APPENDIX D
UPDATED UNCERTAINTY LANGUAGE

Unavailable Information for Project Specific Mobile Source Air Toxic (MSAT) Impact Analysis

This [EA or EIS] includes a basic analysis of the likely MSAT emission impacts of this project. In FHWA's view, the lack of a national consensus on an acceptable level of risk and other air quality criteria assumed to protect the public health and welfare, as well as the reliability of available technical tools do not enable us to predict with confidence the project-specific health impacts of the emission changes associated with the alternatives evaluated here. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process by the assumptions made rather than any real insight into the actual health impacts from MSAT exposure directly attributable to the proposed action. Due to these limitations, the following discussion is included in accordance with Council on Environmental Quality (CEQ) regulations (40 CFR 1502.22(b)) regarding incomplete or unavailable information:

Information that is Unavailable or Incomplete

Evaluating the environmental and health impacts from MSATs on a proposed highway project would involve several key elements; chief among them is what constitutes an "acceptable level" of risk. Incremental risk levels from a new source which are projected to be less than 1 in 1 million are generally considered to be negligible; while, incremental risk levels greater than 100 in 1 million are generally considered to be unacceptable. Indeed, the U.S. Environmental Protection Agency (EPA) prevailed in a recent U.S. Court of Appeals for the District of Columbia decision (Natural Resources Defense Council v. Environmental Protection Agency, No. 07-1053, June 8, 2008) that its 2006 hazardous organic NESHAPs (National Emission Standards for Hazardous Air Pollutants) rule reduced emissions to levels that present "an acceptable level of risk and protect public health with an ample margin of safety" at risks less than 100 in 1 million. The U.S. EPA's benzene NESHAPs is also based on reducing risks to less than 100 in 1 million.

There is also no national consensus on dose-response values for MSATs. For instance, the U.S. EPA provides ranges of air concentrations at specific risk levels for lifetime exposure to benzene, with uncertainty spanning perhaps an order of magnitude. The practical uncertainty is even greater, because the California Environmental Protection Agency (Cal/EPA) puts the air concentration risk levels for benzene at an order of magnitude less than equivalent U.S. EPA values. In addition, most notably, Cal/EPA has implemented an air concentration risk level for diesel PM; whereas, the U.S. EPA has not. The U.S. EPA states in their risk assessment of diesel PM entitled "Health Assessment Document for Diesel Exhaust" (Office of Research and Development, EPA/600/8-90/057F, May 2002, pp 8-15, http://www.epa.gov/risk/basicinformation.htm#g) that:

> "an exploratory risk analysis shows that environmental cancer risks possibly range from 10^{-5} to nearly 10^{-3}, while a consideration of numerous

uncertainties and assumptions also indicates that lower risk is possible and zero risk cannot be ruled out. These risk findings are only general indicators of the potential significance of the lung cancer hazard and should not be viewed as a definitive quantitative characterization of risk or be used to estimate an exposure-specific population impact".

The uncertainties in the unit risk value for diesel PM are exceptionally large, since epidemiological studies of diesel engine exhaust do not consistently find that exposure to diesel PM causes cancer (cohorts of underground miners exposed to the highest concentrations of diesel PM, for example, appear to have no excess risk of lung cancer). Thus, the U.S. EPA has found that the available epidemiological data do not support the development of any unit risk value for diesel PM. Prior to the U.S. EPA's risk assessment, an expert panel organized by the independent, non-profit Health Effects Institute (HEI) examined published diesel PM epidemiological studies. The HEI panel recommended against using current studies of occupationally exposed railroad workers and truck drivers as the basis of quantitative risk assessment in ambient settings ("Diesel Emissions and Lung Cancer: Epidemiology and Quantitative Risk Assessment", June 1999, http://pubs.healtheffects.org/getfile.php?u=282). Their examination of the data demonstrated a decrease in relative risk with increasing duration of employment for three broad categories of railroad workers, which is not consistent with an association between diesel PM exposure and lung cancer risk (refer to Figure 1). In contrast to the U.S. EPA's risk assessment findings and HEI's expert panel recommendations, the Cal/EPA used the railroad workers studies to calculate a unit risk value for diesel PM, which ranged from 1.3×10^{-4} to 2.4×10^{-3} (lifetime – $\mu g/m^3)^{-1}$.

