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PROCEEDINGS OF THE MOBILE SOURCE AIR TOXICS PEER EXCHANGE MEETING

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16. Abstract

Air toxics is an emerging area that receives more and more attention—from transportation/environmental agencies, academic researchers, and the public—because of potential health issues and uncertainties with modeling and the science behind MSAT. Currently 188 air toxics are identified in the Clean Air Act as hazardous air pollutants. Among them, 21 are labeled as mobile source air toxics (MSAT) by the U.S. Environmental Protection Agency (EPA). In particular, 6 of the 21 MSATs are priority MSATs. They are benzene, formaldehyde, acetaldehyde, diesel particulate matter/diesel exhaust organic gases, acrolein, and 1,3-butadiene. There are no regulatory concentration standards set up for the six MSATs. In response to the need for federal guidance in documenting MSAT impacts by state DOTs, the Federal Highway Administration (FHWA) issued Interim Guidance on February 3, 2006 to advise state Departments of Transportation (DOT) on when and how to analyze MSATs in the National Environmental Policy Act (NEPA) process for highway projects. As the science progresses, FHWA will update the MSAT guidance.

Given many uncertainties with the new guidance that is still evolving, on October 5-6, 2006 the Mobile Source Air Toxics Peer Exchange Meeting was successfully held at Allerton Park, Monticello, Illinois, facilitated by University of Illinois at Chicago (UIC). Twenty-one participants from the six state DOTs (Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin), FHWA, US EPA Region 5 Office, Illinois EPA and UIC attended the meeting. The meeting covered both the technical and practical issues/uncertainties emerging from the new MSAT guidance and exchanged ideas and experiences in documenting MSATs in the NEPA documents. These proceedings summarize the topics and issues covered in the presentations and roundtable discussion at the meeting.

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Mobile Source Air Toxics Peer Exchange Meeting

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Table of Contents

Introduction

Jie (Jane) Lin, University of Illinois at Chicago

Air toxics is an emerging area that receives more and more attention — from transportation/environmental agencies, academic researchers, and the public, because of potential health issues and uncertainties with modeling and the science behind mobile source air toxics (MSAT). Currently 188 air toxics are identified in the Clean Air Act as hazardous air pollutants. Among them, 21 are labeled as mobile source air toxics by the U.S. Environmental Protection Agency (EPA). In particular, 6 of the 21 pollutants are priority MSATs. They are benzene, formaldehyde, acetaldehyde, diesel particulate matter/diesel exhaust organic gases, acrolein, and 1,3-butadiene.

There are no regulatory concentration standards set up for the six MSATs. In response to the need for federal guidance in documenting MSAT impacts by state DOTs, the Federal Highway Administration (FHWA) issued Interim Guidance on February 3, 2006. The guidance advises state Departments of Transportation (DOT) on when and how to analyze Mobile Source Air Toxics (MSAT) in the National Environmental Policy Act (NEPA) process for highway projects. As the science progresses, FHWA will update the MSAT guidance.

Given the many uncertainties with the new guidance that is still evolving, the Illinois Department of Transportation (IDOT) proposed convening a meeting of six Midwestern states (Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin) to discuss the technical and practical issues and uncertainties arising from the new MSAT guidance and to exchange ideas and experiences in documenting MSATs in NEPA documents. The idea was first proposed by Walt Zyznieuski at IDOT and received favorable support from the Illinois Department of Transportation (IDOT) and the Illinois Center for Transportation (ICT). On October 5-6, 2006 the Mobile Source Air Toxics Peer Exchange Meeting was successfully held at Allerton Park, Monticello, Illinois, facilitated by the University of Illinois at Chicago (UIC). Twenty-one participants from the six state DOTs, FHWA, US EPA Region 5 Office, Illinois EPA and UIC attended the meeting. Invited speakers included Jeff Houk and Michael Claggett of FHWA Resource Center, Motria Caudill of US EPA Region 5 Air Monitoring & Analysis Section, Terry Sweitzer of Illinois EPA Bureau of Air, and Walt Zyznieuski of IDOT.

The MSAT peer exchange meeting covered a wide range of MSAT-related topics, from big picture regulatory issues dealing with air toxics (Motria Caudill) and mobile source air toxics (Michael Claggett and Jeff Houk), to FHWA's Interim MSAT Guidance (Jeff Houk) and real-world examples, as well as a FHWA white paper of project-level MSAT analysis methodologies (Michael Claggett and Jeff Houk) and use of MOBILE6.2 in MSAT analysis (Michael Claggett). Uncertainties in MSAT analysis were discussed from the view point of FHWA (Jeff Houk). Several case studies were also presented: the O'Hare Airport air toxics study (Terry Sweitzer), the Dan Ryan air quality monitoring project (Walt Zyznieuski), and ongoing university research on receptor modeling of

MSAT source apportionment at UIC (Motria Caudill). The last part of the meeting was roundtable discussion among the participants to share experiences and to identify issues, concerns, and future research needs on MSAT.

There was valuable information, experience, and knowledge shared among the meeting participants. We felt that it would also be valuable to other state DOTs nationally. Therefore, we have put together these proceedings as the end-product of the MSAT peer exchange meeting, and each state will be provided notification of the report.

Finally, we would like to take this opportunity to thank Imad L. Al-Qadi, Director of The Illinois Center for Transportation (ICT), and David Lippert, Engineer of Materials and Physical Research at IDOT, for giving the opening speeches and their support for the project. We also thank David King of ICT, Patty Broers of IDOT, and Matt Fuller and Janis Piland of FHWA for their assistance in the success of the meeting.

More information about the MSAT peer exchange meeting is available from http://msat.cme.uic.edu/.

Clean Air Act — Background and Regulatory Issues Dealing with Air Toxics

Motria Caudill, U.S. Environmental Protection Agency Region 5 Air Monitoring and Analysis Section

This is an overview of rules and regulations for stationary and mobile sources, and measures of success for reducing air toxics and health exposures to toxics.

1. Rules and Regulations

1.1 Point Sources Rules

The 1990 Clean Air Act Amendments (CAAA) identified air toxics and established a two-step procedure in dealing with point source air toxics: first to implement control technologies and then to assess the residual risks. For large stationary sources (e.g., large industries), the first step is to develop regulations, which require industries to limit their emissions based on the level already achieved by the top12% of that industry's cleanest facilities. After all industries nationally have met the regulations, EPA assesses the residual risks of the facilities that have implemented the control technologies and promulgates additional emissions reduction requirements as needed.

> *Step 1: Maximum Achievable Control Technology (MACT) rules.* EPA has issued 96 MACT standards affecting 160 categories of industry, including chrome electroplaters, oil refineries, coke ovens, dry cleaners. These rules collectively will reduce 1.7 million tons per year of hazardous air pollutants (HAPs) compared to 1990 baseline emissions.
>
> *Step 2: Residual Risk Rules.* MACT rules have been issued from 1990 through this past year. The residual risk rules have just started now. Within eight years of setting a MACT, EPA must assess the residual risks as needed to protect public health with an ample margin of safety. If public health is not adequately protected, EPA will issue a Residual Risk Rule to further reduce emissions from a particular industry category. So far, two rules have been finalized – coke ovens and dry cleaners; two rules have been proposed – hazardous organic National Emissions Standards for Hazardous Air Pollutants (NESHAP) and halogenated solvent cleaning; and four industries were deemed to require no further action – cooling towers, gasoline distribution, magnetic tape manufacture, and commercial sterilizers.

1.2 Area Source Technology Rules

While the above major point source MACT rules have resulted in significant reduction in total HAP emissions, area source (i.e., smaller point source) emissions, in fact increased from 1990 to 1999. Currently 16 area source categories are already regulated under existing point source rules. Fifty additional area source rules are to be developed by 2009.

1.3 Mobile Source Rules

Until recently, most of the rules pertaining to mobile sources were largely aimed at reducing ambient concentrations of criteria pollutants, such as CO, lead, ozone precursors, and fine particulate matter. As a side benefit, air toxics such as benzene, other volatile organic compounds (VOCs), diesel particulate matter (DPM), and metals are also reduced in the process.

- **Reformulated Gasoline (RFG):** RFG is blended to burn more cleanly and reduce ozone precursors and HAPs. RFG is used in 17 states and Washington D.C., comprising 30% of gasoline sold in the U.S. About 75 million people live in areas with RFG. A study by the Northeast States for Coordinated Air Use Management (NESCAUM) shows that Phase I RFG reduced cancer risk from gasoline by 12% and Phase II RFG reduced the risk by another 19% (www.nescaum.org/documents/rfg_exsum.pdf/).

- **On-road Diesel Rules:** There are recent rules to significantly reduce NOx and PM pollution from new diesel engines: new emission standards for on-road diesel engines produced from 2004 onward and the even more stringent standards for diesel engines produced from 2007 onward, parallel with the currently available ultra-low sulfur diesel fuel throughout the Midwest. These rules are estimated to prevent thousands of premature deaths, and chronic and acute bronchitis in children every year.

- **Non-road Diesel Rules:** Non-road diesel engine rules for agricultural and construction equipment will be phased in from 2008 to2014. The requirements are similar to the on-road rules. It is expected that beginning in 2010, sulfur content in fuel will be reduced. EPA estimates that controlling these emissions would annually prevent 12,000 premature deaths, 8,900 hospitalizations, and one million work days lost by 2030. There are also rules under development for locomotives and marine engines. These rules are aimed largely at reducing particulate matter as well as other side benefits including health benefits in general.

1.4 Mobile Source Air Toxics Rules (MSAT)

This interim rule was issued in February 2006, which establishes new controls on MSAT, including: (i) gasoline benzene content reduction from 0.97% to 0.62% by volume in 2011, (ii) new vehicle emission rules to be phased in between 2010-15 to reduce non-methane hydrocarbon (NMHC) exhaust emissions from new gas-powered passenger vehicles, and (iii) reduction of VOC leaks from gas cans in 2009. By 2020, mobile source rules are expected to reduce emissions of certain HAPs (benzene, formaldehyde, acetaldehyde, and 1,3-butadiene) from highway vehicles by 75% and diesel PM by over 90% from 1990 levels.

1.5 Voluntary Programs

Several voluntary programs are in place in the Midwest aimed at retrofitting diesel engines that are currently on the road, including Clean School Bus USA. The Midwest Clean Diesel Initiative is a public-private partnership to reduce emissions from the fleet of about 3.3 million engines in Region 5. Three key sectors are targeted: ports, agricultural freight, and rail. All these programs cost about $11.8 million in Region 5 in fiscal year 2006 and affect 163,348 diesel engines.

2. Measures of Success

The 1990 Clean Air Act Amendments require the EPA to reduce long-term population risks (cancer and non-cancer) by 75%. However, it should be recognized that this is a moving target due to many uncertainties associated with air toxics, such as evolving science and methodologies, and limited data. Nevertheless, there are three measures in attempting to quantify HAP emissions trends and population risks: 1) trend in emissions inventories, 2) nationwide risk assessment studies, and 3) ambient air monitoring.

The overall trend in HAP emissions is downward — 24% between baseline (1990-1993) and 1996. Urban areas, in particular, have seen a 31% reduction in 33 top-risk HAPs. Most progress comes from improvements in major stationary sources and on-road mobile sources. Based on the 1999 emission inventory, the 1999 National Air Toxics Assessment (NATA, http://www.epa.gov/ttn/atw/nata1999/nsata99.html) study found that benzene is the greatest driver for cancer risk nationwide. The average excess cancer risk from air toxics for all counties is 48-in-a-million and most urban areas exceed 25-in-a-million. In most urban areas, however, the cancer risk is greater than 25-in-a-million. For non-cancer risk using the hazard index for respiratory effects, the county level average is 6.4 and over 40% of counties have an index greater than 1. The majority of non-cancer risks is attributable to acrolein.

Monitoring air toxics provides ground truths to validate or refute modeling results. The NATA results tend to give good estimates for VOCs but underestimates for metals. This could be due to the metals inventory not being as complete or metals being more difficult to model than VOCs. Air toxics monitoring data show benzene-ambient concentrations decreased continuously between 1994 and 2000, but a mixed picture for metals. Monitoring data can also be used to characterize population exposure.

Nationally, the National Air Toxics Trends Site Network (NATTS) was started in 2002. The network consists of 22 sites, including 3 in Region 5. There are federally funded local-scale monitoring projects for roadway exposure assessment. In addition, there are many state, local, and private monitoring programs that have been around for many years without federal funding.

In summary, despite the many programs that exist for reducing MSATs, mobile sources are still important to public health. Overall mobile sources are large contributors to ozone, $PM_{2.5}$, and benzene. At the local scale there is evidence of adverse health effects from near-roadway exposure. The EPA has research under way, including near-roadway epidemiology studies, monitoring and modeling of pollutant gradients, and characterization of infiltration of pollutants to schools.

Introduction and Background on Mobile Source Air Toxics

Michael Claggett and Jeff Houk, Federal Highway Administration Resource Center

In this session, Dr. Michael Claggett and Jeff Houk of FHWA provided some background information on MSATs, including a description of these pollutants and some discussion of how they became an issue for highway projects, leading to FHWA's issuance of the February 2006 guidance memo.

Overview of MSATs

Mobile source air toxics (MSATs) are a subset of the 188 hazardous air pollutants or air toxics defined by the Clean Air Act. MSAT compounds are emitted by highway vehicles and non-road equipment. Some toxic compounds are present in fuels and are emitted when the fuel evaporates. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products.

In its 2001 MSAT rule, EPA identified 21 mobile source air toxics, and a subset of six MSATs which are believed to represent the bulk of the adverse health effects associated with these pollutants. FHWA refers to these as the six priority MSATs, and they are:

- Acetaldehyde
- Acrolein
- Benzene
- 1,3-Butadiene
- Diesel Particulate Matter
- Formaldehyde

MSATs have carcinogenic and non-carcinogenic health effects. All five of the priority MSATs are considered known or suspected human carcinogens with the exception of acrolein. In the 2006 update to the National Air Toxics Assessment, EPA provided a revised list of MSATs that contribute the most to adverse health effects; this list no longer includes acetaldehyde but includes naphthalene and polycyclic organic matter.

Recent developments in the field of air toxics

In the late 1990s and early 2000s, a number of developments in the field of air toxics led to increasing interest in examining the impact of proposed new highway projects on air toxics emissions and human health. The convergence of these developments led to a marked increase in the number of requests received by the Federal Highway Administration (FHWA) to perform MSAT analysis as part of the National Environmental Policy Act (NEPA) process (e.g., as part of the preparation of a draft or final environmental impact statement [EIS] or environmental assessment [EA]). These developments included:

MATES-II: In 2000, the second Multiple Air Toxics Exposure Study (MATES-II) report in California was published. This was a detailed regional air toxics assessment for the greater Los Angeles area, conducted by the South Coast Air Quality Management District. This study involved development of emissions inventories and dispersion modeling; it also included an air quality monitoring component. The study concluded that 90% of the air toxics cancer risk in the Los Angeles area was due to mobile source emissions, and that 70% was attributable specifically to diesel particulate emissions. Of this, approximately half was due to non-road sources (e.g., ports, construction, locomotives, agriculture) and half to on-road mobile sources (cars, trucks, and buses). Overall, the cancer risk from on-road mobile sources was estimated to be approximately 760 cases of cancer per million people.

NATA: In 2000, the U.S. Environmental Protection Agency (EPA) released the results of the National Air Toxics Assessment (NATA). This nationwide evaluation of air toxics risk was based on a 1996 air toxics emissions inventory, nationwide dispersion modeling, and an estimate of air toxics cancer and non-cancer risks for each county in the United States, excluding Alaska and Hawaii. The NATA found that all counties could have a risk of greater than 10^{-5} (10 cases of cancer per million people), and many areas were estimated to have higher risk. (EPA recently released an updated NATA based on 2002 emissions data and other improvements. This updated study found that most urban locations have a lifetime air toxics cancer risk of 25 in a million, and in transportation corridors, 50 in a million.) These cancer risks do not include estimated risk from exposure to diesel particulate matter, as EPA has not developed a formal risk estimate for that pollutant.

