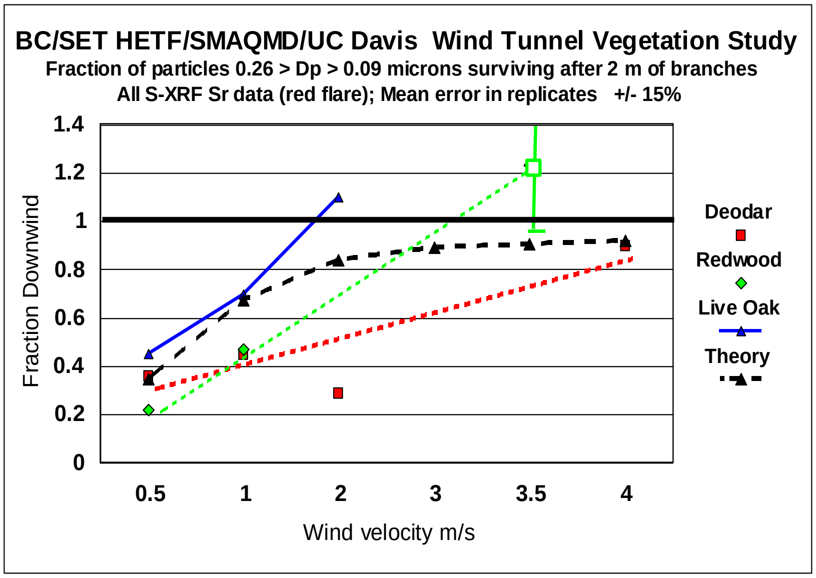


Figure 17. Effect of vegetation type

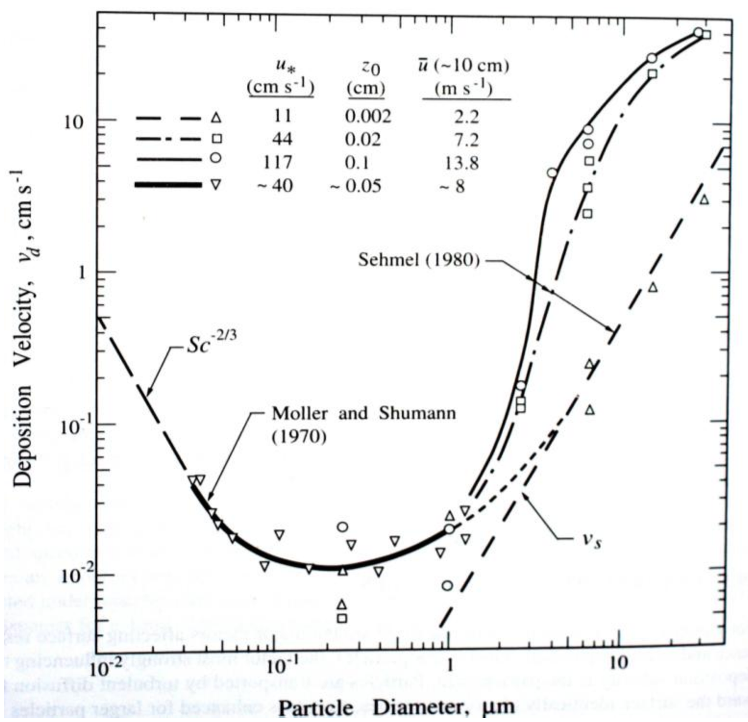


Figure 18. Theoretical and experimental removal rates for aerosols.

The wind tunnel studies also used highway flares to measure removal by vegetation.

Both models and measurements show that ultra-fine aerosols moving slowly through vegetation are as effectively removed as 10 µm particles settling under gravity. The key is having surfaces close enough so that the enhanced diffusion length of the particles intercepts a surface.

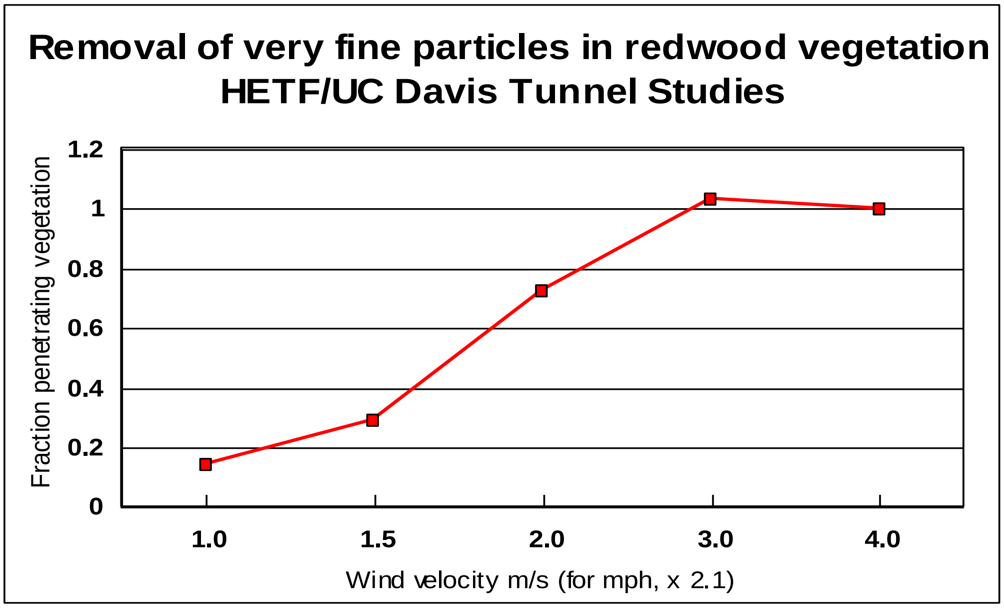


Figure 19. Measured removal rates of very fine and ultra-fine aerosols from 2 m of redwood vegetation as a function of wind velocity (for mph, x 2.1)

Science Advisory Panel

The project team will be assisted by a Science Advisory Panel, composed of experts in the areas of roadway emissions, field measurements, modeling, and health effects. This panel will project technical and logistical advise to the project team in order to obtain the maximum scientific return on the effort.

The Panel will consist of the following persons:

Chair: Dr. Richard Baldauf, US EPA Office of Research and Development, National Risk Management Laboratory, Air Pollution Prevention and Control Division, (APPCD), Emissions Characterization and Prevention Branch (ECPB).

