COMMENTS to CASAC AMBIENT AIR MONITORING & METHODS SUBCOMMITTEE on U.S. EPA's DRAFT NEAR-ROAD MONITORING GUIDANCE

By

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SUMMARY of MAJOR CONCERNS.

The evidence of adverse health effects associated with exposure to highway emissions during the last decade is compelling. Beginning with monitored and modeled exposures provided by the Multiple Air Toxics Exposure Study II (MATES-II) in 2000 that attributed 90% of air pollution-related cancer risk in the South Coast Basin to diesel PM, researchers have focused on documenting the effects of exposure to highway emissions. Major studies during the decade include –

- the confirmation from MATES-III with more sophisticated assessment tools that cancer risks associated with air pollution in the South Coast air basin are primarily attributable to exposure to diesel aerosols;
- work at USC linking proximity to highways with the impairment of lung development among children aged 10-18;
- increased incidence, prevalence and severity of asthma with proximity to highway emissions;
- Kunzli, et al. showing double the carotid atherosclerosis among residents living within 100 meters of a highway compared to others living away from a highway;
- HEI's review of traffic pollution studies leading to the conclusion "that the sufficient and suggestive evidence for these health outcomes indicates that exposure to traffic related air pollution are likely to be of public health concerns and deserve public attention."

The conclusion that the mix of criteria pollutants and mobile source air toxic (MSAT) pollutants emitted from highways causes or threatens serious adverse health impacts is beyond dispute. What remains unresolved is the identification of those pollutants that are most responsible for the observed health effects among populations exposed to highway emissions. Other than the MATES studies, which attempted to define exposures to 33 identified carcinogens, none of the epidemiological studies attempted to apportion causation of observed adverse health outcomes among the various pollutants emitted from highways. The studies identified in EPA's recent NOx rulemaking as providing the basis for requiring NOx monitoring near highways established correlations between elevated NO and NO2 exposures and adverse health effects, but were not designed to, and did not exclude the contribution of particle species or gaseous organic compounds as potential causes or contributors of these effects.

In many respects the problem of identifying the specific agents in highway emissions that cause the observed health effects among exposed populations is similar to the problem of identifying the causative agents in cigarette smoke. Our primary concern is that the regulation of highway emissions not be deferred until all the causative factors have been identified. Sufficient compelling health effects data exists to link adverse effects to NOx, PM2.5 and to various component species of fine particles to require that where highway emissions contribute to violations of NAAQS for these pollutants that control strategies be developed to reduce emissions to the levels needed to meet the NAAQS.

Commenters laud EPA for recognizing the link between NOx emitted from highways and the need to monitor this pollutant within the highway impact zone to ensure that control strategies are designed to reduce emissions from on-road sources to attain the NAAQS. We ask that the same policy be applied to PM2.5 for the purpose of developing control strategies for the 2006 revised 24-hour NAAQS and the next revision of the annual and 24-hour NAAQS. Under the implementation guidance issued for the 1997 NAAQS for PM2.5, attainment of the NAAQS need only be demonstrated at monitored locations. 40 C.F.R. Part 50, Appendix N. In the modeling guidance for PM2.5 EPA "recommends" that supplemental modeling be performed if there is reason to believe that sources of direct particles (i.e., primary particles) may cause NAAQS violations at unmonitored locations. 72 F.R. 20608. But in designating nonattainment areas for the revised 24-hour NAAQS EPA construed this guidance as not requiring supplemental modeling to estimate the impact of highway emissions on near-road concentrations of PM2.5. As a result, EPA has laid the foundation for approving SIP control strategies that only demonstrate attainment at monitor locations even when no monitors are located within the 300 meter zone adjacent to highways where elevated PM2.5 concentrations have been shown to exceed the concentrations monitored outside the highway impact zone.[1]

This approach leaves millions of Americans who reside within 300 meters of major highways without protection from the highest concentrations of PM2.5. In the South Coast air basin 1.5 million reside within 300 meters of highways with 125,000 or more daily trips.[2] HEI estimates 45% of urban dwellers reside within 500 meters of a major road.[3]

EPA has two options to extend the protection of the PM2.5 NAAQS to residents of the near-highway environment –