Figure 1
HEI Panel Analysis of Railroad Worker Study Data

An association between an incremental increase in traffic volumes and the risk level generally considered unacceptable is implied in a screening-level risk analysis included in the National Cooperative Highway Research Program (NCHRP) report entitled "Analyzing, Documenting, and Communicating the Impacts of Mobile Source Air Toxic Emissions in the NEPA Process" (NCHRP 25-25 Task 18, March 2007, http://www.trb.org/NotesDocs/25-25(18)_FR.pdf). For freeways, an incremental increase in traffic volumes of 125,000 to 443,000 AADT is linked with an incremental 1 in 1 million risk level, based on the U.S. EPA's range of unit risk values for benzene. The analysis was conducted for an overly simplified exposure condition, assuming that emission levels associated with a 2008 vehicle fleet would persist for 70 years, discounting the recognized significant mitigation associated with EPA's Tier 2 and heavy-duty truck emissions standards and the 2007 MSAT rule. By extension, based on the same over-simplification, an incremental increase in freeway traffic volumes of 1,250,000 to 4,430,000 AADT are associated with a 10 in 1 million risk level and an incremental increase in freeway traffic volumes of 12,500,000 to 44,300,000 AADT are associated with a 100 in 1 million risk level – the level above which is generally considered unacceptable. The inherent assumption is that the U.S. EPA is correctly estimating benzene and diesel PM air concentration risk levels and Cal/EPA's estimates are incorrect. Different results and conclusions would be obtained if the reverse is true or if neither the U.S. EPA nor Cal/EPA is correct. Consequently, FHWA finds that there is considerable uncertainty associated with estimates of adverse residual risk after implementation of the U.S. EPA's 2007 MSAT rule and other control programs.

According to the U.S. EPA in their Air Toxics Risk Assessment Reference Library, risk and hazard estimates are typically reported as one significant figure. Based on the NCHRP screening-level risk analysis model, the ability to discern between a 1 in 1 million risk level and a 2 in 1 million risk level is associated with a freeway traffic volume increase of 125,000 to 443,000 AADT. In FHWA's view, risk assessment methodologies applied to highway projects are a blunt instrument.

The methodologies for forecasting health impacts include emissions modeling; dispersion modeling; exposure modeling; and then final determination of health impacts – each step in the process building on the model predictions obtained in the previous step. All are also encumbered by technical shortcomings or uncertain science that prevents a more complete determination of the MSAT health impacts of this project.

1. <u>Emissions</u>: The U.S. EPA characterizes their MOBILE6.2 emission factor model as a regional model and not a project-level model. It is a trip-based model, where emission factors are projected based on a "typical" trip of 7.5 miles and vehicle speeds averaged over the trip. MOBILE6.2 does not have the ability to predict emission factors for a

specific vehicle operating condition at a specific location at a specific time. Because of this, it has limited applicability at the project level. The U.S. EPA will be addressing this limitation in its MOVES model, a replacement to MOBILE6.2. The implication of this limitation is illustrated and noted by the University of California, Davis (UCDavis) in Figure 2, i.e., "Smooth flow reduces emissions by a factor of nearly 20", which cannot be reflected in a trip-based or link-based model. Similar results have been found in analyses by UCRiverside (Barth, for CO2) and NC State (Frey, for multiple pollutants).

Even within the confines of regional emissions modeling, the U.S. EPA and Cal/EPA have a different view of what MSAT emissions would look like from a future vehicle fleet required to meet identical vehicle emission standards. Although the same basic concepts were used in developing their respective mobile source emission factor models, widely disparate results are produced for MSATs. The U.S. EPA's MOBILE6.2 model generally predicts higher emission factors for benzene compared to Cal/EPA's Emfac2007 model. Emfac2007 generally predicts higher emission factors for diesel PM compared to MOBILE6.2. Figure 3 provides a comparison of emission factors produced by the models for benzene and diesel PM for the 2030 calendar year. Notice that diesel PM emission factors from MOBILE6.2 do not vary with speed; in Emfac2007 they do. In part, because of this, the U.S. EPA has concluded that (71 FR 12498):

> "we continue to believe that appropriate tools and guidance are necessary to ensure credible and meaningful PM2.5 and PM10 hot-spot analyses. Before such analyses can be performed, technical limitations in applying existing motor vehicle emission factor models must be addressed, and proper federal guidance for using dispersion models for PM hotspot analysis must be issued. With the release of MOBILE6.2, state and local transportation agencies now have an approved model for estimating regional PM2.5 and PM10 emission factors in SIP [State Implementation Plan] inventories and regional emissions analyses for transportation conformity. However, MOBILE6.2 has significant limitations that make it unsatisfactory for use in microscale analysis of PM2.5 and PM10 emissions as necessary for quantitative hot-spot analysis."

The MOBILE6.2 limitations noted by the U.S. EPA also apply to diesel PM emission factors.