MSAT Rules: In 2001, EPA released the Mobile Source Air Toxics rule. The Clean Air Act Amendments of 1990 required EPA to evaluate MSAT impacts from mobile sources and promulgate controls as necessary to reduce risk. The air toxics rule relied on existing mobile source and fuel controls, including the reformulated gasoline program, the light-duty and heavy-duty vehicle emissions control programs, and the gasoline and diesel fuel sulfur control programs. It also established an anti-backsliding requirement regulating the toxics content of gasoline. It was in this rulemaking that EPA first identified the 21 MSATs and the 6 priority MSATs. EPA's MSAT rule was challenged in court, and on February 28, 2006, EPA proposed a strengthened rule which would set new benzene standards for gasoline, cold-temperature hydrocarbon emissions standards for passenger vehicles, and evaporative standards for vehicles and portable fuel containers.

Roadside Health Studies: Many studies have been published in recent years that report associations between proximity to roadways, and an increased incidence of adverse health effects. These types of studies have been performed in several countries, and investigate the frequency of various health impacts, including cancer, asthma, and heart disease. While many of these studies have limitations, most of them have identified associations between proximity to a roadway and an increased incidence of some adverse effect. The Sierra Club, EPA, and Johns Hopkins have published a summary of some of these studies, and FHWA currently has an effort under way to catalog and summarize them as well. These studies have generated news reports and are frequently cited in comment letters to FHWA on proposed highway projects.

MOBILE6.2: In 2002, EPA issued MOBILE6.2, an update to the MOBILE6 emissions model,. This version of the model made it relatively straightforward to analyze MSAT emissions from mobile sources compared to previously available EPA tools. Once this new model became available, various agencies began to use it to assess various regional and localized transportation scenarios, and FHWA began to receive requests to use it to analyze proposed roadway projects for MSAT emissions impacts.

The result of all these developments is that FHWA and state departments of transportation (DOT) have received an ever-increasing number of requests to perform MSAT analysis as part of the NEPA process. This led to FHWA's issuance of the interim guidance.

MSAT emission rates have been declining and are expected to decline in the future as a result of national vehicle and fuel control programs. FHWA closed out the introduction by presenting national trends in MSAT emissions between 2000 and 2020.

Federal Highway Administration's Interim MSAT Guidance

Jeff Houk, Federal Highway Administration Resource Center

On February 3, 2006, FHWA issued its Interim Guidance on Air Toxics Analysis in NEPA documents. This guidance document is built around two principles: conduct analysis of projects that are located in areas where they might affect human health, and match the level of analysis to the scope of the project. FHWA developed this guidance through coordination with its field offices, state DOT stakeholders, and EPA.

The guidance focuses on projects located where they may affect human populations, e.g., in urban areas, or in locations in rural areas near sensitive receptors (i.e., schools, hospitals, or nursing homes). The guidance establishes three tiers of projects in order to determine what level of analysis is needed. For very small projects with no meaningful air quality impacts, e.g., projects that are exempt from transportation conformity, no MSAT analysis would be required. For large projects, an emissions analysis using the EPA MOBILE6.2 model is recommended. For projects that do not fit in either of these categories, a qualitative analysis is recommended.

The quantitative analysis recommended for large projects is an emissions burden analysis (i.e., an emissions inventory analysis). The analysis would reflect current (baseline) conditions, the future No Action alternative, and the future Build alternative(s). This framework for analysis accomplishes two objectives—to show how future emissions levels will compare with emissions levels experienced in the project vicinity today, and to show how emissions levels may change as a result of the alternative selected for the project. While the guidance recommends quantitative analysis only for large projects, this level of analysis is not precluded for smaller projects if there is sufficient community interest.

The guidance does not establish any specific methodology for conducting these types of analyses. FHWA staff are available to provide guidance and technical assistance. FHWA has also developed a training workshop which includes suggestions for conducting this type of analysis and a class exercise for analyzing a hypothetical project.

For purposes of this interim guidance, FHWA based its definition of a "large" project on the definition of a major stationary source of hazardous air pollutants (HAPs) in Section 112 of the Clean Air Act. Section 112 defines a major source of HAPs as one that emits 10 tons per year of any individual HAP, or 25 tons per year of all HAPs combined. FHWA conducted some limited analysis of roadway projects and reviewed analyses that had been conducted for other projects to determine how "large" a project might be before the total emissions in the project area would exceed these thresholds. As one example, a roadway widening project 10 miles long, accommodating 140,000 vehicles per day, would just exceed the 25-ton threshold. These modeled emissions levels assume an opening day of 2010, which is a reasonable assumption for the completion of a project that is undergoing NEPA analysis at the present time. FHWA's guidance applies this traffic volume threshold to the design year of the project, which is typically 2025 or 2030 for projects currently under analysis; since per-vehicle emissions decline precipitously between 2010 and 2025/2030, this approach is viewed as conservative.

A qualitative analysis is recommended for smaller projects. Similar to the qualitative analyses that have been conducted under the transportation conformity rule, a qualitative MSAT analysis is a discussion of project-specific factors that could affect MSAT emissions and exposure. These factors could include additional travel lanes, changes in traffic volumes, changes in truck or bus traffic volumes, changes in travel speeds, changes in distance to nearby receptors, and new development associated with the project. Many recent project NEPA documents have included some level of qualitative discussion, and the guidance provides examples for a few different types of projects. The example language in the guidance needs to be specifically tailored to the project in question.

Since air toxics are an emerging issue, and there are significant uncertainties involved, the guidance requires an assessment under Section 1502.22 of the Council on Environmental Quality NEPA regulations. Section 1502.22 addresses instances where the assessment of an environmental impact is hindered by missing or incomplete information. In cases like these, the NEPA regulations require that the environmental document include: 1) a statement that information is missing or incomplete; 2) a statement of the relevance of this information; 3) a summary of the existing credible scientific information; and 4) in the face of this missing or incomplete information, FHWA's assessment of the likely environmental impacts. The interim guidance includes an example discussion to meet the requirements of 1502.22.

Finally, the guidance discusses mitigation. A number of mitigation options have become available in recent years, particularly for mitigating emissions from construction activity. An appendix to the guidance document addresses what types of mitigation measures are available for MSATs and when they might be applied.

Project-Level Methodologies: FHWA White Paper and Examples of Real-World Analyses

Michael Claggett and Jeff Houk, Federal Highway Administration Resource Center

Even before the FHWA interim guidance was issued, quantitative and qualitative MSAT analyses had been conducted for several projects around the country. In this session, Dr. Claggett presented the results of a "white paper" analysis of a hypothetical highway widening project, and Jeff Houk presented examples of MSAT analysis in four recent NEPA documents.

FHWA White Paper

This presentation provided the results of an analysis of air toxic emissions due to mobile sources for a hypothetical transportation project designed to mitigate traffic congestion. The example project involves the expansion of an existing urban freeway, plus upgraded arterial/collectors and freeway ramps to improve vehicular access. It is assumed that the freeway corridor extends 10 miles and that arterials cross the freeway every 2 miles with freeway/arterial access provided by freeway ramps. A No-Action Alternative was evaluated for the calendar year 2005 (present); the No-Action and two Build alternatives were evaluated for calendar years 2010 (estimated time of completion) and 2030 (design year). The following notation/description is used in referring to the alternatives:

- 6-lane No-Action Alternative-- no upgrades to the existing 6-lane freeway and 4-lane crossing arterials;
- 6- to 8-lane Build Alternative -- upgrade the existing 6-lane freeway and 4-lane crossing arterials by adding 2 travel lanes; and
- 6- to 10-lane Build Alternative-- upgrade the existing 6-lane freeway by adding 4 travel lanes and upgrade the 4-lane crossing arterials by adding 2 travel lanes.

When evaluating the future options for upgrading a transportation corridor, the major mitigating factor in reducing mobile source air toxic emissions is the implementation of EPA's new motor vehicle emission control standards. Substantial decreases in MSAT emissions will be realized from a current base-year through an estimated time of completion for a planned upgrading project and its design year some 25 years in the future. Even accounting for anticipated increases in vehicle-miles of travel and varying degrees of efficiency of vehicle operation, total MSAT emissions were predicted to decline more than 56% from 2005 to 2030. While benzene emissions were predicted to decline more than 41%, emissions of diesel particulate matter were predicted to decline more than twice this rate (i.e., 88%). On a toxicity-weighted basis, the effective decrease in total MSAT emissions is 81% from current to design year levels.

The ability to discern remarkable differences in MSAT emissions among transportation alternatives is difficult given the uncertainties associated forecasting travel activity and air emissions 25 years or more into the future. In this hypothetical congestion-mitigation project, differences in MSAT emissions between the Build and No-Action Alternates ranged from 2 to 6%. While factors such as ambient temperature, implementation of an inspection maintenance program, and use of reformulated gasoline, can affect the magnitude of MSAT emissions specific to a locale, these factors would be common to all project alternatives under review.

The most important factors affecting emission differences among the available options are vehicle-miles of travel and levels of traffic congestion. When evaluating transportation network alternatives operating significantly under-capacity, the difference in vehicle-miles of travel is more important than the difference in congested vehicle speeds. The excess capacity would accommodate an increase in traffic volumes without adversely affecting travel speeds and related MOBILE6.2 emission factors. At the other extreme, where one transportation network alternative is operating significantly over its capacity, then the difference in congested vehicle speeds may be more influential than the difference in vehicle-miles of travel. MOBILE6.2 emission factors are very sensitive to vehicle speeds in the slow, congested speed range. Mitigating this congestion may have more of an effect on reducing emissions than the offset due to a potential increase in vehicle-miles of travel. For transportation network alternatives operating slightly under- or over-capacity, differences in vehicle-miles of travel and differences in congested speeds are equally significant. The level of detail required in formulating vehicle activity data is greater for congestion-mitigation projects. Factors that may mitigate or adversely affect congestion need to be accounted for and it is preferable to represent congestion by an hour-by-hour variation in traffic speeds versus an average for the day.

The approach used in this analysis could be applied for project-level analysis of proposed projects in the National Environmental Policy Act (NEPA) process, or for other purposes. However, the analysis needs to be tailored to reflect local conditions.

The geographic area of analysis should reflect, at a minimum, all roadways where traffic volumes are affected by the proposed project. The affected transportation network can be defined as those links where the annual average daily traffic (AADT) is expected to change by more than ±5% as a result of a project. This analysis is based on assumptions regarding traffic volumes and volume-to-capacity ratios. An actual analysis would use volumes and capacity information specific to the project. Rather than using arbitrary growth rates, future volumes should be projected using a travel demand model or other technique normally used to forecast future travel in the area. Speeds from the travel demand model can also be used, but they should be post-processed using the Texas Transportation Institute (TTI) methodology, Bureau of Public Roads (BPR) formula, or other methodology. An enhancement would be to account for the effects of lower levels of weekend travel.

This analysis is based largely on national defaults in the MOBILE6.2 model. An actual analysis would use MOBILE inputs that are appropriate to the area. To a large extent, these inputs should be consistent with those used for other modeling purposes in the area (e.g., State Implementation Plan inventories, conformity analyses). However, given the limitations of the accuracy of the MOBILE6.2 model, use of annual average inputs is probably appropriate for most analyses. Also, rather than modeling each individual speed calculated for project links, it may be more expedient to generate a speed look-up table, in 5 mph increments, and select emissions rates by rounding to the closest modeled speed. Also note previous comments regarding use of hourly speeds versus daily average speeds. In many cases, daily average speeds would be appropriate.

Next, FHWA provided some examples of how an MSAT analysis was documented in NEPA for four real-world projects. FHWA pointed out that these NEPA documents were all completed before the interim guidance was issued, so they should not be used as an example of how to implement the guidance, but as examples of analysis techniques used and the level of detail that documents can contain.

Interstate 5 Widening Project, Portland, Oregon

This project involves a one-mile widening project to eliminate a 2-lane bottleneck on an existing 3-lane section of Interstate 5. Quantitative emissions analysis would not normally be considered appropriate for a project this small. However, the nature of the project warranted some special attention. Currently, the lane restriction results in rush-hour traffic backups that are largely confined to an industrial area north of the city. However, once the bottleneck is eliminated, there is some concern that new backups will emerge farther downstream, in a residential neighborhood closer to downtown Portland. In addition, the Oregon Department of Environmental Quality recently completed the Portland Air Toxics Assessment (PATA), a localized version of EPA's NATA, and there was existing community awareness and concern about MSATs. Thus, a quantitative analysis was conducted.

Oregon DOT conducted the analysis at several analysis scales: an eight-mile study area including I-5 and one mile on either side; the I-5 mainline only; and sub-areas within these two boundaries. Analysis years were 2003 (for existing conditions) and 2025 (the project design year). Rather than assessing all six of the priority MSATs, the analysis covered the three pollutants examined in the PATA: benzene, 1,3-butadiene, and diesel particulate matter. The results were similar to the other MSAT assessments; emissions declined over time, and there was little difference between the alternatives relative to base year emissions.

Detroit Intermodal Freight Terminal Project, Michigan

This project involves the expansion of intermodal freight terminals in southeast Michigan to serve the increasing volume of truck and rail freight in the area. The analysis used a 2004 base year and 2025 design year, and four alternatives were examined. Because of the nature of the project, the emissions analysis included not only vehicle traffic, but also locomotives and the non-road equipment that is used to move shipping containers between trucks and rail cars. The NEPA study included analysis of the activity at the intermodal terminals themselves; analysis of existing emissions-producing activities that would be displaced if the yards were expanded; analysis of emissions on roadways serving the facilities; and analysis of the benefits of shifting freight from trucks to rail. In addition to the six priority MSATs, the analysis covered criteria pollutants and their precursors.

This analysis found large declines in MSAT emissions between the 2004 base year and the 2025 design year, regardless of the alternative chosen. The decline in total MSAT emissions from 2004 to 2025 No Action was 75%; the maximum difference between 2025 Action alternatives in 2025 was 3.7%. Also, the analysis team found that the non-road sources were the largest single source, representing almost 80% of the total MSAT emissions, and that controls on that source also contributed significantly to the emissions reductions between 2004 and 2025.

US36 Project, Denver

This project involves adding significant additional capacity to the US36 corridor between Denver and Boulder, Colorado. The capacity additions include additional general purpose lanes, bus rapid transit in the median, and commuter rail. The project study area included the entire corridor plus all roadways within a three-mile radius. The emissions analysis was performed for both the study area and the entire Denver metro area. The interesting finding from this analysis was that while emissions increased due to the build alternatives in the study area, they decreased in the metro area as a whole. This is because the project provides so much additional capacity that it diverts trips that are currently occurring outside of the study area. Even though emissions increase in the build alternatives, there is still a large decline between the base year and design year. Unfortunately, this analysis used the same emission factors for all alternatives, so it is essentially a VMT analysis and not a true emissions analysis.

Inter-county Connector Project, Maryland

This was the most recent example provided and the one that comes closest to FHWA’s recommended analysis techniques. The ICC is a new “outer beltway” that connects I-270 and I-95 north of the Washington D.C. metropolitan area. The project corridor is approximately 22 miles long. For this analysis, an affected transportation network was identified that included 193 roadway links. Analysis years included base year, opening day, and the design year. Hourly speeds were calculated; annual average MSAT emission rates were calculated by running MOBILE6.2 for summer and winter conditions and averaging the results. This analysis found a large decrease in MSAT emissions between the base year and design year, and a small difference in emissions between no-build and the build alternatives. A notice of intent has been filed to challenge the approval of this project, but MSATs have not yet been raised as an issue.