1) install monitors near highways to establish design values for the development of control strategies to achieve emission reductions from

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[1] See *ESTIMATING CONTRIBUTIONS OF ON-ROAD EMISSIONS TO NEAR HIGHWAY PM2.5 CONCENTRATIONS*, E.H. Pechan and Associates (April 2008).
[2] GIS Study of Populations within 320 meters of center line of Highways with AADT More than 125,000 (EDF, Comment to EPA on PM2.5 SIP for South Coast Air Basin, April 2008).
[3] *Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects* (Health Effects Institute, 2010).

on-road sources sufficient to reduce measured concentrations to the NAAQS at such monitors; and

2) require that modeling analyses undertaken to demonstrate the effectiveness of control strategies include dispersion modeling to estimate the effects of direct emissions from on-road sources on PM2.5 concentrations on populations exposed near highways.

Commenters urge the Subcommittee to recommend both monitoring and modeling for a number of reasons.

First, monitoring will not likely be adequate to fully characterize the nonattainment condition that must be eliminated by the control strategy. If the guidance is patterned after the NO2 monitoring guidance, large nonattainment areas will at best have two highway-oriented sites, while many moderate sized areas will have only one.

In many nonattainment areas one monitoring site will not likely capture both types of traffic-related hot spots, i.e., hot spots where truck emissions are the predominant cause of violations vs hot spots where light duty vehicle emissions are the predominant cause. Two examples of this condition are observed in Los Angeles and New York City. In Los Angeles the highest truck emissions have been observed along the I-710 which is the heaviest travelled diesel corridor in the U.S. with more than 25,000 diesel trips per day carrying freight between the ports of Los Angeles and Long Beach and the rail yards and distribution centers located 5 to 15 miles inland, whereas the greatest overall AADT is at the I-5, I-10 interchange east of downtown Los Angeles where trucks account for 6% of trips and emissions are dominated by light duty vehicles. In New York City one of the greatest concentrations of truck traffic is focused on the neighborhoods along the arterials connecting the Hunts Point Market in the South Bronx with I-95 and other major regional highways,[4] whereas the greatest concentration of non-truck related vehicle emissions may be at the entrance to the Lincoln Tunnel or along the Long Island Expressway where trucks are not allowed.

The high numbers of vehicles at each of these locations will likely cause NAAQS violations. The violations at both types of vehicle hot spots must be characterized separately because the control strategies suitable for reducing truck emissions will provide no benefits toward reducing the violations at sites dominated by emissions from light duty vehicles. Accurately characterizing the magnitude of NAAQS violations at both types of hot spots is essential for the development of a control strategy designed to eliminate violations at each type of hot spot.

Commenters urge that both types of hot spot locations be monitored to avoid the consequence of omitting one type of hot spot from the SIP process. If only one on-road source-oriented monitor is required for cost or other reasons, and EPA's current SIP policy is retained, then only the one type of hot spot where the monitor is located will be required to demonstrate attainment of the NAAQS. The other type of hot spot will be

[4] "Elemental Carbon and PM2.5 Levels in an Urban Community Heavily Impacted by Truck Traffic," 110 EHP, 1009.

ignored in the SIP process because no monitored design values will be established for any other hot spot.

If the expense of operating monitoring sites is seen as a legitimate reason for limiting the number of monitoring sites, then EPA's current SIP policy must be revised to require that monitoring be supplemented by modeling to characterize other hot spots. SIP guidance must require that unmonitored hot spot locations be modeled as part of the SIP attainment demonstration. The prior guidance for CO that required the modeling of at least three hot spot locations, in addition to a monitored location, should likely be adequate for most metropolitan areas.

To avoid other limitations of monitoring, modeling should be used routinely to supplement monitoring data in the attainment demonstration even if both types of hot spot locations are monitored. Monitoring results are likely to be inadequate to fully characterize hot spot concentrations for a number of reasons, such as the inability to site the monitor at the optimum location to measure the highest expected concentrations, and the inability of one monitor to account for the spatial variations that occur between the peak concentrations for the annual average vs. the peak for the 24-hour NAAQS that result from the differences in meteorology between the average peak for the annual period and the seasonal period when short-term peaks occur.

History of Regulatory Action.