Member: Staff (invited) Sacramento Metro Air Quality Management District
Member: Staff (invited) Sacramento Metro Air Quality Management District
Member: Health Effects Task Force, TBD
Member: TBD

This Panel and the Project Team anticipate participation in the third Health Effects Task Force/EPA workshop focused on the role of vegetation in mitigating air quality impacts from traffic emissions (http://www.epa.gov/nrmrl/appcd/nearroadway/workshop.html). These conferences have been held at UC Davis with key participation from the DELTA Group. Panel members (current and invited) have been past participants and are expected to be future participants as well. This venue will be an excellent opportunity for technical exchange on key scientific issues.

Optional Study Enhancements

Three separate study enhancements are included below as options to be considered in the final technical study design. These additions are considered to be useful to the overall objectives of the study, but are not called out specifically in the project objectives.

Study Enhancement 1: Identifying causal factors in lung function loss in children
John Troidl, UC Davis School of Public Health, UC Davis, Thomas A. Cahill, Depts. of Physics and Atmospheric Sciences, UC Davis, and David E. Barnes, UC Davis DELTA Group, Project manager

Background

1. Extensive data collected in the past decade show health impacts for children living near freeways. (The distances of the effect far exceed the estimates of EMfac 2007.)
2. In addition, CA data on morbidity has improved in areas used in the prior studies.
3. Potential causal factors have been developed through studies of the US EPA particulate Matter research Centers and other sources pointing to very fine and ultra-fine metals as potential causal factors. (Vidrio et al., 2008)
4. Recent papers in the CA Central Valley show a clear association between very fine and ultra-fine metals and ischemic heart disease mortality. (Cahill et al. 2011 a)
   a. The strongest factor involved aerosols associated with braking, especially in trucks.
5. We propose to make measurements of potentially causal factors, including very fine and ultra-fine metals at the same site where the health data on children were collected, and with downwind transects matching the health impact distances.

January 6, 2007

The Sacramento Bee

FRIDAY, JANUARY 26, 2007 · www.sacbee.com · FINAL EDITION · 50 CENTS

Senator: Cheney interfered

ew intelligence panel chief
lls of efforts to stall Iraq probe.

By Jonathan S. Landay
McCLATCHY WASHINGTON BUREAU

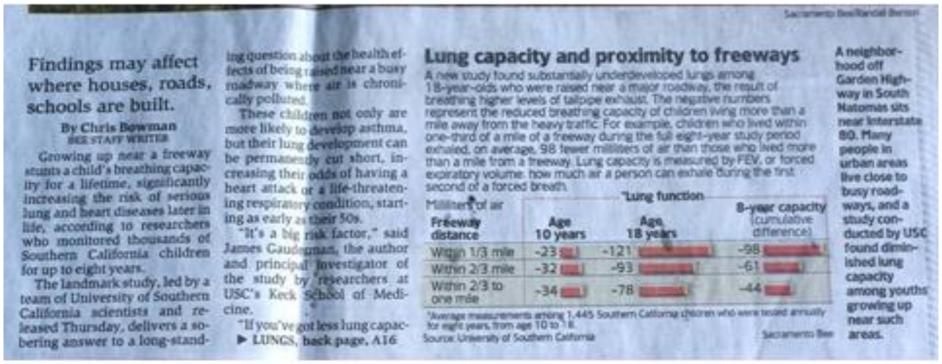
WASHINGTON – Vice President Dick Cheney exerted "constant" pressure on the Republican former chairman of the Senate Intelligence Committee to stall an investigation into the Bush administration's use of flawed intelligence on Iraq, the panel's Democratic chairman charged Thursday.

In an interview with McClatchy Newspapers, Sen. Jay Rockefeller of West Virginia also accused President Bush of running an illegal program by ordering eavesdropping on Americans' international e-mails and

Living near busy roads tied to kids' lung risk

Impact on breathing is long-term health threat, study says

And more ….
Check the distances: <530 m, <1060 m, 1060 m to 1600 m, >1600 m



Findings may affect where houses, roads, schools are built.

By Chris Bowman
BEE STAFF WRITER

Growing up near a freeway stunts a child's breathing capacity for a lifetime, significantly increasing the risk of serious lung and heart diseases later in life, according to researchers who monitored thousands of Southern California children for up to eight years.

The landmark study, led by a team of University of Southern California scientists and released Thursday, delivers a sobering answer to a long-standing question about the health effects of being raised near a busy roadway where air is chronically polluted.

These children not only are more likely to develop asthma, but their lung development can be permanently cut short, increasing their odds of having a heart attack or a life-threatening respiratory condition, starting as early as their 50s.

"It's a big risk factor," said James Gauderman, the author and principal investigator of the study by researchers at USC's Keck School of Medicine.

"If you've got less lung capac-

▶ LUNGS, back page, A16

Sacramento Bee/Randall Benton

Lung capacity and proximity to freeways

A new study found substantially underdeveloped lungs among 18-year-olds who were raised near a major roadway, the result of breathing higher levels of tailpipe exhaust. The negative numbers represent the reduced breathing capacity of children living more than a mile away from the heavy traffic. For example, children who lived within one-third of a mile of a freeway during the full eight-year study period exhaled, on average, 98 fewer milliliters of air than those who lived more than a mile from a freeway. Lung capacity is measured by FEV, or forced expiratory volume: how much air a person can exhale during the first second of a forced breath.

Milliliters of air

Freeway distance	*Lung function: Age 10 years	Age 18 years	8-year capacity (cumulative difference)
Within 1/3 mile	-23	-121	-98
Within 2/3 mile	-32	-93	-61
Within 2/3 to one mile	-34	-78	-44

*Average measurements among 1,445 Southern California children who were tested annually for eight years, from age 10 to 18.

Source: University of Southern California

Sacramento Bee

A neighborhood off Garden Highway in South Natomas sits near Interstate 80. Many people in urban areas live close to busy roadways, and a study conducted by USC found diminished lung capacity among youths growing up near such areas.