Use of MOBILE6.2 in MSAT Analysis

Michael Claggett, Federal Highway Administration Resource Center

FHWA does not plan to issue formal technical guidance for MSAT analysis at the present time. The field is simply too new to define a standard or best practice, and ongoing research will provide better technical tools to support future analyses. Also, the level of analysis to be conducted will depend on the availability of traffic information and emissions modeling expertise. This presentation describes FHWA's recommended technical approach, including traffic analysis and use of the MOBILE6.2 model.

In order to best capture the MSAT emissions effects of project alternatives, it is advised that analysts define an affected transportation network. This would include the links directly affected by the project, as well as other links where traffic volumes change as a result of the project alternatives. For large projects, a volume change threshold may need to be identified in order to keep the number of links analyzed manageable. One suggested threshold is a plus or minus 5% change in volumes. Interagency consultation partners may conclude that higher or lower thresholds are appropriate; the key is that these thresholds be applied consistently for all analysis years and project alternatives.

FHWA is not suggesting that areas must develop a separate new traffic analysis methodology strictly for MSAT analysis. Areas will generally need to work with the information they have already developed for other purposes. For very large corridor projects, it may be easier to simply run the regional travel model than to identify a project network.

Accurate vehicle speeds are an important component for analysis of the VOC-based MSATs, and they may become important for analysis of particulate matter as well. VOC-based MSAT emissions decline throughout the entire MOBILE6.2 speed range, with the largest decline occurring between 2.5 and 25 miles per hour. Because of the higher sensitivity of MOBILE6.2 in this low speed range, it is particularly important to capture accurate speeds during congested conditions (e.g., morning and afternoon peak periods). FHWA's white paper showed that for a hypothetical freeway expansion project, the difference between using hourly and daily-average speeds was greater than the emissions difference between the Build and No-Action alternatives. Even if daily roadway volumes are the only piece of information available, there are simple methodologies that can be used in a spreadsheet environment to calculate hourly volumes and speeds for a MOBILE6.2 emissions analysis.

Analysts should give some consideration to refining the MOBILE6.2 analysis to include only emissions associated with roadway operation. MOBILE6.2 calculates emissions in eight separate categories: start exhaust, running exhaust, running loss, hot soak, diurnal soak, crankcase, resting loss, and refueling. Only the running exhaust and running loss emissions are directly associated with roadway operation. Start exhaust emissions are typically not a factor once vehicles are operating on a roadway large enough to be considered in the NEPA process, and EPA recommends not including start emissions in project-level analysis. Hot soak and diurnal soak emissions are associated with parked cars and by definition do not occur on roadways; likewise, refueling emissions occur at gas stations, not on roadways. Finally, the vast majority of crankcase and resting loss emissions are also attributable to parked cars (these emissions occur continuously, but most vehicles spend the majority of their day parked). Thus, most analyses that are focused strictly on project-level emissions should only consider running exhaust and running loss emissions. (A simple way to partially accomplish this is through use of the MOBILE6.2 STARTS PER DAY command with an external data file listing zero starts per day for all vehicle types; this will eliminate start, hot soak, and diurnal soak emissions from the reported emission rates.) If desired, rather than disregarding these other emissions sources entirely, they can also be included as "off-network" emissions that in most cases will not change as a result of the project alternatives.

FHWA followed this introduction with a comprehensive overview of the necessary MOBILE6.2 inputs and commands for conducting an MSAT analysis. In some cases national default inputs are appropriate, but FHWA highlighted areas where local data should be used. FHWA also presented information on the sensitivity of MOBILE6.2 to various inputs that affect MSAT analysis.

Uncertainties in MSAT Analysis

Jeff Houk, Federal Highway Administration Resource Center

This session covered uncertainties in MSAT analysis. Uncertainties are important in two contexts. First, there are uncertainties associated with the emissions analysis that FHWA recommends should be performed for large projects. Second, some have suggested that more advanced analysis techniques, such as dispersion modeling or a public health risk assessment, are appropriate for roadway projects. FHWA's view is that the limitations and inherent uncertainties in the available tools preclude advanced analysis that would be meaningful in evaluating project alternatives for decision-making purposes.

One area of concern is the MOBILE6.2 model itself. Accurate MOBILE6.2 emission rates are essential for conducting mobile source dispersion modeling at the project level. Since MOBILE6.2 was developed and designed to predict emissions at a regional level, it has limited applicability at the project level. MOBILE6.2 is a trip-based model – emission factors are projected based on a typical trip of 7.5 miles, and on average speeds for this typical trip. This means that 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 limitation, MOBILE6.2 can only approximate the operating speeds and levels of congestion likely to be present on the largest-scale projects, and cannot adequately capture emissions effects of smaller projects. For diesel particulate matter, the model results are not sensitive to average trip speed, although the other MSAT emission rates do change with changes in trip speed. Another deficiency in MOBILE6.2 is that it is not a true forecasting model. It does not account for future changes in technologies that are likely to occur over the timeline of a public health assessment with respect to motor vehicles, fuels, emission controls, and/or environmental regulations. There are also uncertainties associated with the travel data (volumes and speeds) that are used in the emissions calculation process.

These deficiencies compromise the capability of MOBILE6.2 to estimate future MSAT emissions. MOBILE6.2 is an adequate tool for projecting near-term emissions trends, and for performing relative analyses between alternatives for very large projects, but it is not sensitive enough to capture the effects of travel changes tied to smaller projects or to predict emissions near specific roadside locations. Thus, MOBILE6.2 is best suited for relative emissions analysis comparing roadway alternatives, and only for the larger projects that by their nature incorporate a wide range of travel activity (e.g., the projects themselves represent an average speed similar to the way MOBILE6.2 is constructed). However, MOBILE6.2 is not appropriate for microscale MSAT analysis. The EPA's next generation mobile source emission factor model, MOVES, may have such capabilities, perhaps making it a better tool for project-level MSAT emissions analysis.

Another area of concern is the ability to accurately predict ambient MSAT concentrations near highway projects. There have been a number of studies examining the accuracy of air dispersion models by comparing model predictions to measured concentrations. The studies documented by the EPA in their Guideline on Air Quality Models provide these common conclusions: "(1) models are more reliable for estimating longer time-averaged concentrations than for estimating short-term concentrations at specific locations; and (2) the models are reasonably reliable in estimating the magnitude of highest concentrations occurring sometime, somewhere within an area." EPA notes that errors in the highest estimated concentrations of plus or minus 10 to 40% are typical and "estimates of concentrations that occur at a specific time and site are poorly correlated with actually observed concentrations and are much less reliable". The ability to predict concentrations for a specific location at a specific time is not as much of a concern when applying air dispersion models to determine compliance with the NAAQS, such as CO hotspot modeling. Reliably predicting the magnitude of the highest concentrations that occur sometime, somewhere within an area is sufficient for demonstrating compliance with the NAAQS. However, the models do not perform as well for calculating concentrations at a specific time and place, such as a school playground, which would be necessary for MSAT analysis. FHWA presented data from an NCHRP study demonstrating the models perform much worse in this application than they do in simply estimating the highest concentration occurring somewhere, sometime within an area. FHWA also noted that for situations where a project moves traffic closer to receptors, the decline in emissions rates is at least as important a factor as the distance to receptors.

FHWA has also been asked to perform health risk assessment for some projects. In addition to emissions and dispersion modeling, this would also require exposure adjustments and risk calculation. FHWA presented some exposure information, noting that roadside concentrations do not equate to personal exposure. Daily mobility, time spent traveling on roads, and indoor air concentrations also affect exposure.

FHWA feels that there are several issues that preclude accurate risk assessment. Risk assessments cover a 70-year lifetime exposure; MOBILE6.2 is not capable of producing accurate emissions estimates for 70 years into the future, nor is it possible to generate meaningful traffic information that far in the future. Thus, highway analysis is different from other situations where risk assessment has been performed (e.g., Superfund sites, stationary sources). Also, EPA has not released a risk estimate for diesel particulate matter, meaning that FHWA could not perform risk assessment for this pollutant anyway.

FHWA posed two questions regarding the use of advanced analysis techniques. First, are the available tools precise enough to provide meaningful results, given the small change in emissions associated with most projects? Second, is it necessary—are the existing emissions analyses identifying problems that we need advanced analysis to better understand? FHWA's answer to both of these questions was no. FHWA compared the uncertainties associated with advanced analysis tools to the emissions differences resulting from projects to show that the uncertainties are much larger than the differences in emissions resulting from projects. FHWA also showed that the decline in emissions over time was much larger than the build/no-build emissions differences, suggesting that health impacts would likely improve in the vicinity of projects, making advanced analysis less necessary. FHWA did point out that there are some projects where these conclusions might not be true, such as an entirely new roadway impacting populations that previously had low exposure, and that they were working with EPA to continue to evaluate and improve these advanced techniques.

For these reasons, FHWA does not support dispersion modeling or other more advanced analysis for MSATs in NEPA documents at the present time. MSAT dispersion modeling and risk assessment for roadway projects currently involve so many uncertainties and missing pieces of information that the results would not be useful in the decision-making process. This is interim guidance, and FHWA plans to revisit these guidance recommendations when some of these outstanding issues are resolved.

O'Hare Airport Air Toxic Monitoring Study

Terry Sweitzer, Illinois Environmental Protection Agency Bureau of Air

Executive Summary

(Full report can be found online at www.epa.state.il.us/air/ohare/index.html)

O'Hare International Airport (O'Hare) is one of the world's busiest airports and the subject of much interest regarding the environmental impact airport operations have on the surrounding community and the Chicago area in general. As part of its fiscal year 2001 air monitoring program, the Illinois EPA measured the airborne levels of various air contaminants in the vicinity of O'Hare as well as at other locations in the Chicago area. The purpose of this measurement program was to collect information that would help assess the relative impact of airport related emissions and levels of airborne contaminants characteristic of large urban areas. This monitoring program will supplement a national program designed to assess and minimize the impact of toxic air contaminants in urban areas. The national program is referred to as the National Integrated Urban Air Toxics Strategy (National Strategy).

The National Strategy was developed by the United States Environmental Protection Agency (US EPA) in response to requirements specified in the federal Clean Air Act. Under these requirements, US EPA is charged with assessing the impact of airborne levels of various air toxic compounds on human health in urban areas of the United States and taking action to reduce risks caused by unacceptable levels of such contaminants. In July 1999, the US EPA released its National Strategy describing a framework for addressing air toxic emissions from stationary and mobile sources such as O'Hare Airport. As part of the National Strategy, air monitoring programs are to be used to identify and measure compounds believed to present the greatest concern to public health in urban areas.

Federal and State funding was provided to allow the initiation of an urban air toxic monitoring program in calendar year 2000. The funding was adequate to support a limited air quality investigation of targeted compounds through a six-month monitoring program with two sites located near O'Hare Airport and three other sites in the Chicago metropolitan area. The monitoring program began in June 2000 and focused on the urban air toxic compounds identified in US EPA's National Strategy and on mobile source emissions associated with airport operations. The compounds sampled included volatile organics, semi-volatile organics, carbonyls, and trace metals. The monitoring program ended in December 2000.

The Chicago area toxics monitoring program, as deployed in 2000, was designed to provide data to meet four objectives:

1) Measure the concentrations of specific compounds of concern;

2) Assess the geographic variability of various compounds in the Chicago area and perform a comparison of levels measured at the two O'Hare sites to those recorded at the remaining three Chicago area locations;
3) Compare Chicago area results to data collected for other large U.S. cities; and
4) Determine if the emissions associated with O'Hare Airport have a measurable impact on air quality in areas adjacent to the airport.

In order to measure the concentrations of the target compounds, comprehensive sampling was conducted on 16 days through the 6-month period of June through December 2000, using a once every12 days sampling schedule. The sampling results were summarized for each of the five monitoring sites and tabulated into two categories, Urban Air Toxic compounds and Hazardous Air Pollutants (HAPs). The Urban Air Toxics compounds are those identified by US EPA in the National Strategy that present the greatest threat to public health in urban areas, including known or suspected cancer risks from compounds such as benzene, formaldehyde, chromium, and dioxins. The HAPs are compounds required to be regulated by US EPA under the Clean Air Amendments of 1990 that are known or suspected to cause cancer or have other serious health effects but are not included in the list of Urban Air Toxic compounds covered under the National Strategy. The HAPs measured included such compounds as ethyl benzene, styrene, toluene, xylenes and various polycyclic aromatics such as naphthalene and phenanthrene. The tabulated data included the individual daily sampling results along with the overall average concentration found for each target compound.

The program's sampling sites were located to provide air toxic measurements at different points across the Chicago metropolitan area, thereby allowing for a comparison of the levels found at O'Hare Airport to those found in different parts of the metropolitan area. In addition to the two sites located near O'Hare in Bensenville and Schiller Park, sites were also located in Northbrook, just north of the urban core, at Washington School in highly industrialized Southeast Chicago, and in Lemont, just downwind of major refineries and chemical complexes and on the southwestern edge of the metropolitan area.

A review and analysis of the accumulated monitoring results obtained from the five site monitoring network provided the following findings:

1. The average concentrations measured at O'Hare Airport for many of the target compounds were found to be comparable with the concentrations found at the other Chicago area sites;
2. The highest concentrations of several target urban air toxic compounds were found to be spread between several sites but generally the highest levels for many of the air toxics were found to occur in Southeast Chicago;
3. The lowest concentrations of most target compounds were measured at Lemont.

A comparison of measured levels of urban air toxics in Chicago to those found in other large cities served as a point of reference to what would be considered "typical urban" concentrations. The US EPA's Aerometric Storage and Retrieval System (AIRS) was accessed to obtain the air quality data collected from monitoring sites nationwide. A review of information submitted to AIRS found that data for certain air toxic compounds had been reported for a number of large urbanized areas. Based upon a comparison of the results from the Chicago area monitoring program to that of data collected for other large U.S. cities, it was found that:

1. Concentrations of several of the principal urban air toxics, such as acetaldehyde, benzene, and formaldehyde, compared to the metropolitan areas of Atlanta, Detroit, Houston and Milwaukee, were found to be comparable or lower in the Chicago metropolitan area.
2. The acetaldehyde and formaldehyde levels measured near O'Hare Airport were comparable or lower than levels measured in Atlanta, Detroit, and Houston.

In order to assess the possible impact of emissions from O'Hare Airport on adjacent areas, two monitoring sites were deployed on different sides of the airport. This configuration allowed for the collection of sampling data on wind-persistent days that would align one site to be upwind, unaffected by the airport, and the other to be downwind and subject to airport emissions. The difference in concentrations found between the two sites on those wind-persistent days allowed for an approximation of the airport's impact. Of the 16 sampling days, 5 days had such wind-persistent conditions. An analysis of the results from those 5 days found the downwind site to record levels of some target compounds from 20 to 85% higher than the upwind site. The compounds with measurable differences included acetaldehyde, benzene, formaldehyde, polycyclic organics, toluene, and lead. All of those compounds have been associated with emissions from airport operations. An impact from the airport was not unexpected since airport operations are sources of various air contaminants. The concentrations measured downwind of O'Hare were at levels considered to be "typical" of an urban area and in some cases lower than values measured in other cities.

Based upon the review of the air toxics monitoring data collected near O'Hare Airport, from other Chicago area sites, and from US EPA's AIRS database, the following conclusions were reached:

1. The levels of air toxic compounds found near O'Hare and other sites in the Chicago metropolitan area were comparable or lower than those found in other large U.S. cities.
2. The highest levels of most air toxic compounds measured in the Chicago area were found in Southeast Chicago.
3. An analysis of data collected from the sites at O'Hare found that emissions from the Airport have an impact on the air quality in adjacent communities, but that impact did not result in levels higher than those found in a typical urban environment.