The Sierra Club, together with Environmental Defense Fund and Natural Resources Defense Council, have pressed the U.S. EPA to establish regulatory criteria for the implementation of the PM2.5 NAAQS near highways since the promulgation of the 1997 NAAQS, and have asked the Federal Highway Administration (FHWA) to perform health risk assessments under the National Environmental Policy Act (NEPA) to disclose to the public and decisionmakers the public health risks experienced by the millions of Americans who reside, work, attend school or recreate near major highways.

Regulating Highway Emissions Under Transportation Conformity.

After law suits challenging EPA's initial determination that emissions from highways did not present a significant threat to interfering with attainment of the PM2.5 NAAQS, EPA agreed in a settlement to adopt regulations requiring air quality analyses of PM2.5 emissions at hot spots when new or expanded highway projects are proposed. The final Hot Spot conformity rule applies to highway and other transportation projects that are expected to have a significant localized impact on ambient concentrations of PM2.5. 71 F.R. 12467 (March 10, 2006). EPA determined that projects with 125,000 vehicle trips per day, or 10,000 or more diesel vehicle trips per day, would likely add from 1 to 3µg of PM2.5 to local background concentrations of fine particles. New or expanded projects with traffic of this magnitude were identified as presumptively likely to have a significant impact on PM2.5 concentrations, and are therefore required to be analyzed for impacts on attainment of the NAAQS. However, projects carrying smaller traffic loads may also trigger an air quality analysis if emissions might cause local air quality to violate the NAAQS. 40 C.F.R. §§ 93.114, 93.115, 93.123.

The effectiveness of this regulation has been seriously compromised by the failure to conduct air quality monitoring to determine the baseline concentrations of PM2.5 within the localized zone where air quality is expected to be significantly affected by emissions from on-road sources. Where projects will add capacity that significantly expands traffic in a large corridor, baseline air quality should be monitored to determine the attainment status of the existing facility.

SIPs Not Required to Account for PM2.5 Violations Near Highways .

EPA's Implementation guidance for the 1997 PM2.5 NAAQS relies primarily on regional grid modeling to demonstrate that concentrations averaged across large-scale grids will attain the NAAQS at monitored locations. This approach is designed to account for the effects of secondary particles that dominate monitored concentrations at most monitors. In turn, EPA's monitoring guidance in Part 58 directs the states to locate monitors where they will reflect regional concentrations of PM2.5 and not be influenced by local sources of primary particles. The localized incremental effects of major stationary sources and highway sources of primary particles are intentionally excluded by this monitoring and modeling scheme.

The populations exposed to elevated PM emitted by major stationary sources may be relatively small compared to the regional populations exposed to secondary particles, but the populations around the US exposed to primary particles emitted from highways is large. EPA estimates that 35 million Americans reside within meters of a four lane or larger highway. The health effects of these exposures are large, and cannot be ignored.

MANY DATA SOURCES SHOW SIGNIFICANT IMPACT OF HIGHWAY EMISSIONS ON PM2.5 CONCENTRATIONS.

1. PM2.5 Is Elevated In Proximity To Highways.

The link between truck emissions and PM2.5 was first demonstrated in 1999 by monitoring conducted to quantify the effect of diesel traffic on neighborhood PM2.5 and EC in the Hunts Point area of the South Bronx.[5] There both PM2.5 and EC correlated with traffic counts of large trucks compared to a site not near truck traffic. The near tripling of mean EC concentrations from the isolated site (2.57 µg/m3) to the location with the highest large truck counts (7.34 µg/m3) accounted for about half of the increase in PM2.5 (from 19.0 µg/m3 to 29.9 µg/m3) between the isolated site and the most trafficked monitor. These high concentrations reflect the emissions of 1999 vintage vehicles, but the large variance in PM2.5 among the sites closely correlates with the difference in diesel traffic among sites.

A similar variation among sites attributable to traffic emissions is demonstrated by the data reported from the site established adjacent to the I-495/I-95 segment of the Washington Beltway near Beltsville MD when compared with a state monitoring site in

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[5] 110 EHP, 1009 (1999).