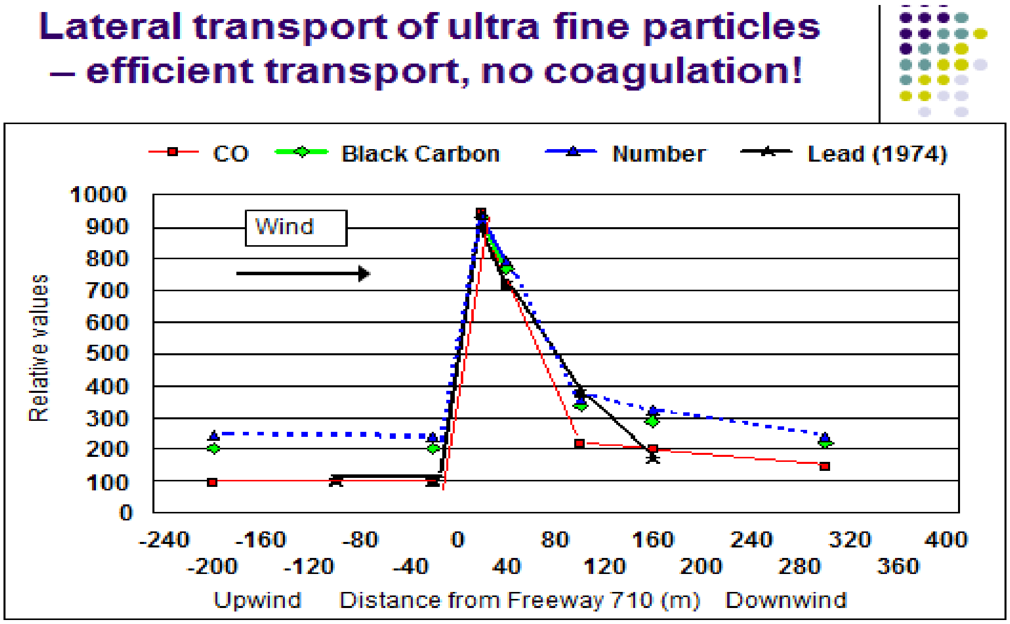
Discussion

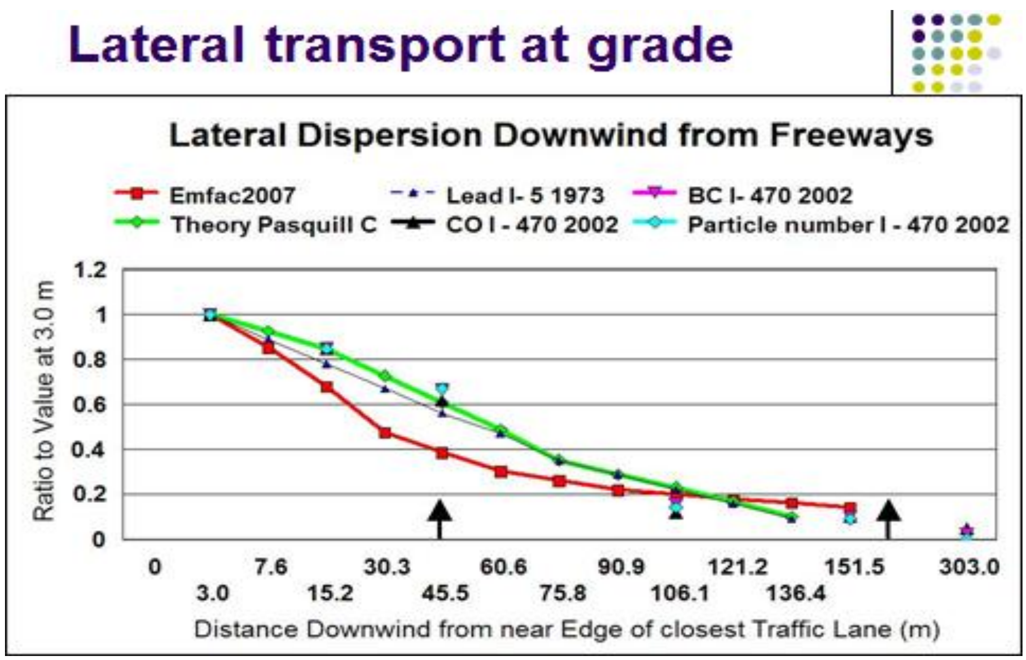
There are at least two outstanding problems that need to be addressed:

1. There are no data available at the sites the health data were collected that explains the loss of lung function in children, and
2. The mismatch between the distances at which the health data were collected and the predicted transport of pollutants,

We propose as a hypothesis that very fine and ultra-fine transition metals from vehicle braking on freeways can cause such health impacts, via the Fenton reaction. Transition metals cause the presence of free radicals in the lung and damage to lung tissue, causing loss of lung function most important in children.

The transport to distances beyond the nominal 150 m in Emfac2007 is well documented. Below we show data from Zhu et al. 2001 from the truck rich 710 freeway. Note that both black carbon and particle number are high upwind of the freeway, and fall off more slowly than CO downwind of the freeway.





With the capabilities developed for the near freeway sound and vegetation barrier study, we propose to:

1. Identify sites used in both the recent USC and prior CEHS sites in Los Angeles used to collect the health data which demonstrates negative impacts in proximity to roadways
2. Overlay these with recent data of health impacts at the same sites from vastly improved health data sources in California
3. Determine characteristics of sites with known health impacts using instrumentation vans configured for the 3 site barrier study transects.
    a. Time resolved, size resolved PM aerosols with elemental characterization (including ultra-fine metals) at 3 sites downwind of the known health impacted sites.

b. Soot
c. CO, CO2, and NO
d. Meteorology
e. Traffic characterizations

These data would be used to see if there is a correlation between the prior health data and the current presence of very fine and ultra fine transition metals from brake debris.

Because this requires only additional site definition, but utilizes the SOP's and instrumentation established for the sound and vegetation barrier study, adding this component is an extremely efficient economy of scale. This study enhancement would give the ARB a tremendously leveraged opportunity to identify causes for previously known health impacts.