The data collected through this study's air monitoring program indicated that the toxics air quality in the vicinity of O'Hare Airport is comparable to the air quality in other parts of Chicago and comparable to the air quality in other major urban areas. There are continuing and ongoing efforts, such as through US EPA's National Strategy, to identify, assess, and reduce risk from air toxics in and around urban areas.

Dan Ryan Air Quality Monitoring Project

Walt Zyznieuski, Illinois Department of Transportation

The Illinois Department of Transportation completed a Phase I study in 2004 for the reconstruction on the Dan Ryan Expressway between 31st Street and I-57/Halsted Street and I-94/Martin Luther King Drive in the City of Chicago. The proposed project is nine miles in length and includes the following improvements:

- New pavement and pavement resurfacing
- Added travel lanes
- New retaining walls
- New bridges, bridge widening, and bridge replacement
- Traffic safety barriers
- Upgrade of substandard ramp geometry and vehicle weaving distances, including added auxiliary lanes
- Consolidation and/or relocation of expressway access (removing and adding ramps) as necessary
- Upgrading the Chicago Skyway interchange
- Traffic signal modernization
- Roadway lighting, drainage improvements, accident investigation sites, and landscaping with aesthetic treatments

The proposed improvement serves the needs of traffic safety and mobility as well as addressing substandard ramp geometry, facility degradation, and roadway drainage deficiencies. The project is being constructed within the existing expressway right-of-way and requires minimal amounts of property acquisition. There will be no residential, industrial, manufacturing, or commercial relocations or displacements.

An Environmental Assessment was completed for the proposed improvement. A public hearing was conducted in April 2004, and a Finding of No Significant Impact (FONSI) was issued by the Federal Highway Administration in June 2004.

The project was partially located in an area that was designated as non-attainment for particulate matter (PM_{10}). In addition, since the FONSI was signed, the entire six-county Chicago Metropolitan Area was designated as a non-attainment area for $PM_{2.5}$.

During the public involvement process, the community voiced concerns on various air quality issues. As a result, the Department committed to pursuing various mitigation strategies to address construction-related air quality concerns. Specific strategies included requiring detailed dust control plans, the reduction of idling times, a prohibition of using “off-road” diesel fuel, the requirement to retrofit equipment with emission control devices and use cleaner burning “on-road” diesel fuel, or use Ultra Low Sulfur

Diesel Fuel. These strategies were identified in a construction Special Provision that was developed for the project.

In addition, IDOT committed to develop and implement a program to monitor air quality in and around the Dan Ryan project.

The Department, in conjunction with its consultant, Environmental Design International, Inc., prepared a work plan that identified air monitoring parameters, identified sensitive receptors (i.e, schools, hospitals, parks) within one mile of the Dan Ryan Construction area, and identified suitable monitoring locations. The Department and EDI also worked closely with the Illinois Environmental Protection Agency (IEPA) on monitoring specifics, including air monitoring parameters, suggested air monitoring action levels, air monitoring intervals, and placement of monitors along the Dan Ryan and in the community.

The Department also formed a Health and Environmental Focus Group, consisting of professionals in the field of air quality from the Department, EDI, IEPA, Illinois Department of Public Health, doctors, educators, and scientists. Input provided from this group helped the Department develop and refine its air monitoring strategy.

The following pollutants are being monitored along the Dan Ryan reconstruction project:

- Total Nuisance Dust
- Respirable Silica
- PM_{10}
- $PM_{2.5}$
- Lead
- Asbestos[1]
- Diesel Components (Polynuclear Aromatic Hydrocarbons)

Two real-time PM Tapered Element Oscillating Microbalance (TEOM) monitors are located on either side of the Dan Ryan Expressway. These monitors provide the mass concentration of ambient PM in real time. If elevated PM readings are detected throughout the day, EDI informs IDOT construction staff of the situation so that appropriate mitigation strategies can be implemented or increased (i.e., street sweeping, watering).

Baseline air monitoring activities were implemented from September 13, 2004 through December 20, 2004. The objective of the monitoring was to determine the baseline air quality along the Dan Ryan Expressway before major reconstruction activities started in 2005. During the baseline period, total nuisance dust, respirable silica, lead, asbestos, and diesel component samples were collected 5 days a week for a period of 8 hours per sampling day, and PM (gravimetric) samples were collected 7 days, 23.5 hours per day.

[1] Asbestos sampling was discontinued March 2006

Reconstruction monitoring was initiated January 2005. From January 2005 to December 2005 total nuisance dust, respirable silica, lead, asbestos, and diesel component air monitoring was conducted 2 days a week; PM (real-time) continuously 7 days a week 24-hours/day; PM (gravimetric) for 7 day periods, 23.5 hours a day.

During the reconstruction period from January 2006 through fall of 2007, air monitoring will occur 1 day a week for a minimum of 8 hours per sampling day; PM (real-time) 24/7; and PM (gravimetric) for 7 days, 23.5 hours a day.

Monitoring Results
Baseline monitoring–September 2004 through December 2004
All pollutants sampled were below exposure limits or standards.

Reconstruction Monitoring
January 2005 through December 2005
All pollutants were below exposure limits or standards except for respirable silica (11 dates), total dust (1 date), $PM_{2.5}$ (2 dates, both Air Pollution Action days), and lead (1 date).

January 2006 through July 15, 2006
All pollutants sampled were below exposure limits or standards except for respirable silica (3 dates) and lead (1 date).

Source Apportionment via Receptor Modeling

Motria Caudill, U.S. Environmental Protection Agency Region 5 Air Monitoring and Analysis Section

In this session, Motria Caudill gave an overview of what she had found in the literature about source apportionment and receptor modeling, as part of her doctoral research at the University of Illinois at Chicago in collaboration with the US EPA.

Source apportionment is useful in developing pollution control strategies by identifying which sources pollutants of interest come from and how much of the pollutants come from the source, when air quality standards or health criteria are exceeded. This is especially desirable when there is complex mixture of pollutants.

This is done via receptor modeling. Simply speaking, receptor modeling procedure is the reverse of air dispersion modeling, where emission inventories of pollution sources are the input to air dispersion models and the model outputs are estimates of ambient pollutant concentrations by considering meteorology and chemical processes. Receptor modeling takes the observed ambient pollutant concentration data, speciates it for different pollutants, and back-calculates from the pollutants' origins.

There are different types of receptos models for different types of applications. The literature generally agrees that the first receptor model was used for VOC source apportionment for ozone control in 1990s, when ozone was a big issue and it was of particular interest to identify the source of the two ozone precursors, VOC and NOx. Since 2000, the EPA has set up $PM_{2.5}$ monitoring of elemental and ion constituencies such as organic and elemental carbons. Source apportionment models can tell us where these constituencies come from. Recently, there has been application of receptor modeling to air toxics specifically or the combination of toxics and PM.

Receptor models rely on the unique combination of species ratios in emissions source profiles, the "source fingerprints". These fingerprints allow the model to differentiate between the sources and figure out the mass composition of the source categories. For example, vegetative burning can be recognized by potassium (K); steel industry pollution often contains iron (Fe), zinc (Zn), and metals; and vehicle emissions can be traced by different elemental-to-organic carbons ratios.

The older generation receptor models are the chemical mass balance (CMB) models in the 1990s. A group of researchers led by Professor Peter Scheff at the University of Illinois at Chicago conducted a VOC source apportionment study in several Midwestern cities in the 1990s using CMB. They found that the vehicle contribution to VOCs ranged between 30% and 40% across the areas, and refinery source contributions varied by location depending on the existence of the industry in the area. The main advantage of CMB is that it requires only a small number of air samples. However, CMB requires extensive prior knowledge of source fingerprints, which may rely on literature and existing data libraries that may be outdated or poorly documented.

The newer generation receptor models are statistical multivariate models such as the Positive Matrix Factorization (PMF) model and UNMIX, which are available at the EPA web site. These models do not require predetermined source profiles like the CMB model does. Instead, the models generate the source profiles from factor analysis. However, they require much larger samples (usually more than 100 data points) to make reliable statistical inferences.

Model results can be validated in different ways. One approach is to compare the model results to the emission inventories. Wind direction analysis can tell whether estimated source distribution is higher in the downwind direction. Similarly, temporal trend analysis can show whether estimated sources follow the logical seasonal and day-of-week trends. For example, nitrates contribute to $PM_{2.5}$ more in the winter than in the summer, while sulfates do the opposite. Studies also show that vehicle emissions contribute the second largest portion of $PM_{2.5}$ in ambient air, after secondary sulfate particles.

Among the most recent applications, receptor modeling is now being applied to datasets that combine speciated $PM_{2.5}$ and VOCs, including benzene, toxics metals, and other MSATs.

MSAT Training and Other Resources

Jeff Houk and Michael Claggett, Federal Highway Administration Resource Center

Jeff Houk gave a short presentation on resources that FHWA offers or is planning to offer to assist with MSAT analysis. These include a longer version of the training materials presented at the peer exchange, including a hands-on exercise; research papers on various aspects of MSAT analysis; an FHWA review of roadside health studies; an MSAT analysis handbook; and an MSAT "quick-start" guide, which includes all the workshop and hands-on materials, and walks the reader through each of the steps of an example MSAT analysis.

Dr. Claggett then presented an overview and demonstration of the EMIT model. EMIT was designed by the FHWA Resource Center Air Quality Technical Services Team, to complete a locale-specific mobile source emission inventory by incorporating a component for forecasting congested vehicle speeds and entering vehicle-miles of travel and a component for employing the MOBILE6.2 model. Although EMIT was designed primarily for mobile source emission inventory calculations, the program can serve as a simplified graphical user interface for the MOBILE6.2 model. The program also provides a mode for creating lookup tables of emission factors as a function of vehicle speed.

EMIT was designed primarily for the practitioner responsible for developing mobile source emission inventories as part of the transportation planning process. The basic procedure of an emissions analysis is to employ the MOBILE6.2 model to calculate on-road mobile source emission factors, multiplied by the vehicle-miles of travel to construct emission inventories. As straightforward as this methodology seems, in practice the computations can become tedious, especially if processing hourly variations of vehicle speeds by facility type and/or accounting for seasonal variations of vehicle fleet turnover, temperature, relative humidity, fuel properties, and daily vehicle-miles of travel. EMIT facilitates and automates much of this work.

Roundtable Discussion Summary on Current Practice by States

Walt Zyznieuski, Illinois Department of Transportation

Adam Alexander (*Ohio DOT*)*:* Ohio DOT has four Categorical Exclusion (CE) project types. CE 1 and 2 are the simple projects, while a CE 4 would be a large-scale project, e.g., widening, adding capacity. So far, one MSAT has been completed by Ohio. The MSAT analysis was performed by the state's Office of Technical Services.

Sherry Kamke (*US EPA*): Ms. Kamke reiterated the research results from the O'Hare Monitoring Study as well as the Detroit Intermodal Study. She encouraged states to engage resource agencies early in the process.

Tom Hanf (*Michigan DOT*): Mr. Hanf gave a detailed overview of the Detroit Intermodal Project which was an EIS[2]. A detailed air quality assessment was performed (vehicles, locomotives, and non-road equipment) for this project as various groups requested information on health impacts. The study can be found on the MSAT web site at http://msat.cme.uic.edu/

Larry Heil (*FHWA-Indiana Division*)*:* The FHWA MSAT guidance is straightforward and helpful. At this point a general discussion occurred between the states on their approach to documenting MSAT in their NEPA documents. Following is a summary of this discussion:

Indiana: Indiana does not report MSAT for all of its projects—primarily only in EISs.

Illinois: Illinois has issued a new procedure memorandum that requires MSAT documentation for all projects.

Michigan: Michigan requires an MSAT discussion for all its projects.

Minnesota: Minnesota does not require an MSAT study for every project.

Ohio: Ohio documents an MSAT study for every project.

Wisconsin: Wisconsin does not document an MSAT study for every project.

Matt Fuller (*FHWA – Illinois Division*): IDOT is addressing MSATs in all environmental documents largely using the language in the FHWA guidance. At this time, no projects have required a quantitative analysis but there are several projects coming up in the Chicago area that will need the quantitative analysis.

Marilyn Jordahl-Larson (*Minnesota DOT*): One MSAT analysis was completed for the St. Croix project. This analysis was completed by a consultant.

Jay Waldschmidt (*Wisconsin DOT*): Wisconsin DOT believes in flexibility on the MSAT issue.

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[2] Jeff Houk mentioned this project in his presentation titled "Project-Level Methodologies: FHWA White Paper and Examples of Real-World Analyses".

Mike Rogers (*IEPA*): Mr. Rogers mentioned a few of the projects that his agency has been involved with, such as the O'Hare Monitoring project discussed by Terry Sweitzer, and the Dan Ryan project mentioned by Walt Zyznieuski. Mr. Rogers also discussed funding issues, a new rulemaking effort in Illinois on mercury reduction, as well as a new idling bill in Illinois.

Suzanne King (*US EPA*): Ms. King discussed the O'Hare study and the Detroit Intermodal project that she was involved in. The US EPA is involved with the many complaints that it receives from citizens on MSAT. She also emphasized early planning and coordination with resource agencies regarding MSATs.

Walt Zyznieuski (*Illinois DOT*): Mr. Zyznieuski handed out and discussed the new MSAT Procedure Memorandum that Illinois DOT issued July 11, 2006. This memo was derived from FHWA's MSAT guidance and tailored specifically for Illinois. Illinois has issued this memorandum to its nine district offices and requires MSAT be documented for all their projects. No quantitative MSAT analysis has been completed yet in Illinois.

Jeff Houk (*FHWA*): Better direction is needed primarily in two areas: 1) how to better target mitigation, and 2) how to better explain it all to the public.

Future Research Needs on Mobile Source Air Toxics

Jie (Jane) Lin and Wenjing Pu, University of Illinois at Chicago

This section summarizes the future research needs on MSAT identified by the meeting participants to facilitate transportation sector needs. They can be organized into the following three focus areas: (1) ambient monitoring and data collection, (2) analysis and modeling, (3) control/mitigation strategies and measures.

Ambient monitoring and data collection
The meeting participants agreed that the census tract level emission data from the 1999 National Air Toxics Assessment (NATA) could be used as a reference point. However, there was consensus among the participants that there is a need for research to identify what additional monitoring stations and data are needed to enhance existing monitoring networks for transportation sector needs, e.g., NEPA documentation of MSAT in response to the FHWA Interim Guidance.

Analysis and modeling
There was consensus that further guidance is expected from the FHWA on MSAT analysis methods and procedures. Protocols and new tools for MSAT emission modeling, air quality analysis, and exposure analysis need to be developed for the local and state agencies that are responsible for MSAT impact assessment. Better scientific understanding of MSAT is required. Finally, research on understanding and reducing major uncertainties in MSAT modeling and analysis, in particular, risk assessment of MSAT, is needed.

Control/mitigation strategies and measures
The participants felt strongly that there are research needs on identifying potential control/mitigation strategies and quantifying their cost-effectiveness. Part of this effort should be devoted to developing sensible exposure/risk measures for effective communication and information dissemination between the reporting state agency and the public.