2. Dispersion. The tools to predict how MSATs disperse are also limited. The U.S. EPA's current regulatory models, CALINE3 and CAL3QHC, were developed and validated with emission rates from the MOBILE4 model more than a decade ago. Based on updated emission rates to MOBILE5, an extensive evaluation of the CAL3QHC model was

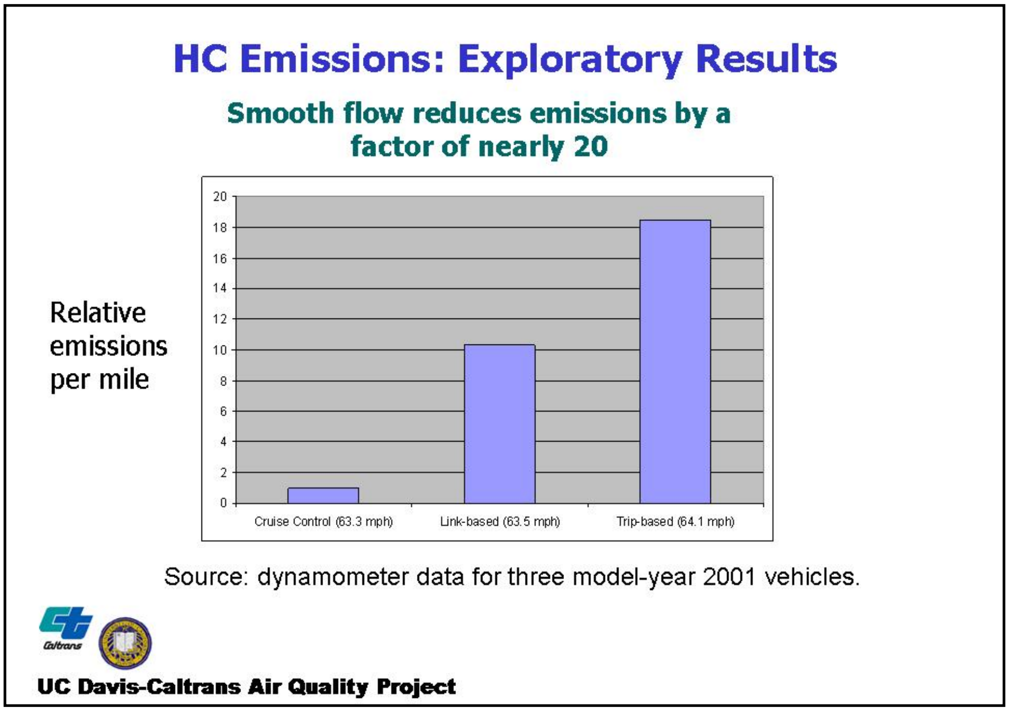

Figure 2
UCDavis Comparison of Emissions
(Trip-based versus Link-based versus Cruise)

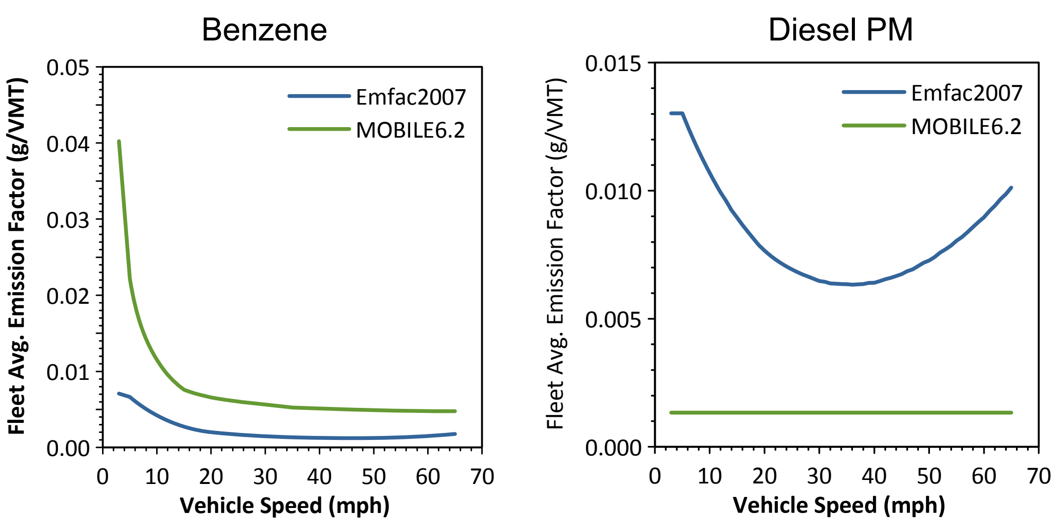

Figure 3
MOBILE6.2/Emfac2007 Comparison of Emissions
(Calendar Year 2030)

conducted in an NCHRP study as part of the development of the HYROAD model. The study report documents poor model performance at ten sites across the country, 3 where intensive CO monitoring was conducted plus an additional 7 with less intensive monitoring. The report is available online from the U.S. EPA at www.epa.gov/scram001/dispersion_alt.htm#hyroad.

