APPENDIX P

MSP 2020 Improvements EA
Vehicular Air Quality Analysis
Memorandum

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MEMORANDUM

TO: Brandon Bourdon, P.E.
Kimley-Horn & Associates, Inc.

FROM: Paul Morris, Senior Engineer

DATE: June 5, 2012

SUBJECT: MINNEAPOLIS-ST. PAUL INTERNATIONAL AIRPORT 2020 IMPROVEMENTS
ENVIRONMENTAL ASSESSMENT
VEHICULAR AIR QUALITY ANALYSIS

This memorandum provides air quality documentation for inclusion in the Minneapolis-St. Paul International Airport 2020 Improvements Environmental Assessment (EA). The methods used to evaluate vehicle Carbon Monoxide and Mobile Source Air Toxic effects were established in cooperation with MnDOT and FHWA.

Introduction

Motorized vehicles affect air quality by emitting airborne pollutants. Changes in traffic volumes, travel patterns, and roadway locations affect air quality by changing the number of vehicles and the congestion levels in a given area. The air quality impacts from the project are analyzed by addressing criteria pollutants, a group of common air pollutants regulated by the U.S. Environmental Protection Agency (EPA) on the basis of criteria (information on health and/or environmental effects of pollution). The criteria pollutants identified by the EPA are ozone, particulate matter, carbon monoxide, nitrogen dioxide, lead, and sulfur dioxide. Potential impacts resulting from these pollutants are assessed by comparing projected concentrations to National Ambient Air Quality Standards (NAAQS).

In addition to the criteria air pollutants, the EPA also regulates air toxics. The Federal Highway Administration (FHWA) provides guidance for the assessment of Mobile Source Air Toxic (MSAT) effects for transportation projects in the National Environmental Policy Act (NEPA) process. A quantitative evaluation of MSATs has been performed for the EA as documented below. The scope and methods of the analysis performed were developed in collaboration with the Minnesota Department of Transportation (MnDOT), Minnesota Pollution Control Agency (MPCA), and Federal Highway Administration (FHWA).

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NAAQS Criteria Pollutants

Ozone

Ground-level ozone is a primary constituent of smog and is a pollution problem throughout many areas of the United States. Exposures to ozone can make people more susceptible to respiratory infection, result in lung inflammation, and aggravate preexisting respiratory diseases such as asthma. Ozone is not emitted directly from vehicles but is formed as volatile organic compounds (VOCs) and nitrogen oxides (NOx) react in the presence of sunlight. Transportation sources emit NOx and VOCs and can therefore affect ozone concentrations. However, due to the phenomenon of atmospheric formation of ozone from chemical precursors, concentrations are not expected to be elevated near a particular roadway.

The MPCA, in cooperation with various other agencies, industries, and groups, has encouraged voluntary control measures to control ozone and has begun developing a regional ozone modeling effort. Ozone concentrations in the lower atmosphere are influenced by a complex relationship of precursor concentrations, meteorological conditions, and regional influences on background concentrations. The MPCA staff has begun development of ozone modeling for the Twin Cities metropolitan area. The MPCA has recently indicated that the ozone models currently use federal default traffic data and a relatively coarse modeling grid. Ozone modeling in Minnesota is in its developmental stage; therefore, there is no available method for determining the contribution of a single roadway to regional ozone concentrations. Ozone levels in the Twin Cities metropolitan area currently meet state and federal standards, and reductions in ozone levels have been observed between 2007 and 2010. Additionally, the State of Minnesota is classified by the EPA as an "ozone attainment area," which means that Minnesota has been identified as a geographic area that meets the national health-based standards for ozone levels. Because of these factors, a quantitative ozone analysis was not conducted for the EA.

Particulate Matter

Particulate matter (PM) is the term for particles and liquid droplets suspended in the air. Particles come in a wide variety of sizes and have been historically assessed based on size, typically measured by the diameter of the particle in micrometers. PM2.5 or fine particulate matter refers to particles that are 2.5 micrometers or less in diameter. PM10 refers to particulate matter that is 10 micrometers or less in diameter.