Beltsville 1.6 miles from the Beltway location. PM2.5 measured by the MD State Highway Administration 149 meters downwind of the Beltway shows quarterly mean concentrations ranging from 3 to 5 µg/m3 higher than the mean concentrations at the Beltsville site.

These variations between near-traffic sites and other nearby sites isolated from traffic emissions are consistent with studies that measure BC or EC as surrogates for diesel PM. In the South Coast Air Basin Zhu's freeway studies on the I-710 and I-405 show significant increases in BC/EC near highways. The studies measured BC concentrations at five distances downwind from the freeway and compared those levels with an upwind measurement near the freeways. The upwind measurements provide a good estimate of regional background BC loadings in the atmosphere not directly affected by highway emissions. These background concentrations provide the basis for estimating the increase in concentrations of primary carbon particles emitted from highways in the downwind direction.

These two studies allow for a comparison of results from a heavily traveled highway (I-405) with traffic dominated by light duty vehicles, and a highway (I-710) which serves as major access point for the diesel trucks servicing the ports of Los Angeles and Long Beach with some of the highest truck traffic of any highway in the U.S. Average traffic flow on the I-405 during the sampling periods was 13,900 vehicles per hour. Traffic primarily was dominated by gasoline-powered cars and light trucks, and less than 5% of vehicles observed were heavy-duty diesel trucks. On the I-710 freeway, average traffic flow during sampling periods was 12,180 vehicles per hour with more than 25% of vehicles being heavy-duty diesel trucks.

Relative concentrations of CO and black carbon BC near the freeways tracked each other well as distance from the freeway increased. The authors concluded that this "result confirmed the common assumption that vehicular exhaust is the major source of CO, BC, and ultrafine particles near a busy freeway." Averaged concentrations at five distances from the freeway are summarized in Table 1.

Table 1. BC Concentrations at Increasing Distances from the 405 Freeway, and Incremental Contribution of Highway Emissions to Regional Background Concentrations.

Distance from highway (m)	Measured Average (and Upper and Lower Limit) BC (µg/m^3)	Downwind Minus Upwind Average Concentration BC (µg/ m^3)
30	5.4 (3.4-10.0)	4.75
60	3.2 (3.0-3.5)	2.55
90	2.5 (2.4-2.6)	1.85
150	1.6 (1.1-2.0)	0.95
300	1.3 (1.1-1.5)	0.65

Upwind concentrations of the same pollutants were used to determine the "background" concentration in the urban air shed not directly affected by highway emissions. By subtracting these upwind concentrations from the concentrations measured at the downwind monitors, the incremental contribution of emissions from the highway could be determined. The incremental contributions of BC from the I-405 range from 4.75 (µg/ m3) at 30 meters to 0.65 (µg/ m3) at 300 meters.

The I-710 freeway has a much higher percentage of heavy-duty diesel truck travel than the I-405. Despite lower AADT than the I-405, relative concentrations of CO and BC downwind from the freeway were found to be many micrograms per cubic meter greater than upwind concentrations. Measured average BC concentrations at increasing distances from the I-710, and the increases above background are shown in table 2.

Table 2. BC Concentrations at Increasing Distances from the 710 Freeway

Distance from highway (m)	Measured Average (and Upper and Lower Limit) BC (µg/m^3)	Downwind Minus Upwind Average Concentration BC (µg/m$_3$)
200 m (upwind)	4.6 (3.1-5.9)	N/A
17 m (downwind)	21.7 (20.3-24.8)	17.1
20	19.4 (16.5-21.6)	14.8
30	17.1 (12.6-19.3)	12.5
90	7.8 (4.5-9.3)	3.2
150	6.5 (3.9-9.2)	1.9
300	5.5 (3.5-7.7)	0.9

These studies show that in the impact zone downwind of a heavily traveled freeway in the Air Basin with average truck traffic (I-405), emissions of BC from the freeway will add 4.75 µg/m3 to PM2.5 at 30 meters from the freeway dropping off to 0.65 µg/m3 greater than the regional concentration at 300 meters, and that a freeway with heavy truck traffic will add 12.5 µg/m3 at 30 meters dropping off to 1.9 µg/m3 increase above the regional levels at 300 meters.