3. Exposure Levels and Health Effects. Finally, even if emission levels and concentrations of MSATs could be accurately predicted, shortcomings in current techniques for exposure assessment and risk analysis preclude us from reaching meaningful conclusions about project-specific health impacts. Exposure assessments are difficult because it is difficult to reliably forecast long-term concentrations of MSATs near roadways, and to determine the portion of time that people are actually exposed to those concentrations at a specific location. These difficulties are magnified for lifetime, 70-year risk assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over that time frame. There are also considerable uncertainties associated with the existing estimates of toxicity of the various MSATs, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by the Health Effects Institute.

   For example, consider the exposure-response relationship for alcoholic beverages. Alcoholic beverages are established causes of cancer in humans; about 3% of all cancers world-wide are thought to be caused by over-consumption of alcoholic beverages. There is a clear dose-response relationship for alcoholic beverages, with risk of cancer death increasing (essentially) linearly for exposures ranging from 2 drinks per day through 6-plus drinks per day. But there is neither evidence nor reason to suppose that, for example, one or a half a drink per day also increase people's risk of cancer death. Indeed, the exposure-response data, interestingly enough, show a "J-shaped" dose response relationship, such that people consuming 1 drink per day are significantly *less* likely to die of cancer than those who drink no alcoholic beverages. If one were to make the standard "regulatory style" assumption about low-level exposure to alcohol, one would both vastly overestimate the cancer risk, and also miss entirely what turns out to be a low-level protective effect. In such a case, it would hardly be "erring on the side of public health" to estimate that exposures that are orders of magnitude smaller than the 2 drinks-per-day cancer-effect-level put people at risk of cancer. This is not to say, of course, that very-low-level exposures to MSAT emissions prevent cancer; nor is it to assert that such exposures are demonstrably or obviously safe. It is only to point out that extrapolation beyond observable exposures and responses are at best an uncertain business and become increasingly uncertain the farther one strays from the empirical data.

Because of these shortcomings, any calculated difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with calculating the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against project benefits [name specific benefits with available supporting statistics, such as reducing traffic congestion, accident rates, and fatalities plus improved access for emergency response] that are better suited for quantitative analysis.

Summary of Existing Credible Scientific Evidence Relevant to Evaluating the Impacts of MSATs

Research into the health impacts of MSATs is ongoing. For different emission types, there are a variety of studies that show that some either are statistically associated with adverse health outcomes through epidemiological studies (frequently based on emissions levels found in occupational settings) or that animals demonstrate adverse health outcomes when exposed to large doses.

Exposure to toxics has been a focus of a number of U.S. EPA efforts. Most notably, the agency conducted the National Air Toxics Assessment (NATA) in 1996 to evaluate modeled estimates of human exposure applicable to the county level. While not intended for use as a measure of or benchmark for local exposure, the modeled estimates in the NATA database best illustrate the levels of various toxics when aggregated to a national or state level.

The U.S. EPA is in the process of assessing the risks of various kinds of exposures to these pollutants. The U.S. EPA Integrated Risk Information System (IRIS) is a database of human health effects that may result from exposure to various substances found in the environment. The IRIS database is located at http://www.epa.gov/iris. The following toxicity information for the six prioritized MSATs was taken from the IRIS database *Weight of Evidence Characterization* summaries, which represents the Agency's most current evaluations of the potential hazards and toxicology of these chemicals or mixtures.

- **Benzene** is characterized as a known human carcinogen.

- The potential carcinogenicity of **acrolein** cannot be determined because the existing data are inadequate for an assessment of human carcinogenic potential for either the oral or inhalation route of exposure.

- **Formaldehyde** is a probable human carcinogen, based on limited evidence in humans, and sufficient evidence in animals.

- **1,3-butadiene** is characterized as carcinogenic to humans by inhalation.

- **Acetaldehyde** is a probable human carcinogen based on increased incidence of nasal tumors in male and female rats and laryngeal tumors in male and female hamsters after inhalation exposure.