Motor vehicles (i.e., cars, trucks, and buses) emit direct PM from their tailpipes, as well as from normal brake and tire wear. Vehicle dust from paved and unpaved roads may be re-entrained, or re-suspended, in the atmosphere. In addition, PM2.5 can be formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and VOCs. PM2.5 can penetrate the human respiratory system's natural defenses and damage the respiratory tract when inhaled. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including:

Increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing for example;

- Decreased lung function;
- Aggravated asthma;
- Development of chronic bronchitis;
- Irregular heartbeat;
- Nonfatal heart attacks; and
- Premature death in people with heart or lung disease.

Source: http://www.epa.gov/air/particlepollution/health.html

The EPA issued a final rule on October 17, 2006 that tightened the NAAQSs for PM2.5 to include a 24-hour standard of 35 micrograms per cubic meter (µg/m^3) and retained the 1997 annual PM2.5 standard of 15.0 µg/m^3. The annual standard is based on a three-year average of annual mean PM2.5 concentrations; the 24-hour standard is based on a three-year average of the 98th percentile of 24-hour concentrations. The NAAQS 24-hour standard for PM10 is 150 µg/m^3, not to be exceeded more than once per year on average over three years. The following statement was published by the MPCA in the *Air Quality in Minnesota: 2011 Report to the Legislature*,

> *EPA is reevaluating the particulate standards in response to scientists' better understanding of the serious risks associated with breathing even low levels of fine particles. In light of these potential health effects, EPA's new standards, expected in 2013, will likely be more stringent.*

The Clean Air Act conformity requirements include the assessment of localized air quality impacts of federally-funded or federally-approved transportation projects that are deemed to be projects of air quality concern located within PM2.5 nonattainment and maintenance areas. The entire State of Minnesota has been designated as an unclassifiable/attainment area for PM. This means that Minnesota has been identified as a geographic area that meets the national health-based standards for PM levels, and therefore is exempt from performing PM qualitative hot-spot analyses.

Nitrogen dioxide (Nitrogen oxides)

Nitrogen oxides, or NOx, are the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. Nitrogen oxides form when fuel is burned at high temperatures, as in a combustion process. The primary sources of NOx are motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels. The MPCA's Annual Pollution Report to the Legislature: A Summary of Minnesota's Air Emissions and Water Discharges (April 2011) indicates that

> *On-road gasoline vehicles and diesel vehicles account for 40% of NOx emissions in Minnesota. In addition to being a precursor to ozone, NOx can cause respiratory irritation in sensitive individuals and can contribute to acid rain.*

Nitrogen dioxide (NO2), which is a form of nitrogen oxide (NOx), is regularly monitored in the Twin Cities metropolitan area. Currently, NO2 levels meet state and federal standards. Data presented in the MPCA's 2010 Annual Air Monitoring Network Plan for the State of Minnesota, indicates that

> *The lowest annual average level of NO2 in the State of Minnesota for the study year (2007) was 0.0054 ppm and the highest was 0.0093 ppm. These two concentrations are approximately 10-20% of the National Ambient Air Quality Standards' annual average standard for NO2 of 0.053 ppm. Therefore, Minnesota currently meets applicable NAAQS for NO2; however, continued reductions are sought, in light of the role of NO2 in forming other pollutants of concern.*

The EPA's regulatory announcement, EPA420-F-99-051 (December 1999), describes the Tier 2 standards for tailpipe emissions, and states:

> *The new tailpipe standards are set at an average standard of 0.07 grams per mile for nitrogen oxides for all classes of passenger vehicles beginning in 2004. This includes all light-duty trucks, as well as the largest SUVs. Vehicles weighing less than 6000 pounds will be phased-in to this standard between 2004 and 2007.*
>
> *As newer, cleaner cars enter the national fleet, the new tailpipe standards will significantly reduce emissions of nitrogen oxides from vehicles by about 74 percent by 2030. The standards also will reduce emissions by more than 2 million tons per year by 2020 and nearly 3 million tons annually by 2030.*

Within the Minneapolis-St. Paul International Airport 2020 Improvements EA project area, it is unlikely that NO2 standards will be approached or exceeded based on the relatively low ambient concentrations of NO2 in Minnesota and on the long-term trend toward reduction of NOx emissions. Because of these factors, a specific analysis of NO2 was not conducted for the EA.