The incremental effect of highway emissions downwind from the I-710 were confirmed in 2008 by data collected by the SCAQMD by deploying a mobile monitoring platform. *See* Mobile Monitoring Platform Update and Results Reported by CARB, April 17, 2008, at the HCMS Community Meeting, Wilmington Senior Center. Results from this investigation include BC concentrations within the so-called buffer zone 500 feet from the freeway compared with results measured beyond the 500 feet buffer. Concentrations measured in West Long Beach residential area on the morning of July 17, 2007, show nearly a four-fold greater BC level within 500 feet from the I-710 freeway compared to the same neighborhood outside the 500 feet zone (18 µg/m3 versus 5 µg/m3). This difference of 13 µg/m3 is highly consistent with the upwind/downwind results reported in Zhu's 2001 I-710 study.

These results were supported by measurements made in other regions. A study in Seattle, WA (Curtis, Gilroy, and Harper, 2004) measured the relationship between BC levels at an urban near-roadway monitoring site, and a heavily traveled freeway. This study showed that there were frequently peak evening rush hour BC levels of 5 µg/m3 or above near I-5. The BC data were obtained from the Olive Street monitoring site located at the EPA-defined "microscale" within the I-5 traffic corridor. Hourly traffic volumes and BC readings correlate well, supporting the conclusion that traffic is a major contributor to PM2.5 at the site. The Olive Street air monitoring site is about 20 meters west of the southbound lane of I-5 in the CBD. Daily traffic along this section of I-5 averaged 284,700 vehicles per day in 2003. Light-duty traffic has peak weekday flows above 10,000 vehicles per hour, with diesel traffic of about 1,000 vehicles per hour (10%). BC levels peak during weekdays with high traffic volumes, and is sharply lower on weekends. This reduction parallels the significantly lower weekend diesel traffic volumes. Peak BC measurements occur during the afternoon rush hour (4-6 pm).

The Seattle study also measured BC at a Beacon Hill neighborhood site about 600 meters from a major freeway, which is used as the urban background for Seattle. Hourly BC readings during the study period stayed within the range of 0 to 2 µg/m3, with readings mostly below 1.0 µg/m3. Comparing these sites demonstrates results similar to the data obtained from the I-405 study with BC concentrations in the near-highway environment being about 4 µg/m3 greater than the urban regional concentration.

The "East Bay [California] Children's Respiratory Health" study (Kim et al., 2004), conducted with support from California EPA's Office of Environmental Health Hazard Assessment, obtained measurements of PM2.5 concentrations at monitors located in the schoolyards of 10 middle schools in communities across the East Bay. This study reported the distance of each monitor from major freeways, the traffic density on the nearest freeway, and whether the school was located downwind of the traffic source. The PM2.5 measured at the school closest to (60 meters), and downwind from a major freeway, was 15 µg/m3 which was 3 µg/m3 greater than the 12 µg/m3 PM2.5 concentrations reported at the nearest regional air district network monitor located about 1 mile from major traffic sources.

The recently released West Oakland Health Risk Assessment conducted by CARB provides similar results from a modeling study that shows highly elevated concentrations of diesel PM in a neighborhood downwind of the Port of Oakland and surrounded by heavily traveled major freeways. The risk assessment concluded that despite the significant contribution of emissions from ocean going vessels, local watercraft, railyard and port activities, the emissions from non-port related on-road truck operations accounted for 80% of the diesel PM (and related cancer risk) in West Oakland.

Other studies discussed by Pechan in their review of reports evaluating the impact of highway emissions on near-highway concentrations on PM2.5[6] provide independent

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[6] *ESTIMATING CONTRIBUTIONS OF ON-ROAD EMISSIONS TO NEAR HIGHWAY PM2.5 CONCENTRATIONS*, E.H. Pechan and Associates (April 2008).

sources of analysis that confirm the magnitude of PM2.5 impacts contributed by on-road sources. These include speciation studies, and a modeling analysis of traffic on I-95 north of the Capitol Beltway in Maryland.