Study Enhancement 2: Organic pollutant analysis

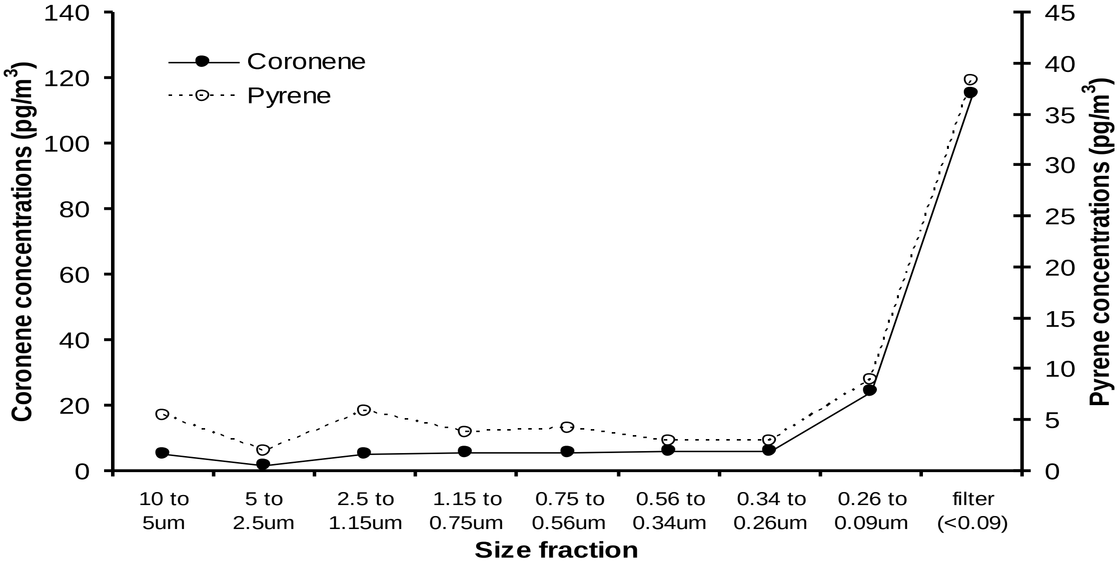
The proposed study mainly relies on assessing the effects of vegetation and sound walls of pollutant dispersion and removal by 1) observing differences in ambient aerosol concentrations and 2) the decline of an inorganic tracer compound (namely strontium from a road flare). Unfortunately, organic aerosols may behave differently than inorganic aerosols in their ability to adsorb to surfaces such as leaves. In particular, leaves tend to have a waxy cuticle that might collect organic aerosols better than inorganic aerosols. Therefore, organic aerosols, which are common in vehicle emissions, also need to be assessed. There are two potential parts to project enhancement:

Organic option 1) Conduct organic aerosol sampling at the primary study sites to assess differences in concentrations resulting from the vegetation.

Organic option 2) Determine the deposition of organics to vegetation by both measuring the deposition to "synthetic leaves" and by measuring differences in PAH concentrations on leaves adjacent to the freeway and at remove areas.

Size resolved speciated organic matter measured upwind and downwind of freeways. Organic option #1:

The objective of this part of the project is to observe differences in organic chemical concentrations between vegetated freeway areas and freeway sections that lack vegetation. This part of the project will follow the same basic design as the main aerosol project with the organic samplers located at two(?) sites and operated for the three time periods of the main project. The organic aerosol sampler is the same type as the inorganic aerosol samplers, namely 8-stage DRUM samplers equipped with an after filter to collect the ultrafine aerosols. The samples will be collected onto fired aluminum substrates for approximately one month. Afterwards, the samples will be extracted by toluene and then analyzed by Gas Chromatography-Mass Spectrometry (GC-MS) for particulate PAHs (mass of 202 and greater) and *n*-alkanes.



Coronene and pyrene concentrations (pg/m^3) in the different size fractions of the 8-stage DRUM sampler and the afterfilter.

The focus will be on these non-polar compounds since they have well documented vehicular sources and they might be prone to adsorb to the waxy surfaces in leaves. The differences between the sites should shed light on the influence of vegetation on the ambient concentrations of these chemicals, especially since size differentiation is accomplished in this method.

Analysis of tracer elements collected on real and artificial surfaces
Organic option 2:

The second approach to determining the effect of vegetation on roadway emissions is to measure it directly by determining how much chemical is being adsorbed by real and synthetic leaves. The inherent limitation in the observation study listed above is that meteorological conditions could easily confound the results (e.g. an atmospheric inversion that raises the concentrations of all pollutants at all sites, which would diminish the impact of the roadside emissions). Therefore, this part of the project would focus more on the removal rate of pollutants by vegetation rather than the amount of pollutants transmitted through the vegetation.

The study design for this part of the project is rather simple. The first aspect is to create synthetic leaves, which would be strips of polypropylene plastic with a known surface area, and deploy these "leaves" along the roadway in existing vegetation (or on a stand when vegetation is not present). Additional sets of synthetic leaves will be place farther away from the roadway along the transect. A series of samples substrates will be retained for both laboratory blanks and field blanks. The synthetic leaves will be deployed for one month and then they will be collected and analyzed for GC-MS for PAHs and *n*-alkanes. The mass loading on the synthetic leaves is likely to be low, hence many "leaves" will need to be combined into a single sample. Once the mass on the chemical deposited onto the synthetic leaves is known, then a deposition rate (expressed as mg chemical per cm surface area per day) can be calculated. The influence of roadside vegetation can be estimated by assuming a reasonable leaf surface area for the type of vegetation in question.

The second part of this deposition measurement estimation would be to conduct a comparative analysis of PAH concentrations in real leave in roadside vegetation compared to leaves of the same plant species in a clean environment. The difference in PAH concentrations will demonstrate how much chemical has been deposited to the leaves. This comparative part of the project would not identify the source of the PAHs (vehicular or ambient), but it will give an indication of how much chemical was removed by the leaf. With a few simple leaf area measurements and an estimate of leave turnover, a removal rate (once again in ng chemical per cm of leaf area per day) could be estimated for a plant in the typical roadside environment. Careful selection of the test species (e.g. a deciduous species) could make this analysis easier.

Ultimately, vegetation does not destroy the organic chemicals emitted by vehicles, but it does remove them from the atmosphere. The leaves are eventually dropped by the plant and the leaves (and associated chemicals) become part of the soil environment where the chemical will likely be degraded by microbial action over a period of time.

Study Enhancement 3: Particle Deposition and CFD Modeling

The dynamics of pollutant transport in relation to roadside barriers has been a subject of numerous modeling studies. However, many of the findings of these models have not been tested in data collection efforts, particularly as it comes to aerosol transport and the evolution of various size distributions. In addition, the effect of leaf surfaces in combination with the physical barrier is still not fully understood.