Appendices — A1. FHWA MSAT Interim Guidance

Memorandum

U.S. Department of Transportation
Federal Highway Administration

SENT BY ELECTRONIC MAIL

Subject: **INFORMATION:** Interim Guidance on Air Toxic Analysis in NEPA Documents

Date: **February 3, 2006**

Original Signed by:

From: Cynthia J. Burbank
Associate Administrator for Planning, Environment and Realty

Reply to Attn. of : HEPN-10

To: Division Administrators

PURPOSE

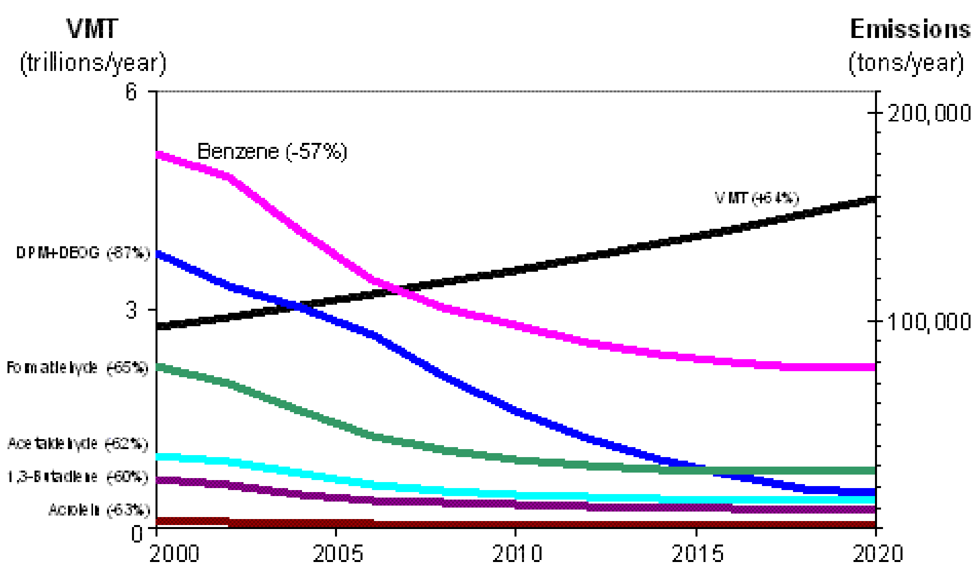
The purpose of this guidance is to advise FHWA Division offices on when and how to analyze Mobile Source Air Toxics (MSAT) in the NEPA process for highways. This guidance is interim, because MSAT science is still evolving. As the science progresses, FHWA will update the guidance.

BACKGROUND

The Clean Air Act identified 188 air toxics, also known as hazardous air pollutants. The Environmental Protection Agency (EPA) has assessed this expansive list of toxics and identified a group of 21 as mobile source air toxics, which are set forth in an EPA final rule, *Control of Emissions of Hazardous Air Pollutants from Mobile Sources (66 FR 17235)*. The EPA also extracted a subset of this list of 21 that it now labels as the six priority MSATs. These are *benzene, formaldehyde, acetaldehyde, diesel particulate matter/diesel exhaust organic gases, acrolein, and 1,3-butadiene*. While these MSATs are considered the priority transportation toxics, the EPA stresses that the lists are subject to change and may be adjusted in future rules.

The EPA has issued a number of regulations that will dramatically decrease MSATs through cleaner fuels and cleaner engines. According to an FHWA analysis, even if VMT increases by 64 percent, reductions of 57 percent to 87 percent in MSATs are projected from 2000 to 2020, as shown in the following graph:

U.S. Annual Vehicle Miles Traveled (VMT) vs. Mobile Source Air Toxics Emissions, 2000-2020



Notes: For on-road mobile sources. Emissions factors were generated using MOBILE6.2. MTBE proportion of market for oxygenates is held constant, at 50%. Gasoline RVP and oxygenate content are held constant. VMT: Highway Statistics 2000, Table VM-2 for 2000, analysis assumes annual growth rate of 2.5%. "DPM + DEOG" is based on MOBILE6.2-generated factors for elemental carbon, organic carbon and SO4 from diesel-powered vehicles, with the particle size cutoff set at 10.0 microns.

National trend information is provided as background. For specific locations, the trend lines may be different, depending on local parameters defining vehicle mix, fuels, meteorology and other factors.

Air toxics analysis is a continuing area of research. While much work has been done to assess the overall health risk of air toxics, many questions remain unanswered. In particular, the tools and techniques for assessing project-specific health impacts from MSATs are limited, as discussed in Appendix C. These limitations impede FHWA's ability to evaluate how mobile source health risks should factor into project-level decision-making under the National Environmental Policy Act (NEPA). In addition, EPA has not established regulatory concentration targets for the six relevant MSAT pollutants appropriate for use in the project development process.

Nonetheless, air toxics are being raised more frequently on transportation projects during the NEPA process. As the science emerges, we are increasingly expected by the public and other agencies to address MSAT impacts in our environmental documents. We have several research projects underway to try to more clearly define potential risks from MSAT emissions associated with transportation projects. However, while this research is ongoing, we are issuing this interim guidance on how MSATs should be addressed in NEPA documents for highway projects. The FHWA will continue to monitor the developing research in this emerging field.

ANALYSIS OF MSATs IN NEPA DOCUMENTS

Given the emerging state of the science and of project-level analysis techniques, there are no established criteria for determining when MSAT emissions should be considered a significant issue in the NEPA context. Therefore, a range of responses may be appropriate for addressing this issue in NEPA documentation. The response may involve quantitative analysis of emissions to compare or differentiate among proposed project alternatives, qualitative analysis to explore the general nature of the project and inform interested parties, or no analysis depending on the circumstances as set out in this interim guidance. For projects warranting MSAT analysis, the six priority MSATs should be analyzed.

The FHWA has developed a tiered approach for analyzing MSATs in NEPA documents. Depending on the specific project circumstances, FHWA has identified three levels of analysis:

- No analysis for projects with no potential for meaningful MSAT effects;
- Qualitative analysis for projects with low potential MSAT effects; or
- Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

(1) Exempt Projects or Projects with No Meaningful Potential MSAT Effects.

The types of projects included in this category are:

- Projects qualifying as a categorical exclusion under 23 CFR 771.117(c);
- Projects exempt under the Clean Air Act conformity rule under 40 CFR 93.126; or
- Other projects with no meaningful impacts on traffic volumes or vehicle mix

For projects that are categorically excluded under 23 CFR 771.117(c), or are exempt under the Clean Air Act pursuant to 40 CFR 93.126, no analysis or discussion of MSATs is necessary. Documentation sufficient to demonstrate that the project qualifies as a categorical exclusion and/or exempt project will suffice. For other projects with no or negligible traffic impacts, regardless of the class of NEPA environmental document, no MSAT analysis is required[1]. However, the project record should document the basis for the determination of "no meaningful potential impacts" with a brief description of the factors considered. Prototype language that could be included in the record is attached as Appendix A.

(2) Projects with Low Potential MSAT Effects

The types of projects included in this category are those that serve to improve operations of highway, transit or freight without adding substantial new capacity or without creating a facility that is likely to meaningfully increase emissions. This category covers a broad range of projects.

We anticipate that most highway projects will fall into this category. Any projects not meeting the threshold criteria for higher potential effects set forth in subsection (3) below and not meeting the criteria in subsection (1) should be included in this category. Examples of these types of projects are minor widening projects and new interchanges, such as those that replace a signalized intersection on a surface street or where design year traffic is not projected to meet the 140,000 to 150,000 AADT criterion[2].

For these projects, a qualitative assessment of emissions projections should be conducted. This qualitative assessment would compare, in narrative form, the expected effect of the project on traffic volumes, vehicle mix, or routing of traffic, and the associated changes in MSATs for the project alternatives, based on VMT, vehicle mix, and speed. It would also discuss national trend data projecting substantial overall reductions in emissions due to stricter engine and fuel regulations issued by EPA. Because the emission effects of these projects are low, we expect there would be no appreciable difference in overall MSAT emissions among the various alternatives. In addition, quantitative emissions analysis of these types of projects will not yield credible results that are useful to project-level decision-making due to the limited capabilities of the transportation and emissions forecasting tools.

Appendix B includes prototype language for a qualitative assessment, with specific examples for four types of projects: (a) a minor widening project; (b) an interchange with a new connector road; (c) an interchange without a new connector road; and (d) minor improvements or expansions to intermodal centers or other projects that affect truck traffic.

In addition to the qualitative assessment, a NEPA document for this category of projects must include a discussion of information that is incomplete or unavailable for a project specific assessment of MSAT impacts, in compliance with CEQ regulations (40 CFR 1502.22(b)) regarding incomplete or unavailable information. This discussion would explain how air toxics analysis is an emerging field and current scientific techniques, tools, and data are not sufficient to accurately estimate human health impacts that would result from a transportation project in a way that would be useful to decision-makers. Also in compliance with 40 CFR 150.22(b), it should contain a summary of current studies regarding the health impacts of MSATs. Prototype language for this discussion is contained in Appendix C.

(3) Projects with Higher Potential MSAT Effects

This category includes projects that have the potential for meaningful differences among project alternatives. We expect only a limited number of projects to meet this two-pronged test. To fall into this category, projects must:

- Create or significantly alter a major intermodal freight facility that has the potential to concentrate high levels of diesel particulate matter in a single location; or
- Create new or add significant capacity to urban highways such as interstates, urban arterials, or urban collector-distributor routes with traffic volumes where the AADT is projected to be in the range of 140,000 to 150,000[3], or greater, by the design year;

And also

- be proposed to be located in proximity to populated areas or in rural areas, in proximity to concentrations of vulnerable populations (i.e., schools, nursing homes, hospitals).

Projects falling within this category should be more rigorously assessed for impacts. If a project falls within this category, you should contact Michael Koontz or Pamela Stephenson in the Office of Planning, Environment, and Realty in FHWA for assistance in developing a specific approach for assessing impacts. This approach would include a quantitative analysis that would attempt to measure the level of emissions for the six priority MSATs for each alternative, to use as a basis of comparison. This analysis also may address the potential for cumulative impacts, where appropriate, based on local conditions. How and when cumulative impacts should be considered would be addressed as part of the assistance outlined above. The NEPA document for this project would also include relevant prototype language on unavailable information included in Appendix C.

If the analysis for a project in this category indicates meaningful differences in levels of MSAT emissions, mitigation options should identified and considered. See Appendix E for information on mitigation strategies.

You should also consult with the Office of Planning, Environment and Realty if you have a project that does not fall within any of the types of projects listed above, but you think has the potential to substantially increase future MSAT emissions. Although not required, projects with high potential for litigation on air toxics issues may also benefit from a more rigorous quantitative analysis to enhance their defensibility in court.

CONCLUSION

The guidance presented in this memorandum is interim. The guidance will be revised when FHWA completes studies underway to develop and evaluate better analytical tools for MSAT analysis and to better assess the health impacts of MSATs. The FHWA will continue to revise and update this guidance as the science on air toxic analysis continues to evolve. Additional background information on MSATs is attached to this memorandum as Appendix D.

The FHWA recognizes that some projects already are moving through the environmental analysis process and that immediate application of this interim guidance would be impractical. All future approvals of projects in "Category 1" (no meaningful MSAT effects) should include the information in Appendix A, commencing as soon as practicable after the date of this guidance. For projects already underway that would require qualitative or quantitative analysis of MSAT emissions (categories 2 and 3), the FHWA Division Offices should work to incorporate the appropriate analysis into the NEPA document if practicable, given the amount of resources already invested, the need for the project, and the stage of completion of the document. We expect that this guidance can be incorporated into any NEPA documents for which the completion of the DEIS, FEIS, or EA is more than 6 months from the date of this guidance. We recognize that in some cases this may not be possible for a variety of reasons (e.g., lack of necessary traffic data or emissions modeling expertise) and will rely on the judgment of the individual division offices to determine whether this guideline is reasonable for any given project. The FHWA Headquarters and Resource Center staff is available to provide guidance and technical assistance during this phase-in period to support any necessary analysis and limit project delays.

Attachment 1
Attachment 2
Attachment 3
Attachment 4
Attachment 5

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[1] The types of projects categorically excluded under 23 CFR 771.117(d) or exempt from conformity under 40 CFR 93.127 do not warrant an automatic exemption from an MSAT analysis, but they usually will have no meaningful impact.

[2] This guidance does not specifically address the analysis of construction-related emissions because of their relatively short duration. We will be considering whether more guidance is needed on construction activities in future versions of this guidance. We have also included a discussion of mitigation strategies for construction related activities in Appendix E.

[3] Using EPA's MOBILE6.2 emissions model, FHWA technical staff determined that this range of AADT would be roughly equivalent to the CAA definition of a major HAP source, i.e. 25 tons per year (tpy) for all HAPs or 10 tpy for any single HAP. Significant variations in conditions such as congestion or vehicle mix could warrant a different range for AADT; if this range does not seem appropriate for your project please consult with the contacts from the Office of Planning, Environment and Realty identified in this memorandum.

A2. Peer Exchange Meeting Agenda

Time	Topic	Speaker
Oct. 5, 2006		
Morning Session		
8:30AM	Welcome	Walt Zyznieuski, Illinois Department of Transportation Jane Lin, University of Illinois at Chicago David Lippert, Illinois Department of Transportation Imad L. Al-Qadi, Director, Illinois Center for Transportation
8:45AM	Introductions	Walt Zyznieuski, Illinois Department of Transportation
9:00AM	Clean Air Act—Background and Regulatory Issues Dealing with Air Toxics	Motria Caudill, US EPA Region 5
9:30AM	Introduction and Background on Mobile Source Air Toxics	Jeff Houk and Mike Claggett, FHWA
10:00AM	BREAK	
10:15AM	FHWA's Interim MSAT Guidance	Jeff Houk, FHWA
10:45AM	Project-Level Methodologies: FHWA White Paper and Examples of Real-World Analyses	Jeff Houk and Mike Claggett, FHWA
11:45AM	LUNCH	
Afternoon Session		
12:45PM	Use of MOBILE6.2 in MSAT Analysis	Mike Claggett, FHWA
1:30PM	Uncertainties in MSAT analysis	Jeff Houk, FHWA
2:15PM	BREAK	
2:30PM	Summary and Discussion of MSAT Issues	Jane Lin, University of Illinois at Chicago
3:00PM	O'Hare Airport Air Toxic Monitoring Study	Terry Sweitzer, IEPA
3:30PM	Dan Ryan Air Quality Monitoring	Walt Zyznieuski, Illinois Department of Transportation
4:00PM	University Research on MSAT	Motria Caudill, US EPA, Region 5
5:30-6:30PM	Reception	
Oct. 6, 2006		
Morning Session		
8:30AM	State DOT experiences on reporting MSAT in NEPA documents	Roundtable Discussion
9:15AM	State DOT experiences on MSAT analysis	Roundtable Discussion
10:00AM	BREAK	
10:15AM	MSAT Training and other Resources	Jeff Houk, FHWA
10:45AM	Identification of MSAT Research Needs for Project Level Analysis	Jane Lin, University of Illinois at Chicago
11:15AM	Wrap-up	
11:30AM	LUNCH	

A3. List of Participants

Name	Organization	Address	Email
Imad Al-Qadi	Department of Civil and Environmental Engineering University of Illinois at Urbana-Champaign	1203 Newmark Civil Engineering Laboratory, 205 North Mathews Avenue, Urbana, IL 61801-2352	alqadi@uiuc.edu
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Motria Caudill	US Environmental Protection Agency Region V Air Monitoring & Analysis Section	77 W. Jackson Blvd. Chicago, IL 60604	Caudill.Motria@epamail.epa.gov
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Matt Fuller	Federal Highway Administration-Illinois Division	3251 Executive Park Drive Springfield, IL 62703	Matt.Fuller@fhwa.dot.gov
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Terry Sweitzer	Illinois Environmental Protection Agency Bureau of Air	1021 North Grand Avenue, East P.O. Box 19276, Springfield, IL 62794-9276	Terry.Sweitzer@epa.state.il.us
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Peter Wasko	Minnesota Department of Transportation	1500 W. County Road B2 Roseville, Minnesota 55113	Peter.Wasko@state.mn.us
Walt Zyznieuski	Illinois Department of Transportation	2300 S. Dirsken Parkway Springfield, IL 62764	Walter.Zyznieuski@illinois.gov

A4. Selected Presentation Slides

Four of the nine presentations at the peer exchange meeting are included in the following order:

1. Federal Air Toxics Regulatory Programs
   By Motria Caudill, U.S. Environmental Protection Agency Region 5

2. Introduction and Background on Mobile Source Air Toxics
   By Michael Claggett and Jeff Houk, Federal Highway Administration

3. FHWA Interim MSAT Guidance
   By Jeff Houk, Federal Highway Administration

4. Uncertainties in MSAT Analysis
   By Jeff Houk, Federal Highway Administration

The first three presentations include all of the original slides presented at the meeting. In the last one (Uncertainties in MSAT Analysis), four slides from the original presentation have been excluded. Those four slides contained comparison results of the model estimates and the measured ones, which have been discussed in the summary section of the proceedings.