The on-going modeling study conducted by the Maryland State Highway Administration (MSHA) at a site 149 meters downwind from the Capitol Beltway in Beltsville, MD, adds significantly to the speciation of near-highway PM2.5. Since very few FR monitors are located near highways because of EPA's past monitoring guidance, and no PM2.5 speciation sites are located near highways, species data collected at nearly all PM2.5 monitors in the East and Midwest show the filter catch is dominated by secondary particles, with the largest share typically sulfates. See EPA's Air Trends data site. But at the MSHA Beltway monitoring site organic and elemental carbon contribute 50% of the filter catch, and sulfate is only 25% of total mass.[7] The lower sulfate share or total mass is not because the sulfate mass is less; it is because the total mass is consistently about 25% to 35% greater at the Beltway site than at the Beltsville monitor 1.6 miles from I-95. The increased mass is almost entirely attributable to the increased carbon species.

These and other studies provide credible evidence that the BC/EC/OC component of PM2.5 concentrations near highways are expected to range from 3 µg/m3 to as much as 13 µg/m3 greater than BC/EC/OC concentrations measured at regional monitors located outside the high impact zone of heavily traveled freeways. When these BC concentrations are considered together with the evidence presented in MATES-III that total diesel PM is about 72% greater than measured BC, the carbon emitted from both diesels and gasoline vehicles contribute significantly to total ambient concentrations of PM2.5 near highways. The incremental concentrations contributed by direct (primary) particles emitted from on-road sources is significantly greater than PM2.5 measured outside the 300 meter high pollution zone near highways. Compared to the annual NAAQS for PM2.5 (15 µg/m3), these increased concentrations downwind from major highways add significantly to the severity of NAAQS violations measured at regional monitors, or can cause NAAQS violations in areas where regional monitors are in attainment.

These studies, combined with the large populations that reside within the 300 meter high impact zone adjacent to highways, demonstrate the critical importance of monitoring for PM2.5 within the 300 meter zone near highways for the purposes of --

1) determining whether an area should be designated nonattainment for PM2.5,
2) establishing the design values to be used in developing control strategies for a nonattainment area, and
3) measuring attainment by the statutory deadline.

[7] Monitored data for the Capitol Beltway study site are not published or posted by Maryland SHA, but are submitted to Plaintiffs EDF and Sierra Club as part of the settlement of the ICC Highway litigation. Three MSHA quarterly reports of the data collected during 2009 are submitted with these comments.

II. AADT Alone is Not the Appropriate Benchmark for Identifying Hot Spot Monitoring Sites for PM2.5, and One Site is Not Adequate.

The measurements made by Zhu et al. upwind and downwind of the I-710 and I-405, and the study from Seattle on the I-5 demonstrate that concentrations of truck traffic must be given first priority for the selection of a monitoring site. AADT should not be the only, or even primary determinant of site selection.

However, these study results also demonstrate that highways where truck trips are a relatively low share of total AADT, but where total AADT is high, can also add 4-5 µg/m3 to concentrations measured outside the highway impact zone. Where regional monitors report an annual average greater than 10 µg/m3, or a 24-hour design value more than 31 µg/m3, the highest AADT site for the nonattainment area should also be monitored in addition to the site with the highest concentration of HD diesel vehicles.

Monitoring both kinds of hot spot locations, i.e., HD diesel-dominated sires and LD high AADT sites, is critical because the control strategies for each type of hot spot is likely to be different. In California the State has adopted a statewide rule requiring the accelerated replacement of diesel engines to reduce emissions from the diesel fleet. But even this rule is not expected to solve the PM2.5 problem along the I-710. To resolve this port traffic problem, the regional transportation plan for the South Coast basin was amended in 2008 to provide for an electric powered High-Speed Regional Transport system linking the seaports with the airports, the rail yards and the freight distribution centers. The ports are now undertaking pilot projects to identify the preferred technology, and private investors are developing project proposals. This system will remove most of the freight from the freeways and eliminate most of the diesel traffic and diesel PM that now violates the NAAQS along the I-710. But this system is not likely to reduce LD VMT enough to eliminate the 4-5 µg/m3 incremental contribution to PM2.5 from the I-405 and other major freeways with LD AADT greater than 300,000 trips per day. Other strategies will be needed to resolve those violations caused by LD vehicles.

Therefore the modeling guidance should require monitoring at both types of transportation hot spots to ensure that strategies are developed that will be adequate to eliminate NAAQS violations at both types of hot spots.

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