For this study, it is understood that the end use of these data is into a model that can be used to predict other locations. This model is likely to be based on a sophisticated computational fluid dynamics (CFD) micro-scale model as opposed to the typical ISC/AERMOD/CALPUFF/CALINE model because of those models' limitations on the scale. The CFD on the leaf and barrier analysis would consist of two components: 1) sorption/desorption of the leaf surface, and 2) transport of the particles and gases over, around, and through the barriers, both solid and vegetative. The second aspect will require high frequency micrometeorological measurements (e.g., fast 3D sonic anemometers, also fast NOx, CO2, or CO measurements) in order to obtain turbulence and friction velocity information, as well as minute and small-scale descriptions of the plumes from the highway. The UC Davis Department of Civil and Environmental Engineering has pioneered this work under Prof Neimeier, and she has recommended Prof Fabian Bombardelli to perform these analyses. He will also help on all the micromet work.

References: (partial)

Barzyk, T. M., Ciesielski, A., Shores, R. C., Thoma, E. D., Seila, R. L., Isakov, V., and Baldauf, R. W., **Near Road Multi-pollutant Profiles: Associations between Volatile organic compounds and a tracer gas surrogate near a busy highway**, JAWMA 62, #4, 604 (2012)

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Thomas A. Cahill , David E. Barnes, Earl Withycombe , and Mitchell Watnik**, Very Fine and Ultra-Fine Metals and Ischemic Heart Disease in the California Central Valley 2: 1974 – 1991**, Aerosol Science and Technology 45, 1135-1142 (2011)

Thomas A. Cahill, David E. Barnes, Nicholas J. Spada, Jonathan A. Lawton, and Thomas M. Cahill , **Very Fine and Ultra-Fine Metals and Ischemic Heart Disease in the California Central Valley 1: 2003 – 2007**, Aerosol Science and Technology 45, 1125-1134 (2011)

Thomas A. Cahill, Thomas M. Cahill, David E. Barnes, Nicholas J. Spada and Roger Miller , **Inorganic and organic aerosols downwind of California's Roseville Railyard**, Aerosol Science and Technology 45, 1049-1059 (2011)

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Feeney, P.J., T.A. Cahill, R.G. Flocchini, R.A. Eldred, D.J. Shadoan, and T. Dunn. **Effect of roadbed configuration on traffic derived aerosols.** *Journal of the Air Pollution Control Association.* 25:1145-1147 (1975).

Raabe, Otto G., David A. Braaten, Richard L. Axelbaum, Stephen V. Teague, and Thomas A. Cahill. **Calibration Studies of the DRUM Impactor**. *Journal of Aerosol Science.* 19.2:183-195 (1988).

Vidrio, E., Jung, H. and Anastasio, C. (2008**). Generation of hydroxyl radicals from dissolved transition metals in surrogate lung fluid solutions**. *Atmos. Environ.* 42:4369-4379.

Attachments:

1. Project Schedule
2. Project Staff and Organization
3. Staff CV/Resumes
4. Preliminary Cost Proposal

Project Staff

Principal Investigator:
Thomas A. Cahill, Professor of Physics and Atmospheric Sciences, and Head, DELTA Group

Co- Principal Investigators:
David E. Barnes, Ph. D., Physics. Primary Responsibilities: Overall Project management, time lines, and deliverables, Quality assurance of aerosol instrumentation, Mass and optical measurements (soot)

Eric Winegar, Ph. D., Chemistry. Primary responsibilities: Particle number measurements Continuous PAH, Measurement of gases – CO, CO2, NOx, Micro- and Local meteorology

Investigators:
Fabian A. Bombardelli, Ph. D., Professor of Civil and Environmental Engineering Aerodynamic modeling of aerosol transport, Capture on surfaces, Turbulence from roadway barriers

Greg McPherson, Ph.D., USDA, Urban Ecosystems and Social Dynamics Program PSW Research Station, USDA Forest Service, Definition of leaf structure of vegetation barriers, Comparison to leaf structures used in eastern US work, Design of optimum vegetation barriers.

Study Enhancement #1
Identifying causal factors in prior children lung function studies
John J. Troidl, MBA, PhD, School of Public Health, University of California, Analysis of prior health data near freeways; Extraction of morbidity and mortality data for current transects.

Study Enhancement #2
Organic pollutant analysis
Thomas M. Cahill, School of Mathematical and Natural Sciences, Arizona State University, Glendale AZ, Integrated speciated organic matter by size, PAH, alkanes.

Study Enhancement #3
Particle Deposition and CFD Modeling
Fabian A. Bombardelli, PhD.

Project Schedule

Task 1: Literature Review; Define Study Targets: barrier features, impact definition, site parameters
Task 2: Evaluate vegetative feature targets: prior work, important parameters, optimum design
Task 3: Define Equipment Set, Identify any needs
Task 4: Purchase, Install, Prep Equipment for Pilot Study
Task 5: Pilot Study
Task 6: Analysis of Pilot Study, Pilot Study Report
Task 7: Review of SOPs, finalize with ARB approval
Task 8: Purchase, Install, Prep Equipment for Primary Study
Task 9: Primary Studies, transects for multiple sites
Task 10: Analysis of Primary Transects
Task 11: Draft Final Report
Task 12: Amend Final Report

Enhancements not included in draft Project Schedule
Task 13: Casual factors of prior recognized reduced lung function:
Task 14: Organic pollutant analysis
Task 15: Particle Deposition and CFD Modeling

Month

Task	1	2	3	4	5	6	7	8	9	10	11	12
1												
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9												
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	Month											
Task	25	26	27	28	29	30	31	32	33	34	35	36
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10												
11												
12												
13												
			P				dm					F

p = Quarterly progress report
d = Deliver draft final report
F = Deliver final report
m = Meeting with ARB staff

THOMAS A. CAHILL
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PROFESSIONAL PREPARATION

1965 **Ph.D. in Physics**, University of California, Los Angeles
(National Defense Fellow 1959-1962)