{Presentation slides, in a separate PDF file, are attached for reference.}

Federal Air Toxics Regulatory Programs

Motria Caudill
USEPA Region 5 Chicago
October 5, 2006

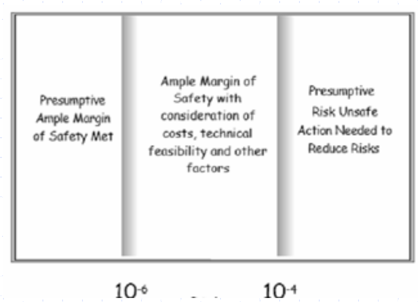
Topics

- Air toxics rules and regulations
  - Stationary sources
  - Mobile sources
- Measures of success
  - Emissions inventories
  - Risk assessment
  - Ambient monitoring
- Closing: why are mobile sources so important to public health?

1990 CAAA: "Technology First, Then Risk" Approach

- Two step process:
  1. EPA develops regulations requiring sources to meet emissions limits, based on levels already achieved by top 12% of facilities.
  2. EPA applies a risk-based approach to assess how the rules are reducing risks. EPA may then implement additional standards to further reduce risks.

Risk management framework



Step 1. Maximum Achievable Control Technology (MACT) rules

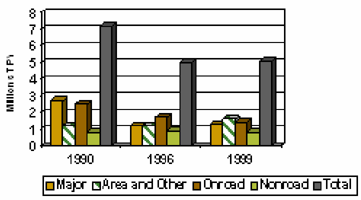
- EPA issued 96 MACT standards affecting 160 categories of industry, including chrome electroplaters, oil refineries, coke ovens, dry cleaners, and more
- These rules collectively will reduce 1.7 million tons per year of HAPs compared to 1990 baseline emissions

Step 2. Residual Risk Rules

- Within 8 years of setting a MACT, EPA must assess and reduce risks as needed to protect public health with an ample margin of safety.
- Residual Risk Rules to date
  - 2 rules finalized – coke ovens & dry cleaners
  - 4 no further actions – cooling towers, gasoline distribution, magnetic tape manufacture, commercial sterilizers
  - 2 rules proposed – hazardous organic NESHAP and halogenated solvent cleaning

Area Source Technology Rules

- While total HAP emissions have decreased, smaller (area) sources emit more
- 50 area source rules are to be developed



Mobile sources rules

- Many regulations primarily aimed at reducing ozone precursors and fine particulate matter
- Air toxics reductions are an additional benefit of these rules
  - Benzene & other VOCs (ozone rules)
  - Diesel PM & metals (PM rules)

Reformulated gasoline (RFG)

- RFG is blended to burn cleaner and reduce ozone precursors (and HAPs)
- Where is RFG used?
  - In 17 States and Washington DC
  - About 75 million people live in areas with RFG
  - About 30% of gas sold in the U.S. is reformulated
- A study by NESCAUM shows Phase I RFG reduced cancer risk from gasoline by ~12% and Phase II RFG reduced risk by ~19%.

On-road Diesel Rules

- Significantly reduce NOx/PM pollution from new diesel engines:
  - 2004: new emission standards for diesel engines
  - 2006: ultra-low sulfur diesel fuel
  - 2007: even more stringent emission stds (95%)
  - Estimated to prevent 8,300 premature deaths, 5,500 cases of chronic bronchitis and 17,600 cases of acute bronchitis in children every year.

Non-road diesel rules

- Non-road diesel engine rule for agricultural & construction equipment phased in 2008-2014
- Engine requirements similar to on-road rules
- Sulfur reduced in fuel starting 2010
- EPA estimates that by 2030, controlling these emissions would annually prevent 12,000 premature deaths, 8,900 hospitalizations, and one million work days lost.
- Rules also under development for locomotives & marine engines

Mobile source air toxics rule (MSAT)

- Proposed rule signed February '06
- Establish new controls:
  - In 2011 refiners would meet an annual average gasoline benzene content of 0.62% by volume (down from 0.97%)
  - Phased in between 2010-15, reduce non-methane hydrocarbon (NMHC) exhaust emissions from new gas-powered passenger vehicles
  - In 2009 reduce VOC leaks from gas cans

MSAT rule costs & benefits

- Additional cost
  - $5 million per refinery upgrade
  - $0.0013 per gallon of gasoline
  - $1 cost per vehicle manufactured
- By 2020, mobile source rules are expected to reduce emissions of certain HAPs (benzene, formaldehyde, acetaldehyde, and 1,3-butadiene) from highway vehicles by 75% and diesel PM by over 90% from 1990 levels.

Voluntary programs

- Address pollution from heavy-duty vehicles that are currently on the road.
- Midwest Clean Diesel Initiative – public and private partners work to reducing emissions from fleet of ~ 3.3 million engines in R5, focus on 3 key sectors: ports, agriculture-freight and rail.
- Clean School Bus USA and other programs
- $11.8 million total spent in Region 5 in FY06 affecting 163,348 engines

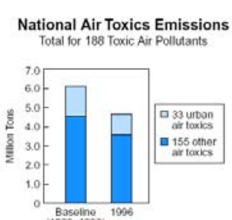
Diesel voluntary program contacts

- Midwest Clean Diesel Initiative www.epa.gov/midwestcleandiesel
- Julie Magee, program lead
  - 312-886-6063
  - magee.julie@epa.gov

Reducing HAP emissions - Measures of success

- Trends in emissions inventories
- Nation-wide risk assessment studies
- Ambient air monitoring

HAP emissions trends



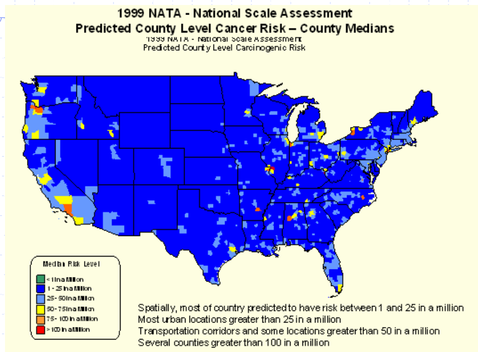
- HAP emissions down 24% from baseline (1990-1993) to '96.
- 33 HAPs that pose the greatest risk in urban areas are down 31%.
- Most progress in major stationary sources and onroad mobile sources

National Air Toxics Assessment (NATA)

- Objectives
  - characterize risk from 177 HAPs
  - identify priorities for risk reduction
- Cancer and noncancer risk estimates based on modeled chronic exposures
- Based on 1999 emissions inventory
- Available at:

www.epa.gov/ttn/atw/nata1999/nsata99.html

1999 NATA cancer risk estimates



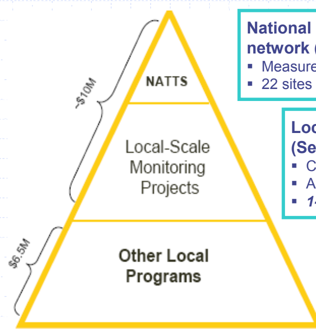
'99 NATA results summary

- Average cancer risk is 48-in-a-million
  - Benzene is the greatest contributor
  - Most urban locations >25-in-a-million
  - A few counties >100-in-a-million
- Average noncancer risk is 6.4 (hazard index for respiratory effects)
  - Acrolein contributes majority of risk
  - Over 40% of counties w/HI > 1

Uses of air toxics monitoring

- Ground-truth dispersion modeling
  - NATA results under-estimate metals
- Track long-term trends
  - Evidence of benzene/VOC reductions
  - Mixed record for toxic metals
- Characterize population exposure

National air toxics monitoring program

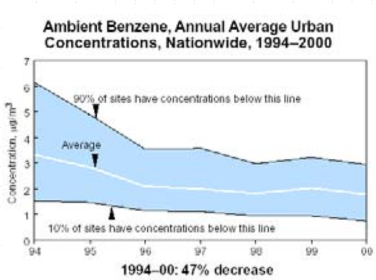


National Air Toxics Trends Site (NATTS) network (Section 103)
- Measures long-term program progress
- 22 sites nationally, ***3 sites in Region 5***

Local-Scale Monitoring Projects (Section 103)
- Competitively awarded each year
- Address specific local-scale issues
- ***1-3 projects per Region every year***

Other Local programs (Section 105)
- S/L/T agency discretion
- ***~80 sites in Region 5 in '05***

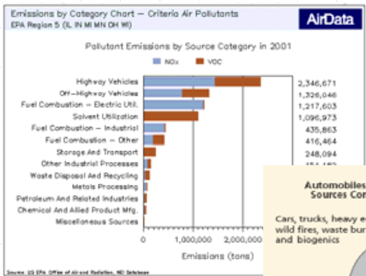
National ambient benzene trends

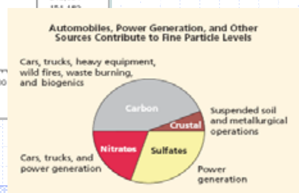


So, despite the progress already made in reducing MSATs..

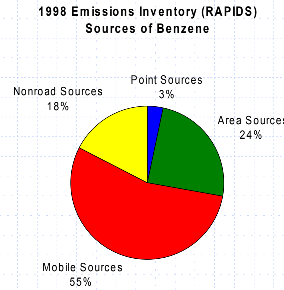
.. why are mobile sources still important to public health?

Big picture: sources of O_3 & $PM_{2.5}$:





Big picture – benzene sources in R5:



Local hotspots – near-roadway exposures

- Evidence of adverse health effects from exposures within ~500 ft. of major roadways
  - respiratory & cardiovascular effects
  - premature adult mortality
  - adverse birth outcomes, incl. low birth weight
  - some evidence for new onset asthma
- EPA has research underway including:
  - analysis of near-roadway epidemiology studies
  - monitoring & modeling studies pollution gradients
  - characterizing infiltration of pollutants into schools

Any questions?

- caudill.motria@epa.gov
- 312-886-0267

U.S. Department of Transportation Federal Highway Administration

Federal Highway Administration RESOURCE CENTER

Mobile Source Air Toxics Peer Exchange Meeting
Allerton Park – Monticello, Illinois

Introduction and Background on Mobile Source Air Toxics

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October 5, 2006

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This Session

Overview of mobile source air toxics

How and where MSATs have become an issue

Overview of Mobile Source Air Toxics (MSATs)

MSATs are emitted from mobile sources and have the potential for serious health effects

In their March 2001 final rule, *Control of Emissions of Hazardous Air Pollutants from Mobile Sources* (66 FR 17235), EPA identified a group of 21 compounds of concern that are emitted from motor vehicles

Of these, 6 were identified as significant contributors to national emissions of hazardous air pollutants

In our *Interim Guidance on Air Toxic Analysis in NEPA Documents*, FHWA refers to these as the 6 priority MSATs

---

MSAT Compounds from EPA's March 2001 Rule

Acetaldehyde	**Formaldehyde**
Acrolein	n-Hexane
Arsenic	Lead
Benzene	Manganese
1,3-Butadiene	Mercury
Chromium	Methyl Tertiary Butyl Ether
Chromium III	Naphthalene
Chromium VI	Nickel
Diesel Particulate Matter	Polycyclic Organic Matter
Diesel Exhaust Organic Gases	Benzo(a)pyrene
Dioxin/Furans	Chrysene
2,3,7,8-Tetrachloro-dibenzo-p-dioxin	Styrene
2,3,7,8-Tetrachloro-dibenzofurans	Toluene
Ethylbenzene	Xylene

Primary MSATs in bold font

Additional MSATs of Concern

In the preamble to this year's proposal, *Control of Hazardous Air Pollutants From Mobile Sources; Proposed Rule* (71 FR 15804) EPA identifies 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS)

In addition, EPA identifies 7 compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their National Air Toxics Assessment (NATA)

Mobile Source Contribution to the 1999 NATA Risk Drivers

Acrolein	Chrysene
Benzene	Benzo[a]pyrene
1,3 – Butadiene	Dibenz(a,h)anthracene
Diesel PM + Diesel exhaust organic gases	Anthracene
Formaldehyde	Pyrene
Napthalene	Benzo(g,h,i)perylene
Polycyclic organic matter	Fluoranthene
Benzo[b]fluoranthene	Acenaphthylene
Benz[a]anthracene	Phenanthrene
Indeno(1,2,3-c,d)pyrene	Fluorene
Benzo[k]fluoranthene	Acenaphthene

Air Quality Criteria

Worker Exposures

- NIOSH
  - Immediately Dangerous to Life or Health (IDLH)
  - Lethal Concentration
  - Recommended Exposure Limit (REL)
- OSHA
  - Permissible Exposure Limit (PEL)

Air Quality Criteria (continued)

Ambient Air Exposures

- U.S. EPA
  - National Ambient Air Quality Standards (NAAQS)
  - Reference Concentration for Chronic Inhalation Exposure (RfC)
  - Air Concentration Providing Cancer Risks of 1 in 10,000; 1 in 100,000; or 1 in 1,000,000 (ACR)

Air Quality Criteria (continued)

Ambient Air Exposures

- New York State
  - Short-term Guideline Concentrations (SGC)
  - Annual Guideline Concentration (AGC)
- State of California
  - Acute Reference Exposure Limit (REL)
  - Chronic Inhalation REL
  - Unit Risk Value

Air Quality Criteria (continued)

	U.S. DHHS	U.S. DoL	U.S. EPA			New York		California		
Compound	NIOSH IDLH	OSHA PEL	NAAQS	RfC	ARC 10^{-5} Risk	SGC	AGC	Acute REL	Chronic REL	ARC 10^{-5} Risk
Acetaldehyde	3,600,000[Ca]	360,000	None	9	5	4,500	0.45	None	9	3.7
Acrolein	4,600	250	None	0.02	None	0.19	0.02	0.19	0.06	None
Arsenic	5,000 [Ca]	10	None	None	0.002	None	0.00023	0.19	0.03	0.003
Benzene	1,600,000[Ca]	3,200	None	30	1.3 – 4.5	1,300	0.13	1,300	60	0.34
1,3-Butadiene	4,400,000[Ca]	2,200	None	2	0.3	None	0.028	None	20	0.059
Chromium	250,000	1,000	None	None	None	None	1.2	None	None	None
Chromium III	25,000	500	None	None	None	None	0.01	None	None	None
Chromium VI	15,00 [Ca]	None	None	0.1	0.0008	None	0.00002	None	0.2	6.7E-05
Diesel Particulate Matter	None [Ca]	None	None[1]	5	None	None	None	None	5	0.033
Dioxin/Furans	None	None	None	None	None	None	None	None	None	None
2,3,7,8-Tetrachloro-dibenzo-p-dioxin	None [Ca]	None	None	None	None	None	3.0E-08	None	0.00004	2.6E-07
2,3,7,8-Tetrachloro-dibenzofurans	None	None	None	None	None	None	3.0E-08	None	0.00004	2.6E-06
Ethylbenzene	3,500,000	435,000	None	1,000	None	54,000	1,000	None	2,000	None