Sulfur Dioxide

Sulfur dioxide (S02) and other sulfur oxide gases (SOx) are formed when fuel containing sulfur, such as coal, oil, and diesel fuel is burned. Sulfur dioxide is a heavy, pungent, colorless gas. Elevated levels can impair breathing, lead to other respiratory symptoms, and at very high levels aggravate heart disease. People with asthma are most at risk when SO2 levels increase. Once emitted into the atmosphere, SO2 can be further oxidized to sulfuric acid, a component of acid rain.

The MPCA's Annual Pollution Report to the Legislature: A Summary of Minnesota's Air Emissions and Water Discharges (April 2011) indicates that on-road mobile sources account for just 14 percent of SO2 emissions in Minnesota. Over 53 percent of SO2 released into the air comes from electric utilities, especially those that burn coal. MPCA monitoring shows that ambient SO2 concentrations are consistently below standards. The MPCA has concluded that long-term trends in both ambient air concentrations and total SO2 emissions in Minnesota indicate steady improvement.

Emissions of sulfur oxides from transportation sources are a small component of overall emissions and continue to decline due to the desulphurization of fuels. Additionally, the State of Minnesota is classified by the EPA as a "sulfur dioxide attainment area," which means that Minnesota has been identified as a geographic area that meets the national health-based standards for sulfur dioxide levels. Because of these factors, a quantitative analysis for sulfur dioxide was not conducted for the EA.

Lead

Due to the phase out of leaded gasoline, lead is no longer a pollutant associated with vehicular emissions.

Carbon Monoxide

Carbon monoxide (CO) is the traffic-related pollutant that has been of concern in the Twin Cities Metropolitan area. In 1999, the EPA redesignated all of Hennepin, Ramsey, Anoka, and portions of Carver, Scott, Dakota, Washington, and Wright counties as a maintenance area for CO. This means the area was previously classified as nonattainment but has now been found to be in attainment. This area includes the Minneapolis-St. Paul International Airport 2020 Improvements

EA project area, which is located in Hennepin County. Evaluation of CO for assessment of air quality impacts is required for environmental approval in NEPA documents.

Air Quality Conformity

The 1990 Clean Air Act Amendments (CAAA) require that State Implementation Plans (SIPs) must demonstrate how states with nonattainment and maintenance areas will meet federal air quality standards.

The EPA issued final rules on transportation conformity (40 CFR 93, Subpart A) which describe the methods required to demonstrate SIP compliance for transportation projects. It requires that transportation projects must be part of a conforming Long Range Transportation Policy Plan (LRTPP) and four-year Transportation Improvement Program (TIP). The proposed improvements are not considered regionally significant, as the proposed auxiliary lane addition along I-494 is less than one mile in length and no new interchange access would be provided. Therefore, these improvements do not conflict with the assumptions and conformity determination in the current LRTPP (approved by FHWA on February 2, 2011) and TIP (approved by FHWA on December 16, 2011).

On November 8, 2010, the EPA approved a limited maintenance plan request for the Twin Cities maintenance area. Under a limited maintenance plan, the EPA has determined that there is no requirement to project emissions over the maintenance period and that "an emission budget may be treated as essentially not constraining for the length of the maintenance period. The reason is that it is unreasonable to expect that our maintenance area will experience so much growth within this period that a violation of CO National Ambient Air Quality Standard (NAAQS) would result." (US EPA Limited Maintenance Plan Option for Nonclassifiable CO Nonattainment Areas, October 6, 1995). Therefore, no regional modeling analysis for the LRTPP and TIP is required; however federally funded and state funded projects are still subject to "hot spot" analysis requirements. The limited maintenance plan adopted in 2010 determines that the level of CO emissions and resulting ambient concentrations will continue to demonstrate attainment of the CO NAAQS.

Hot-Spot Analysis

A CO evaluation is performed by evaluating the worst-operating (hot-spot) intersections in the Minneapolis-St. Paul International Airport 2020 Improvements EA project area. The EPA has approved a screening method to determine which intersections need hot-spot analysis. The hot-spot screening method uses a traffic volume threshold of 79,400 entering vehicles per day. Entering traffic volumes at all intersections in the EA are forecast to be less than this threshold, as shown in Table 1. The results of the screening procedure indicate that the intersections do not require a hot-spot analysis.