1961 **M.A. in Physics**, University of California, Los Angeles

1959 **B.A. in Physics**, Holy Cross College, Worcester, MA

PROFESSIONAL EXPERIENCE

2003 – present	**Professor (recalled),** Department of Physics, UC Davis
1999 – 2003	**Research Professor**, College of Engineering, UC Davis
1997 – present	**Founder and Director, δ Group**, (Determination of Extinction and Long Range Transport of Aerosols), University of California, Davis
1977 – 1997	**Designer and Principal Investigator**, US EPA and IMPROVE Program, Aerosols, at National Parks and Monuments (76 sites)
1970 – 1997	**Founder and Head of the Air Quality Group at Crocker Nuclear Laboratory**, University of California, Davis
1980 – 1989	**Director, Crocker Nuclear Laboratory**, University of California, Davis
1993 – 1994	**Professor of Atmospheric Sciences and Physics**, University of California, Davis
1972 – 1975	**Director, Institute of Ecology**, University of California, Davis
1968	**OAS Fellow,** Chile
1967 – 1993	Professor of Physics, University of California, Davis
1966 – 1967	NATO Fellow, Centre d'Etudes Nucleaires, Saclay, France
1965 – 1966	**Adjunct Professor**, Physics, UCLA

PARTIAL LIST OF SERVICE AWARDS

2010 – present	Appointed by the Speaker of the Assembly to the California Inspection and Maintenance Review Committee
2003 – 2010	Who's Who in the World
2002	American Lung Association Outstanding Scientist Volunteer
1994	UC Davis Academic Senate Public Service Award

PARTIAL LIST OF PUBLICATIONS ON HEALTH IMPACTS OF AEROSOLS

Thomas A. Cahill, David E. Barnes, Earl Withycombe, and Mitchell Watnik. Very Fine and Ultra-Fine Metals and Ischemic Heart Disease in the California Central Valley. 2: 1974 – 1991. Aerosol Science and Technology 45:1135-1142 (2011)

Thomas A. Cahill, David E. Barnes, Nicholas J. Spada, Jonathan A. Lawton, and Thomas M. Cahill. Very Fine and Ultra-Fine Metals and Ischemic Heart Disease in the California Central Valley. 1: 2003 – 2007. Aerosol Science and Technology 45:1125-1134 (2011)

Thomas A. Cahill, Thomas M. Cahill, David E. Barnes, Nicholas J. Spada and Roger Miller. Inorganic and organic aerosols downwind of California's Roseville Railyard. Aerosol Science and Technology 45:1049-1059 (2011)

Cahill, T. A., Cliff, S. S.; Shackelford, J. F.;Meier, M.; Perry, K. D.; Bench, G. and Leifer, R. Very Fine Aerosols from the World Trade Center Collapse Piles: Anaerobic Incineration? Advances in Chemistry Vol 919 (2004)

Thomas A. Cahill, Steven S. Cliff, Michael Jimenez-Cruz, James F. Shackelford, Michael Dunlap, Michael Meier, Peter B. Kelly, Sarah Riddle, Jodye Selco, Graham Bench, Patrick Grant, Dawn Ueda, Kevin D. Perry, and Robert Leifer. Analysis of Aerosols from the World Trade center Collapse Site, New York, October 2 to October 30, 2001. *Aerosol Science and Technology* 38:165–183 (2004)

RECENT STUDIES ON HEALTH IMPACTS OF AEROSOLS NOT YET PUBLISHED

2010-current	Near railyard impact of the San Bernardino BNSF intermodal facility
2007-2010	Terminal Island car shredder, CA DTSC
2010	NEXUS, near roadway impacts on children, US EPA Detroit
2009	Cleveland EPA urban air shed study

SUMMARY

Professor Cahill pioneered the use of nuclear and atomic instrumentation to study air pollution in 1970, and his data in 1973 on the impacts of airborne lead was instrumental in the final establishment of the catalytic converter in California, 1976. He proposed and supported the law to lower sulfur in gasoline, 1977. There followed 20 years having designed, building, and running the aerosol network an US national parks and monuments, now the national IMPROVE program. In 1994, he founded the DELTA Group to work in two areas: aerosols and global climate change, for NSF and NOAA, and aerosols and human health impacts, for the ARB, Lung Association and the Health Effects Task Force of Breathe California, Sacramento Emigrant Trails. He was an author on the US EPAS Fine Particle Criterion Document (2005), and currently serves on the board of the CA Inspection and Maintenance Review Committee that oversees smog check programs.

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PROFESSIONAL PREPARATION

1992 **Ph.D. in Physics**, University of California, Davis
1987 **M.S. in Physics**, University of California, Davis
1982 **B.S. in Physics, B.S. in Oceanography**, Humboldt State University, Arcata, Calif.

PROFESSIONAL EXPERIENCE

2007-Present	Project Scientist III - IV, JMIE, University of California, Davis
2005-2007	Post-Doc/Researcher/Project Manager, CEMS Dept., UC Davis
2003-2004	Researcher/Lecturer, Physics Dept., University of California, Davis
2000-2002	Process Development Engineer, CSpeed Corp., Santa Clara, CA
1998-2000	Microfabrication Process Engineer, Consulting, Davis, CA
1998	Sputter Process Engineer, HMT Technology, Fremont, CA
1997	Senior Advisory Yield Engineer, Seagate Recording Media, Milpitas, CA
1995-1997	Manager, Microfabrication Facility, ECE Dept., UC Davis, CA
1988-1995	Lecturer, Researcher, Research Assistant, Physics Dept., UC Davis

AEROSOLS RESEARCH STUDIES (DELTA GROUP)

A. I have been a researcher and the projects manager for the DELTA group for 6 years. The following are some of the funded studies that I have helped manage, including being primarily responsible for all field and day-to-day activities for most of these contracts with the UC Davis DELTA Group, T. A. Cahill, P.I. or co-P.I. with Prof. Jim Shackelford (Chem. Eng./MS) or Geoff Schladow (TERC). List shows funding interval and source.