Notes: All Concentrations in ug/m^3
IDLH – U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, Immediately Dangerous to Life or Health
PEL – U.S. Deparment of Labor, Occupational Safety and Health Administration, Permissible Exposure Limit, 8-hour Time Weighted Average
NAAQS – National Ambient Air Quality Standard
RfC – U.S. EPA Reference Concentration for Chronic Inhalation (lifetime, 70-year average)
EPA ARC 10^{-5} Risk – Air Concentration Providing Cancer Risk of 1 in 100,000 (lifetime, 70-year average)
SGC – Short-term Guideline Concentration (1-hour average)
AGC – Annual Guideline Concentration
Acute REL – Acute Reference Exposure Limit (1-hour average, except for arsenic, 4-hr avg and benzene, 6-hr avg)
Chronic REL – Chronic Inhalation Reference Exposure Limit
California-based ARC 10^{-5} Risk = 1 / California Unit Risk Value * 10^{-5} (lifetime, 70-year average)
[Ca] Potential occupational carcinogen
[C] Ceiling limit
[1] For comparison: PM-10 – 50 $\mu g/m^3$ (annual) and 150 $\mu g/m^3$ (24-hr); PM-2.5 – 15 $\mu g/m^3$ (annual), 35 $\mu g/m^3$ (24-hr)
[2] As Coal Tar Pitch Volatiles (bezene soulable fraction)

Air Quality Criteria (continued)

Compound	U.S. DHHS NIOSH IDLH	U.S. DoL OSHA PEL	U.S. EPA NAAQS	U.S. EPA RfC	U.S. EPA ARC 10^{-5} Risk	New York SGC	New York AGC	California Acute REL	California Chronic REL	California ARC 10^{-5} Risk
Formaldehyde	25,000 [Ca]	920	None	None	0.8	30	0.06	94	3	1.7
n-Hexane	3,900,000	1,800,000	None	700	None	None	200	None	7,000	None
Lead	100,000	50	1.5	None	None	None	0.38	None	None	0.83
Manganese	500,000	5,000 [C]	None	0.05	None	None	0.05	None	0.2	None
Mercury	10,000	100	None	0.3	None	1.8	0.3	1.8	0.09	None
Methyl Tertiary Butyl Ether	None	None	None	3,000	None	None	3,000	None	8,000	38
Naphthalene	1,300,000	50,000	None	3	None	7,900	3	None	9	None
Nickel	10,000 [Ca]	1,000	None	None	None	6	0.004	6	0.05	0.038
Polycyclic Organic Matter	80,000 [2]	200 [2]	None	None	None	None	0.48 [2]	None	None	None
Benzo(a)pyrene	80,000 [2]	200 [2]	None	None	None	None	0.002	None	None	0.0091
Chrysene	80,000 [2]	200 [2]	None	None	None	None	0.02	None	None	0.91
Styrene	3,000,000	430,000	None	1,000	None	17,000	1,000	21,000	900	None
Toluene	1,900,000	750,000	None	5,000	None	37,000	400	37,000	300	None
Xylene	3,900,000	435,000	None	100	None	4,300	100	22,000	700	None

Notes: All Concentrations in ug/m^3
IDLH – U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, Immediately Dangerous to Life or Health
PEL – U.S. Deparment of Labor, Occupational Safety and Health Administration, Permissible Exposure Limit, 8-hour Time Weighted Average
NAAQS – National Ambient Air Quality Standard
RfC – U.S. EPA Reference Concentration for Chronic Inhalation (lifetime, 70-year average)
EPA ARC 10^{-5} Risk – Air Concentration Providing Cancer Risk of 1 in 100,000 (lifetime, 70-year average)
SGC – Short-term Guideline Concentration (1-hour average)
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[2] As Coal Tar Pitch Volatiles (bezene soulable fraction)

Health Impacts of MSATs

Internal combustion engines emit chemicals of varying degrees of potential toxicity

While the science is evolving, regulatory agencies are concerned about MSAT exposure

Benzene (a known carcinogen) and DPM are viewed as especially harmful

- California MATES II study identifies DPM as the primary cancer risk of all MSATs

Health Impacts of MSATs

Benzene is a known human carcinogen. Non-cancer effects include anemia and other blood disorders.

The potential carcinogenicity of acrolein cannot be determined because the existing data are inadequate. However, acrolein is believed to account for the bulk of non-cancer respiratory effects associated with air toxics, including upper respiratory tract irritation.

Formaldehyde is a probable human carcinogen, based on limited evidence in humans, and sufficient evidence in animals. Non-cancer effects include eye, nose and throat irritation.

Health Impacts of MSATs

1,3-butadiene is characterized as carcinogenic to humans by inhalation. It also has non-carcinogenic reproductive and developmental effects.

Napthalene is a probable human carcinogen based on increased incidence of nasal tumors in rats and laryngeal tumors in hamsters after inhalation exposure.

Diesel exhaust (DE) 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. Non-cancer effects include respiratory and cardiovascular effects, as well as premature mortality.

Health Impacts of MSATs

Polycyclic Organic Matter is a large class of organic compounds, many of which are classified as probably human carcinogens. Polycyclic aromatic hydrocarbons (PAHs) are a chemical subset of POM. Non-cancer effects include adverse birth outcomes, including low birth weight and size.

How did MSATs become an issue for highway projects?

Multiple Air Toxics Exposure Study (MATES-II)

Los Angeles study that helped focus attention on the effects of MSATs on human health

Key findings:

- 90% of the total air toxics cancer risk from mobile sources
- 70% of the total air toxics cancer risk from mobile source diesel particulate matter (DPM)
- 98% of the total DPM emissions due to mobile sources (52% on-road / 48% off-road)

FHWA commissioned an independent review in 2003 that identified several limitations and concerns:

www.fhwa.dot.gov/environment/airtoxic/casesty1.htm

Other Studies

Numerous studies in recent years have looked for, and many have found, adverse health impacts that seem to be linked to proximity to a roadway, including increases in respiratory and cardiovascular effects, premature adult mortality, and adverse birth outcomes (low birth weight and size).

The Sierra Club assembled one summary of studies that is frequently submitted to FHWA in comment letters (www.sierraclub.org/sprawl/report04_highwayhealth/).

Other Studies (continued)

Other summaries are available from EPA, and from the Johns Hopkins School of Public Health (www.jhsph.edu/RiskSciences/Research/TrafficProximity.html)

Unanswered research questions include:

Do effects result from chronic or acute exposure?

What role do specific pollutants play?

What is the role of co-stressors (e.g., socioeconomic status)?

Other Recent Developments

EPA Mobile Source Air Toxics Rule (March 2001)

Relied on existing control programs (Tier 2 standards, RFG, heavy duty standards) plus gasoline anti-backsliding requirement to reduce MSAT emissions; predicted reductions of 67-90% in MSAT emissions by 2020

EPA proposed a new rule in March 2006; includes limits on benzene in fuels, new cold-temperature HC standards for passenger vehicles, new evap standards for passenger vehicles, and evap standards for gas cans.

Both rules contain updated information on the science behind MSAT effects and controls.

Other Recent Developments

EPA's National Air Toxics Assessment (NATA); originally published in 2002, updated February 2006

Nationwide modeling and risk assessment to pedict air toxics cancer and non-cancer risk for the entire US:

- US population – 1-25 cases of cancer per million people
- Urban areas – >25 cases per million
- "Transportation corridors" (areas with significant development) – >50 cases per million

Comparative risks:

- Cancer from all causes: 330,000 per million
- Radon: 2000 per million

EPA Caveats on NATA

Cancer risk estimates do not include diesel particulate, since EPA has not developed a risk factor

Other risk estimates assume 70-year lifetime exposure to 1999 emissions levels, which is very uncertain (EPA projections show that MSAT emissions decline through 2020, and then begin to increase after that based on current vehicle technology)

NATA not designed to pinpoint specific risk values within a census tract or to compare neighborhoods

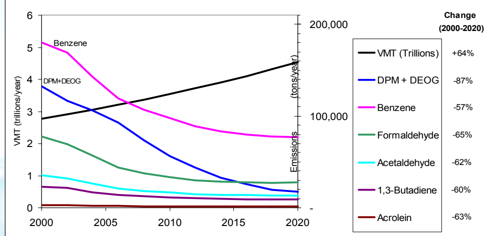
The assessment is subject to a number of limitations and uncertainties

Other Recent Developments

MOBILE6.2 emissions model

- **EPA modeling tool used to estimate mobile source emissions; version 6.2 makes it much easier to estimate air toxics emissions than previous models**

Vehicle Miles Traveled (VMT) vs. Mobile Source Air Toxics Emissions, 2000-2020



Notes: For on-road mobile sources. Emissions factors were generated using MOBILE6.2. MTBE proportion of market for oxygenates is held constant, at 50%. Gasoline RVP and oxygenate content are held constant. VMT: *Highway Statistics 2000*, Table VM-2 for 2000, analysis assumes annual growth rate of 2.5%. "DPM + DEOG" is based on MOBILE6.2-generated factors for elemental carbon, organic carbon and SO4 from diesel-powered vehicles, with the particle size cutoff set at 10.0 microns. 1 short ton = 907,200,000 mg.

Mobile Source Air Toxics Peer Exchange Meeting
Allerton Park – Monticello, Illinois

FHWA Interim MSAT Guidance

Jeff Houk
FHWA Resource Center

October 5, 2006

Guidance Principles

Conduct MSAT analysis for projects that:

1) **Are large enough to have likely impacts, and**
2) **Impact human populations**

Contents of Guidance

Guidance memo
Appendix A: Sample language for exempt projects
Appendix B: Sample language for qualitative analysis
Appendix C: Sample 1502.22 compliance language
Appendix D: Background
- **Attachment A: List of MSAT compounds**
- **Attachment B: FHWA Research Activities**
- **Attachment C: 40 CFR 1502.22**

Appendix E: MSAT mitigation strategies

Guidance Framework

Traditional NEPA air quality analysis (before MSAT Guidance):

- Hotspot modeling for carbon monoxide (CO) using MOBILE6.2 to model emission rates, and CAL3QHC to model concentrations
- For large projects, emissions burden analysis of emissions that contribute to the criteria pollutants CO, ozone, and particulate matter (CO, VOCs, NOx, particulate)
- Project-level conformity (where required)

Guidance Framework

Additional NEPA air quality analysis for MSATs:

- Projects with no or minimal AQ impact (e.g., conformity-exempt projects): No MSAT analysis
- Other projects: apply screening criteria (ADT) to determine likely level of impacts

Applying the Guidance

1) **If project is exempt, no analysis is needed—include Appendix A language in the project record**

2) **If not exempt, evaluate project against screening thresholds in guidance:**
   a) Low impact projects: perform qualitative analysis and 1502.22 assessment using Appendix B & C
   b) Higher impact projects: perform quantitative analysis and 1502.22 assessment; evaluate mitigation if meaningful differences in MSAT emissions identified

Qualitative Analysis for Projects with Low Potential MSAT Effects

The NEPA document should include a qualitative discussion of project-specific factors that could affect MSAT emissions and exposure. Factors include ADT, truck traffic, speeds, proximity of receptors

Similar to qualitative analysis conducted in the past for PM10 project-level conformity

Example language for different types of projects is included in Appendix B of guidance; modify this language as appropriate to account for the unique characteristics and impacts of each project

Screening Thresholds for Higher Impact Projects

Quantitative emissions analysis is required for projects that

1) Involve new or additional capacity on roadways where the traffic volume will be 140,000-150,000 AADT (or higher) in the design year, or
2) Create or significantly alter an intermodal freight facility that generates high levels of diesel particulate emissions in a single location

AND

are in proximity to populated areas, or, in rural areas, in proximity to vulnerable populations (near schools, nursing homes, hospitals)

Quantitative Analysis for Projects with Higher Potential MSAT Impacts

Emissions burden analysis for the project study area using MOBILE6.2. Similar to burden analyses performed in the past for existing pollutants (CO, ozone, PM).

Analyze emissions of the six MSATs listed in the guidance for base year (current conditions), future no action, future build alternatives.

FHWA RC and HQ staff can provide technical guidance on project-specific methodologies.

Quantitative Analysis—General Approach

Define affected transportation network
All project links, plus other links where volumes change by +/- 5% as a result of the project

Define other travel activity parameters
Roadway capacities, hourly speeds

Calculate VMT on the links

Calculate emission factors with MOBILE6.2

Calculate total emissions for each alternative

Mitigation

If meaningful differences in emissions identified between alternatives, evaluate and consider mitigation

Possible mitigation options:

- Cleaner (newer) construction equipment
- Retrofit of construction equipment/cleaner fuels
- Alternative fuels (propane, biodiesel)
- School bus retrofit
- Truck stop electrification
- Anti-idling ordinances
- Move receptors

1502.22 Assessments

A 1502.22 Assessment is required in the NEPA document for all non-exempt projects

Air toxics is an emerging field, and defining a significant impact in the NEPA context involves many assumptions and uncertainties. In cases like this, 1502.22 requires:
1) statement that information is incomplete or unavailable
2) statement of the relevance of the information
3) summary of existing credible scientific information
4) our evaluation of impacts

Template language is provided for this discussion in Appendix C; needs to be tailored for each project

Summary

Exempt projects

- no analysis—include Appendix A in project record

Low impact projects

- conduct qualitative analysis using Appendix B as a starting point
- conduct 1502.22 assessment by tailoring Appendix C as appropriate

Higher impact projects (meet screening threshold)

- conduct quantitative emissions burden analysis
- evaluate mitigation if meaningful emissions differences
- conduct 1502.22 assessment by tailoring Appendix C as appropriate

RESOURCE CENTER

Mobile Source Air Toxics Peer Exchange Meeting
Allerton Park – Monticello, Illinois

Uncertainties in MSAT Analysis

Jeff Houk
FHWA Resource Center

October 5, 2006

Uncertainties in MSAT Analysis

The FHWA Interim Guidance requires qualitative or quantitative emissions analysis for projects.

However, the actual impact of a project for NEPA purposes is not emissions levels or concentrations or exposures or risk projections; it's health outcomes (e.g., asthma or cancer)

Techniques are available to conduct health risk assessments, but in FHWA's view, these tools and assumptions incorporate too many uncertainties for us to support their use for MSAT risk assessments for individual transportation projects.

This session summarizes some of the reasons.

Uncertainties in MSAT Analysis

Uncertainties are important in three contexts:

1) There are uncertainties associated with the MOBILE6.2 modeling that we will be performing for projects
2) EPA has expressed interest in dispersion modeling for some projects
3) EPA and interest groups have also suggested that we perform 70-year cancer risk assessments for some projects.

MOBILE6.2 Emissions Analysis

The MSAT guidance requires MOBILE6.2 emissions analysis for large projects; however, there are uncertainties inherent in this analysis

Travel Activity Data

Travel demand forecasting (TDF) models are used to project future travel activity and evaluate travel impacts of alternatives

Current TDF models are not designed to be accurate at forecasting localized travel volumes or speeds; more accurate at the regional scale

Greater uncertainties are associated with the models for predicting speeds and other travel activity measures on highly-congested (LOS F) facilities. This compromises our ability to compare emissions from a highly-congested No Action alternative to less-congested Build alternatives.

MOBILE6.2 Emissions Modeling

MOBILE6.2 is designed as a regional-scale, trip-based model. It is not designed to produce good estimates of emissions at any particular speed in any particular place (although people often use it that way, e.g., for CO hotspot analysis).

Because MOBILE6.2 is based on average trip speeds, it is better suited to regional-scale or study-area analysis. The results are not designed to be reliable at the segment level.

Thus, MOBILE6.2 is not designed to give us the information we need for localized assessments, e.g., what are the emissions occurring next to this school? (or hospital, or house, etc.)