- **Diesel exhaust** is likely to be carcinogenic to humans by inhalation from environmental exposures. Diesel exhaust is the combination of diesel particulate matter and diesel exhaust organic gases. **Diesel exhaust** also represents chronic respiratory effects, possibly the primary non-cancer hazard from MSATs. Prolonged exposures may impair pulmonary function and could produce symptoms, such as cough, phlegm, and chronic bronchitis.

Some recent studies have reported that proximity to roadways is related to adverse health outcomes – particularly respiratory problems.[1] Many health studies use an epidemiological approach to relate the possibility of harm due to the proximity to the roadway. FHWA has concerns about reaching conclusions regarding health impacts from highway emissions based on proximity studies in areas known to exceed ambient air quality standards, such as the recent study by Dr. James Gauderman, et al., entitled "Effect of Exposure to Traffic on Lung development from 10 to 18 Years of Age: A Cohort Study". These studies do not measure specific pollutants but only roadway proximity, so any reported negative health impacts may be due to either the criteria pollutants or MSATs. Epidemiological studies suffer from the limitation that they cannot by their very nature establish causality. They may indicate statistical associations, but other confounding factors may be missed and may represent the true cause of the impact. Furthermore, not all studies show a negative impact. For example, the "Long term Effects of Traffic-Related Air Pollution on Mortality", Beelen et al., only found weak associations between proximity to major roadways and health effects. This fact was also reported as a major shortcoming in health studies of this nature in, "Does Traffic-Related Air Pollution Contribute to Respiratory Disease Formation in Children", M. Jerritt, ERJ 2007, Vol. 29. In his review, Jerritt also points out another shortcoming in recent health studies dealing with determining the effect of proximity. He points out that most of these studies utilize a basic measure of distance to roadway as a proxy of exposure; however, because of the variable nature of particles and gaseous pollutants, the true variability of air pollutants within the neighborhood scale needs to be captured to identify the health effects of specific components of the air pollution mixture. Additionally, he states "exposures assigned on distance to traffic or traffic counts near the home are prone to . . . errors . . . and biased results".

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[1] South Coast Air Quality Management District, Multiple Air Toxic Exposure Study-II (2000); South Coast Air Quality Management District, Multiple Air Toxic Exposure Study-III (2007); Highway Health Hazards, The Sierra Club (2004) summarizing 24 Studies on the relationship between health and air quality); NEPA's Uncertainty in the Federal Legal Scheme Controlling Air Pollution from Motor Vehicles, Environmental Law Institute, 35 ELR 10273 (2005) with health studies cited therein.

Because analytical methodologies vary greatly between individual health studies, and all studies have limitations, it is not practical to draw definitive conclusions based solely on individual studies. Rather the total body of literature needs to be consulted before conclusions can be made. To that end, the Health Effects Institute has undertaken a major series of studies to research near-roadway MSAT hot spots, the health implications of the entire mix of mobile source pollutants, and other topics. The first study was completed and the findings published last year in Special Report 16 – *Mobile-Source Air Toxics: A Critical Review of the Literature on Exposure and Health Effects*, available online at www.healtheffect.org. For each of the MSATs reviewed, the analysis answers three questions:

1. To what extent are motor vehicles a significant source of exposure?

2. Does it affect human health?

3. Does it affect human health at environmental concentrations?

HEI concludes that exposure to many MSATs comes from sources other than vehicles and that mobile sources are the primary sources of exposure for only a few of the 21 MSATs listed by the U.S. EPA in its 2001 Rule. For many of the MSATs reviewed, HEI concluded that there is insufficient data for an assessment of ambient exposures on human health.

Relevance of Unavailable or Incomplete Information to Evaluating Reasonably Foreseeable Significant Adverse Impacts on the Environment, and Evaluation of Impacts Based Upon Theoretical Approaches or Research Methods Generally Accepted in the Scientific Community

Given the uncertainties outlined above, a quantitative assessment of the effects of air toxic emissions impacts on human health cannot be reliably made at the project level. While available tools do allow us to reasonably predict relative emissions changes between alternatives for larger projects, the amount of MSAT emissions from each of the project alternatives and MSAT concentrations or exposures created by each of the project alternatives cannot be predicted with enough accuracy to be useful in estimating health impacts. (As noted above, the current emissions model is not capable of serving as a meaningful emissions analysis tool for smaller projects.) Therefore, the relevance of the unavailable or incomplete information is that it is not possible to make a determination of whether any of the alternatives would have "significant adverse impacts on the human environment."

In this document, FHWA has provided a qualitative assessment of MSAT emissions relative to the various alternatives and has acknowledged that the project build alternatives may result in increased exposure to MSAT emissions in certain locations, although the concentrations and duration of exposures are uncertain, and because of this uncertainty, the health effects from these emissions cannot be reliably estimated.