1) Aerosols on the Greenland Ice Cap, Summit site 2003 – 2014
   a) NSF Polar Programs currently renewed through 2014, $185 K
2) Continuous measurement of ultra fine aerosols, near roadways and Indoor/Outdoor
   a) (OAPQS/ORD, Cleveland study) EPA 2009 – 2010, $24.4 K
   b) (OAPQS/ORD, Detroit, NEXUS study) EPA 2010 – 2011, $ 25 K
3) Deposition of toxic aerosols in California CA DTSC 2009- 2012, $350 K
   a) (Wilmington car shredder, 710 corridor studies)
4) Effect of off-road vehicles on PM_{10}, Oceano Dunes 2008-2010, $118 K
   a) (San Luis Obispo, APCD Study)
5) Aerosol Research Studies and Educational Programs with Breathe Calif.
   a) Impact of near roadway aerosols SMAQMD, BCSET 2007 – 2009, $50 K
   b) Smoke at Del Paso Manor SMAQMD, BCSET 2009 – 2010, $26 K
6) Comparison of DRUM sampler with ARB FRMs 2007 – 2008
   a) Breathe California/ARB, ended volunteer effort
7) Aerosol Measurements for El Paso Asthma study 2008 – 2011. $52 K
   a) NIH active
8) Aerosols form the Roseville rail yard 2005 – 2008, $26K
   a) Breathe California, EPA Region IX
9) Central Valley aerosols and ischemic heart disease BC/SET 2008 – 2009, $26K
   a) Legacy Law Group,
10) Aerosols before and after Ice-Slicer™ Applications to Highway 50 at South Lake Tahoe,
   a) Cal Trans Storm Water Studies 2005 – 2006, 73 K

11) Fine particulate pollution at Lake Tahoe 2006 – 2009, $180 K
    a) TERC, EPA Region IX

Related Peer Reviewed Articles

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Inorganic and organic aerosols downwind of California's Roseville rail yard,
T. A. Cahill, T. M. Cahill, David E. Barnes, N. J. Spada and R. Miller, (currently in review, AS&T)

Aerosol measurements from a recent Alaskan volcanic eruption: Implications for volcanic ash transport predictions, Journal of Volcanology and Geothermal Research, in press, C. F. Cahill, P. G. Rinkleff, J. Dehn, P. W. Webley, T. A. Cahill, David E. Barnes

Related Technical Reports

Aerosol Measurements for the NIPOMO MESA/SOUTH COUNTY PARTICULATE STUDY – PHASE 2, Final Report to the San Luis Obispo Air Pollution Control District
(SLO APCD), Larry Allen, APCO, T. A. Cahill, P.I., and G.Schladow, co P.I.,
David E. Barnes, Project Manager, B. Lee, J. Lawton, N.Nguyen, C.i Chen, A. Chow, N. Williams, T. E. Gill, R. Velarde, and K. Floyd, November 9, 2009, pages 55.

Deposition of coarse toxic particles in Wilmington, CA for the Department of Toxic Substances Control (DTSC), Final Report, T. A. Cahill, David E. Barnes, Project Manager, UC Davis DELTA Group, and Kristen Smeltzer, DTSC, April 4, 2009, pages 44.

Removal Rates of Particulate Matter onto Vegetation as a Function of Particle Size,
Final Report to Breathe California of Sacramento Emigrant Trails Health Effects Task Force (HETF) and Sacramento Metropolitan AQMD, E. Fujii, J. Lawton, T. A. Cahill, David E. Barnes, Chui Hayes (IASTE intern), and N. Spada, and G.McPherson of the Pacific Southwest USFS Urban Forest Program, Dr., UC Davis, February 24, 2008, pages 45.

Connecticut Aerosol Studies Analysis Report, David E. Barnes, Project Manager, February 12, 2008, pages 14.

Mass, Organic, and Elemental Aerosols by size, time, and composition for the Roseville Railyard Aerosol Monitoring Project (RRAMP), Final Report to the Roseville Railyard Monitoring Program (RRAMP), Placer County and US EPA Region IX, T. M. Cahill, T. A. Cahill, N. J. Spada, David E. Barnes, S. S. Cliff, K. D. Perry and E. Fujii, September 21, 2007, pages 97

Mass, Organic, and Elemental Aerosols by size, time, and composition at the Union Pacific Rail Road's Roseville Railyard , Final Report to the Health Effects Task Force (HETF), Breathe California of Sacramento-Emigrant Trails, T. A. Cahill, T. M. Cahill, David E. Barnes, S. S. Cliff, K. D. Perry, and E. Fujii, November 14, 2007, pages 96.

Aerosol Generation before and after Ice-SlicerTM Applications to Highway 50 at South Lake Tahoe, Final Report to Caltrans, under Caltrans Storm Water Studies, T. A. Cahill, David E. Barnes, N. Spada, E. Fujii, S. Cliff, T. Young, and M. Kayhanian, November 2006, pages 98.

Final Report: Aerosol Sampling in Huron, California, for the Environmental Defense Fund, Kathryn Phillips, T. A. Cahill and David E. Barnes, May 24, 2006, pages 24.

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(916) 837-4251 Direct, edwinegar@udavis.edu

PRIMARY CAPABILITY: Monitoring and Measurement of Airborne Pollutants

AREAS OF TECHNICAL PROFICIENCY

- Problem-solving oriented sampling and analysis of airborne pollutants.
- Source and ambient air sampling and analysis.
- On-site analysis.
- Analytical method development.
- Quality assurance program development.
- Data Review and Interpretation.

EDUCATION

Ph.D., Physical and Environmental Chemistry, University of California, Davis
M.S., Physical Chemistry, Brigham Young University, Provo, Utah
B.A., Chemistry, Brigham Young University, Provo, Utah

EXPERIENCE

Co-Director: UC Davis DELTA Group, 2012-present.
Principal: Winegar Air Sciences/Applied Measurement Science, 1997-present.
Technical Director, Field Analytical Services and Training: Air Toxics Limited, 1996-1997.
Director of Research and Technical Services: Air Toxics Limited, Folsom, CA. 1992-1997.
Senior Chemist, Radian Corporation, Sacramento, CA: 1992.
Group Leader, Environmental Chemistry Group, Radian Corporation: 1989-1992.
Staff Chemist, Radian Corporation, Sacramento, CA: 1988-1991.

PUBLICATIONS/PRESENTATIONS

Books/Chapters

Winegar, Eric D., Larry O. Edwards, “Current Sampling and Analytical Methods for Point and Area Source Emission Measurements,” Chapter 24 in Principles of Environmental Analysis, second edition, Lawrence H. Keith, ed., American Chemical Society Press, 1996.

Winegar, Eric D., and Lawrence H. Keith, eds. Sampling and Analysis of Airborne Pollutants, Lewis Publishers, 1993.

Presentations/Publications

Over 60 professional presentations and publications.