MOBILE6.2 Speed Modeling

Most of the emissions data in MOBILE6.2 are based on the Federal Test Procedure, which has an average trip speed of 19.6 miles per hour

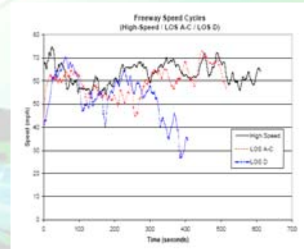
EPA has developed alternative testing cycles at different speeds, so that we can model average trip speeds other than 19.6 mph

However, because of the way these driving cycles work, MOBILE6.2 cannot actually predict emissions for any one particular speed; when a particular speed is entered in MOBILE6.2, the resulting emissions rate reflects a trip at that speed which actually covers a wide range of speeds.

MOBILE6.2 Speed Modeling

High Speed = 63.2 mph
LOS A-C = 59.7 mph
LOS D = 52.9 mph

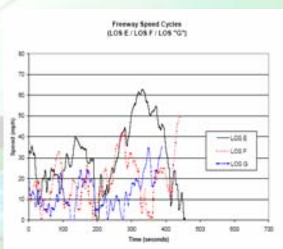
When modeling "55 mph", MOBILE6.2 interpolates between the "LOS A-C" and "LOS D" cycles, meaning you are getting emissions for speeds that range from 73 to 27 mph.



MOBILE6.2 Speed Modeling

LOS E = 30.5 mph
LOS F = 18.6 mph
LOS G = 13.1 mph

When modeling "25 mph", MOBILE6.2 interpolates between the "LOS E" and "LOS F" cycles, meaning you are getting emissions for speeds that range from 63 to 0 mph



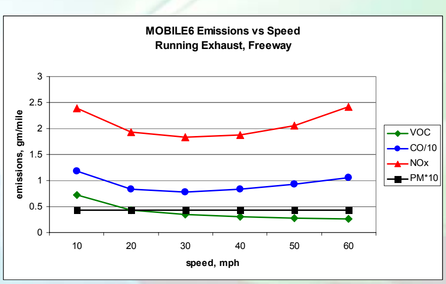
MOBILE6.2 Emissions Modeling: Speeds & PM

Diesel particulate matter is suspected to be a large contributor to MSAT risk nationwide, but—

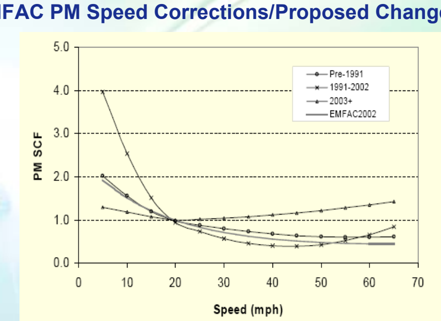
MOBILE6.2 does not correct particulate emissions rates for changes in speed, while the emissions rates for other pollutants are very sensitive to this input. While the purpose of most current highway projects is to reduce congestion (increase speeds), we have no way of knowing whether this improves or worsens diesel particulate emissions.

This is a major handicap for project-level MSAT analysis: the effects of changes in volumes and in truck % can be captured, but not changes in speed.

MOBILE6.2 Emissions Modeling: Speeds & PM



EMFAC PM Speed Corrections/Proposed Changes



MOBILE6.2 Emissions Modeling

MOBILE6.2 diesel particulate emissions rates are also not sensitive to:

- Roadway type
- Driving behavior
- Vehicle malfunctions and deterioration
- Temperature
- Frequency and distribution of engine starts

The other pollutants addressed by MOBILE6.2 are highly sensitive to these inputs

MOBILE6.2 Emissions Modeling

MOBILE6.2 does not give particulate emissions rates at idle, except for heavy-duty vehicles. Idle emissions are an important input to the CAL3QHC intersection dispersion model.

MOBILE6.2 does not report separate start and running emissions for particulate. Most project-level analyses of major roadways should not include start emissions; on the other hand, start emissions may be very important for analyses near locations where vehicles are parked (for diesel, this includes distribution terminals, bus maintenance facilities, truck stops, etc.)

With these limitations, why are we using MOBILE6.2?

MOBILE6.2 is reasonably reliable for predicting near-term trends in emissions (e.g., between now and a project design year)

The lack of resolution of MOBILE6.2 speed corrections and other activity measures is not as much an issue at a large scale (affected transportation network or study area), where the scope of the analysis captures a wide range of travel activity, just like MOBILE6.2 does

The lack of sensitivity to temperature and other inputs is not critical when all you are doing is a relative emissions comparison between years and alternatives

MOBILE6.2 Emissions Modeling: Summary

MOBILE6.2 emissions estimates are most reliable at the regional scale, and least reliable at the segment level

MOBILE6.2 is useful for making *relative* emissions comparisons between years and alternatives for large projects

In FHWA's view, MOBILE6.2 is not sufficient for:
characterizing MSAT emissions from small projects,
predicting emissions at any one specific location, or
producing *absolute* MSAT emissions estimates for use in a dispersion model (or the remaining steps of the risk assessment process).

Dispersion Modeling

FHWA has received several requests to perform dispersion modeling for projects

Dispersion modeling could be used for:

- Analyzing the impact on ambient concentrations of MSATs due to moving traffic closer to receptors (through widening or realignment)
- Comparison of ambient concentrations near a project to EPA reference concentrations for the MSATs (RfCs) or state benchmarks
- Calculating concentrations to use in a 70-year cancer risk assessment

Dispersion Modeling

One obvious problem with conducting dispersion modeling is the shortcomings with MOBILE6.2 emission rates:

- Inability to produce localized emission rates
- Inability to produce emission rates for specific speeds or highly-congested conditions
- Limitations of diesel particulate emission rates

In the March 2006 rulemaking on PM hotspot analysis, EPA ruled out dispersion modeling for PM until the MOVES model is released and modeling guidance is issued

Dispersion Modeling

Studies examining the accuracy and precision of air quality models as documented by the EPA in their Guideline on Air Quality Models provide these common conclusions:

- "(1) models are more reliable for estimating longer time-averaged concentrations that for estimating short-term concentrations at specific locations, and
- (2) the models are reasonably reliable in estimating the magnitude of the highest concentrations occurring sometime, somewhere within an area" – errors of ± 10 – 40% are typical
- "Estimates of concentrations that occur at a specific time and site are poorly correlated with actually observed concentrations and are much less reliable" – factor of 2 often quoted

Dispersion Modeling

Why is this important? For MSATs, we are often asked to analyze exposures at specific locations (e.g., a school playground, or the air intake for a building). The available models may not be capable of doing this precisely.

The ability to predict exposures at a specific time may also be important; residential exposures may be more significant at night; while exposures at places of work and schools may be more significant during the day.

Air dispersion models are reasonably accurate in predicting long-term concentrations; but it is also important to note if the long-term predictions are right for the right reasons.

But we use CAL3QHC for CO hotspots . . .

For CO hotspot analysis under conformity or NEPA, we don't care where the hotspots are, or when, we just want to know whether there are any (and if so, if build is less than no-build).

The location and timing of hotspots is not important for these analyses, so this use of the model is consistent with CAL3QHC's capabilities.

Is dispersion modeling necessary?

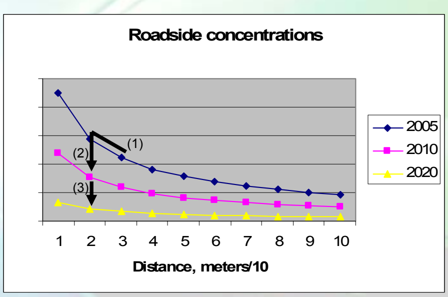
Dispersion modeling is sometimes requested in order to evaluate alternatives that could move traffic closer to roadside receptors (e.g., through widening or realignment of the roadway)

These requestors assume that moving traffic closer to receptors will result in higher concentrations, but emissions reductions from fleet turnover are also an important factor

The next graph shows what concentrations might look like, taking both distance and lower emissions into account (disregarding the uncertainties in MOBILE6.2 and CALINE):

Illustrative Example

(1) If receptor is 30 meters from the roadway in the base case, and
(2) we move the road 10 meters closer, values are still lower by opening day,
(3) and are even lower in the design year.



Dispersion Modeling

Because of these issues, FHWA is currently not supportive of performing dispersion modeling for projects, even for comparative purposes

This is one area where both EPA and FHWA are conducting research on improved modeling tools and techniques

Risk Assessment

EPA and interest groups have requested risk assessments for some projects

Other federal agencies sometimes conduct risk assessments for proposed projects or activities

Risk assessment involves emissions and dispersion modeling, along with adjustments for exposure and calculation of cancer or non-cancer risk based on that exposure

Exposure

Dispersion modeling results need to be adjusted to account for exposure when conducting risk assessments

People aren't typically at the same location for 24 hours a day, 365 days a year, for 70 years

Using the worst case assumption that people will be exposed to a given concentration for an entire year or 70 years could grossly overestimate exposure and risk for near-roadway locations

Exposure

Exposure adjustment factors to consider for annual analysis:

- daily travel to other parts of the metro area
- working hours at workplaces
- length of hospital or nursing home stays
- school hours and length of school year
- exposure among people who use the facility but don't live near it, live near it but don't use it, and people who do both

Exposure adjustment factors to consider for 70-year analysis:

- length of time at a given school or job
- length of time at a given residence

Exposure Factoids

The average person in the US makes 4.1 trips covering about 40 miles per day

People without cars or with medical conditions limiting travel still report an average of 2.7 trips per day

One hour of commuting can result in higher MSAT exposure than 23 hours in a residence

The average person in the US changes residence every 7 years

The average worker in the US changes jobs every 3 years

Exposure Modeling

EPA's HAPEM6 model could be used to translate near-roadway exposure to total exposure, instead of assuming 24/7/365 exposure (worst-case). However, FHWA's concern is that this research-level tool is not practical for routine use in NEPA analysis.

Exposures to other sources of the same pollutant, including indoor air exposures, add to total exposure. Incorporating these exposures into NEPA analysis would involve considerable resources; not including them introduces additional uncertainty into project-level analysis.

Risk Assessment: MOBILE6.2 Emissions Modeling

In addition to the other issues with MOBILE6.2, it is not helpful for 70-year risk assessments because it is not a true forecasting model.

MOBILE6.2 does not include assumptions or estimates regarding future technology or emissions improvements; instead, it treats the emissions standards in place today as the last improvements to vehicle technology that will ever happen.

This is clearly not realistic, given the trend over the last 35 years of vehicle emissions control.

Risk Assessment: Travel Activity Data

MSAT risk assessments are based on an assumed 70-year lifetime exposure.

However, we don't have any reasonable way to guess what traffic volumes and speeds will be 70 years from now, or 70 years from project completion.

Any attempt to guess what travel activity and vehicle emissions will be like 70 years from now would be too speculative to be useful for decision-making purposes.

Risk Characterization

The most significant shortfall here is the lack of a unit risk factor for diesel particulate. While EPA has classified diesel particulate as a probable human carcinogen, they have so far declined to publish a formal risk estimate.

Even though diesel particulate is believed to contribute a large portion of MSAT risk nationwide, without a unit risk estimate, dispersion and exposure modeling cannot be used to produce estimates of cancer risk.

California has issued a risk estimate, which was used in the MATES study, but EPA and the Health Effects Institute do not believe that the existing data support taking this step.

Risk Characterization

The current EPA view of risk from diesel particulate is contained in its Health Assessment Document for Diesel Engine Exhaust (U.S. Environmental Protection Agency, 2002):

> "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"* [emphasis added].

Why is FHWA different from others that do perform risk assessment?

Other agencies have better information to work with.

For example, it's reasonable to assume that a landfill will continue to leach contaminants into groundwater for 70 years as long as annual precipitation stays roughly the same, or that a stationary source will operate at its permit limits for its 40-year useful life, and then shut down. Thus, it's easier to predict future emissions and concentrations without making a lot of assumptions.

Also, MOBILE6.2 does not allow us to accurately predict diesel emissions or emissions at specific speeds, while better data can be obtained for other facilities (testing groundwater, stack testing for a stationary source)

Considerations for Advanced Analysis

1) Will advanced analysis contribute to the decision-making process? Will it yield results accurate enough to distinguish between alternatives and help inform decisions?

2) Is it necessary? Are emissions analyses identifying potential problems that we need advanced modeling to better understand?

Uncertainty Associated with Dispersion Modeling

Uncertainty associated with dispersion modeling results is a function of uncertainty in the emissions rates and the dispersion model and its inputs

Past evaluation studies have generally found that MOBILE6 produces emissions rates within 20-30% of "actual" emissions; in model to monitor comparison studies, researchers are usually satisfied with factor of 2 accuracy from dispersion models, although better performance is possible with refined methodologies

CA Case study in characterizing uncertainty identified a -23% to +104% range for neighborhood scale modeling

Uncertainty Associated with Risk Assessment

For risk assessment, in addition to uncertainty in dispersion modeling results, additional uncertainty is introduced in accounting for (or not accounting for) exposure

Worst-case assumptions (24 / 7 / 365, 70 year) tend to overestimate exposure to near-roadway concentrations

Exposure modeling can reduce, but not eliminate, uncertainty, and is not practical to perform as part of NEPA project-level analysis

Differences Between Alternatives

Project	Max % Change, future No Action/Build
I-5 Delta Park to Lombard	0.36%
DIFT	3.7%
US36	2.6%
ICC	5.7%

Is Advanced Analysis Useful for Decision-making?

FHWA's assessment of the current state of the science is that the error ranges associated with the analysis tools are much greater than the percent differences in emissions that we are seeing so far for project alternatives.

Advanced methodologies can help reduce uncertainty, but are generally not practical to use in the NEPA context

Thus, FHWA's NEPA MSAT guidance relies on emissions analysis as an indicator of potential changes in health risk, along with qualitative analysis to disclose other potential outcomes

2) Is advanced analysis necessary?

Project	Max % Change, future No Action/Build	% Change, baseline to future No Action
I-5 Delta Park to Lombard	0.36%	79% reduction
DIFT	3.7%	75% reduction
US36	2.6%	53% reduction
ICC	5.7%	82% reduction

Is advanced analysis necessary?

Nearly all of the existing analyses show that emissions decline over time as a result of EPA's national control programs, and that the difference between future alternatives is typically much less than the overall reduction.

In other words, the situation will usually get better regardless of which alternative is chosen, and the only difference between alternatives is how much better.

There are exceptions to this, including entirely new roadways that expose populations to traffic that didn't exist before, and projects that move traffic considerably closer to receptors.

Conclusions

At this point, we are comfortable with using MOBILE6.2 to project trends, and reasonably comfortable with using it to compare alternatives

However, given the limitations associated with MOBILE6.2, FHWA does not consider this model suitable for use in producing absolute emissions estimates as inputs to dispersion modeling or the subsequent steps in the risk assessment process

FHWA is working with EPA to improve the emissions model, improve dispersion models, and reduce the uncertainty associated with transportation risk assessment tools.

Future Directions

Emissions: **FHWA is working with EPA on the MOVES model, to be released in draft form for MSAT analysis next year. MOVES will be a major improvement, with:**

- True microscale emission rates
- Improved diesel emissions modeling
- Advanced technology modeling

FHWA has completed the EMIT model, which serves as a graphical user interface for MOBILE6.2 and enables modelers to develop improved MSAT analyses (e.g., through use of monthly inventories and hourly speeds).

Future Directions

Exposure: **EPA and FHWA could work together to define representative exposure adjustment methods or assumptions, so that dispersion modeling results can be adjusted to account for exposure without research-level exposure modeling.**

Dispersion: **FHWA has written a proposal and is seeking funding for contract work to develop a new roadway dispersion model, combining the best aspects of HYROAD & TRAQSIM, and designed to work with MOVES. EPA is also evaluating dispersion models.**

Future Directions

Risk: **Research is always ongoing to improve MSAT risk estimates. EPA needs to continue work to define a diesel particulate risk factor.**

Risk Communication: **FHWA could use EPA's expertise to help us explain MSAT analysis results in NEPA documents.**

Illinois Department of Transportation

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