PROFESSIONAL ACTIVITIES

EPA Science Advisory Panels
August 24 - 25, 2004 - Fumigant Bystander Exposure Model Review: Probabilistic Exposure and Risk model for FUMigants (PERFUM) Using Iodomethane as a Case Study

August 26-27, 2004 - Fumigant Bystander Exposure Model Review: The Fumigant Exposure Modeling System (FEMS) Using Metam Sodium as a Case Study

September 9-10, 2004 - Fumigant Bystander Exposure Model Review: SOil Fumigant Exposure Assessment System (SOFEA) Using Telone as a Case Study

Continuing membership on SAP:2004-2012.

EPA Special Studies
May, 2005. Environmental Technology Verification Program—Measurement Systems for Hydrogen Sulfide. Provided in-situ verification analysis for continuous H2S monitors.

Professional Societies
Vice-Chair, Secretary, AWMA Technical Council Committee, AM-3 Ambient Monitoring, 2003-2004.
Chair, Mother Lode Chapter of the Air and Waste Management Association, 2001-2002.
Director, Mother Lode Chapter of the Air and Waste Management Association, 1994-2003.

Conferences
Organizer, Co-Chairman, Executive Committee , Air and Waste Management Association Air Quality Measurement Methods and Technology Symposium, San Francisco, CA and RTP, NC, 2002 to present.
Co-Chairman of Air and Waste Management Association Conference on “Current Issues in Air Toxics,” Sacramento, CA, November, 1992, 1993, 1994.
Vice-Chairman of Air and Waste Management Association Conference on “Current Issues in Air Toxics,” Sacramento, CA, November, 1991.
Chairman and Organizer, American Chemical Society Symposium on “Measurement of Airborne Compounds: Sampling, Analysis, and Data Interpretation,” Washington, DC, 1990.
Session chairman at several conferences.

Teaching
Restek Corporation, “Air Monitoring Workshop,” October, 1996.
Instructor: University of California, Davis Extension Courses “Introduction to Air Sampling and Analysis,” 1991-1996.
Instructor: University of California, Davis Extension Courses “Air Pollution Aspects of Site Remediation,” 1993-1995.
Instructor: University of California, Berkeley Extension Courses “Air Pollution Aspects of Site Remediation,” 1993, 1994.
Instructor: University of California, Berkeley Extension Courses “Introduction to Air Quality,” 1994-1996.

Professional Courses
Data Logging Training, Campbell Scientific, 2012
PTR-MS Training Course, Ionicon Analytik, Innsbruck, Austria, 2010/2011.
Industrial Hygiene—Fundamentals: Center for Occuptional and Environmental Health, University of California, Berkeley, 2009.
Good Laboratory Practice (GLP) Essentials for Technical Staff: SOPs, 2003.
Good Laboratory Practices(GLPs) for Study Directors and Monitors, 2003.

Air Modeling Using ISC and Aermod, Lakes Environmental, 2001.
Deposition Preparation/*Daubert* Standard Evaluation: American Academy of Forensic Sciences, 2000.
Air and Waste Management Association. Advanced Air Sampling and Analysis Course, 1992.
Air and Waste Management Association Remote Sensing Course, 1991.
Radiation Safety, University of California, Davis, 1990.
American Chemical Society Air Sampling and Analysis Course, 1989.
40-hour Safety Training, OSHA 29 CFR, 1988, and continuing.

MEMBERSHIPS

Air and Waste Management Association
American Chemical Society

CERTIFICATIONS

Qualified Environmental Professional, Institute of Professional Environmental Practice, Number 05960099

Preliminary cost proposal

Below are preliminary costs broken out by task. It is anticipated that revisions and refinements to these costs will be possible upon final preparation for the research plan.

Task	Labor	Employee Fringe Benefits	Subs, Consultants	Equip	Travel Subsit	EDP	Copy Print	Mail Phone Fax	Materials and Supplies	Analyses	Misc.	Overhead	Total
1	$ 4,660.00	$ 1,411.98									$ 303.60	$ 1,657.65	$ 8,033.23
2	$ 4,660.00	$ 1,411.98									$ 303.60	$ 1,657.65	$ 8,033.23
3	$ 500.00	$ 151.50									$ 32.58	$ 177.86	$ 861.93
4	$ 4,000.00	$ 1,212.00		$8,000.00					$1,000.00		$ 710.60	$ 3,879.88	$ 18,802.48
5	$ 2,500.00	$ 757.50			$ 150.00						$ 170.38	$ 930.25	$ 4,508.12
6		$ -								$22,000.00	$ 1,100.00	$ 6,006.00	$ 29,106.00
7	$ 900.00	$ 272.70									$ 58.64	$ 320.15	$ 1,551.48
8	$ 3,500.00	$ 1,060.50		$1,000.00							$ 278.03	$ 1,518.02	$ 7,356.54
9	$ 8,000.00	$ 2,424.00			$6,000.00						$ 821.20	$ 4,483.75	$ 21,728.95
10		$ -								$66,000.00	$ 3,300.00	$18,018.00	$ 87,318.00
11	$ 5,000.00	$ 1,515.00							$ 100.00		$ 330.75	$ 1,805.90	$ 8,751.65
12	$ 1,000.00	$ 303.00							$ 50.00		$ 67.65	$ 369.37	$ 1,790.02
	$34,720.00	$ 10,520.16	$ -	$9,000.00	$6,150.00	$ -	$ -	$ -	$1,150.00	$88,000.00	$ 7,477.01	$40,824.46	$ 197,841.63
13			$35,000.00										$35,000.00
14			$35,000.00										$35,000.00
15			$35,000.00										$35,000.00

Task 1: Literature Review; Define Study Targets: barrier features, impact definition, site parameters
Task 2: Evaluate vegetative feature targets: prior work, important parameters, optimum design
Task 3: Define Equipment Set, Identify any needs
Task 4: Purchase, Install, Prep Equipment for Pilot Study
Task 5: Pilot Study
Task 6: Analysis of Pilot Study, Pilot Study Report
Task 7: Review of SOPs, finalize with ARB approval
Task 8: Purchase, Install, Prep Equipment for Primary Study
Task 9: Primary Studies, transects for multiple sites
Task 10: Analysis of Primary Transects
Task 11: Draft Final Report
Task 12: Amend Final Report

Optional Enhancements
Task 13: Casual factors of prior recognized reduced lung function:
Task 14: Organic pollutant analysis
Task 15: Particle Deposition and CFD Modeling