Table 1
Project Area Intersection Volumes

Intersection	Year 2030 Volume
34th Ave & I-494 Westbound Ramps	77,550
34th Ave & I-494 Eastbound Ramps	61,450
Post Rd & TH 5 Westbound Ramps	39,100
Post Rd & TH 5 Eastbound Ramps	18,400

Improvements in vehicle technology and in motor fuel regulations continue to result in reductions in vehicle emission rates. The EPA Mobile 6.2 emissions model estimates that emission rates will fall by 29 to 31 percent between years 2009 and 2030[1]. Consequently, year 2030 vehicle-related CO concentrations in the Minneapolis-St. Paul International Airport 2020 Improvements EA study area are likely to be lower than existing concentrations even considering the increase in development-related and background traffic.

Mobile Source Air Toxics

Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments (CAAA) of 1990, whereby Congress mandated that the EPA regulate 188 air toxics, also known as hazardous air pollutants. The EPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (http://www.epa.gov/ncea/iris/index.html).

In addition, EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 1999 National Air Toxics Assessment (NATA) (http://www.epa.gov/ttn/atw/nata1999). These are acrolein, benzene, 1,3-butadiene, diesel particulate matter plus diesel exhaust organic gases (diesel PM), formaldehyde, naphthalene, and polycyclic organic matter. While FHWA considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules.

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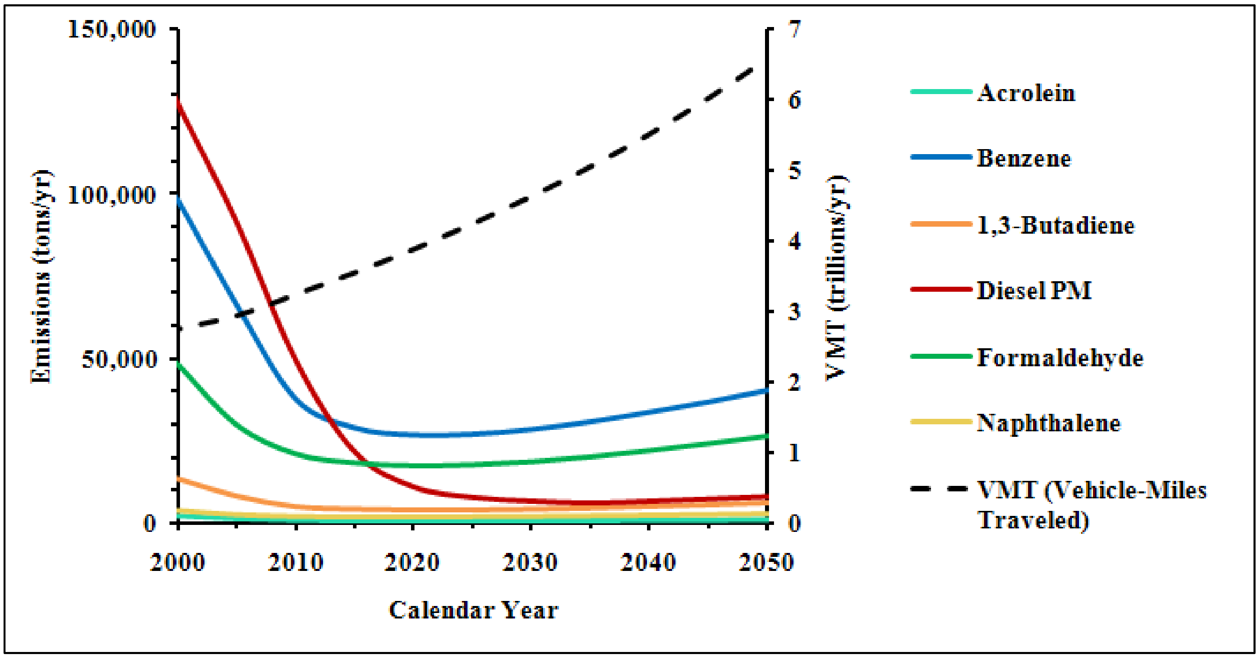
[1] MOBILE 6.2 model run performed October 27, 2004 by SRF Consulting Group, Inc. Stated reductions in CO emissions represent average reductions across vehicle speeds from 0 to 65 miles per hour (mph).

The 2007 EPA rule mentioned above requires controls that will dramatically decrease Mobile Source Air Toxics (MSAT) emissions through cleaner fuels and cleaner engines. According to an FHWA analysis using EPA's MOBILE6.2 model, even if vehicle activity (vehicle-miles traveled, VMT) increases by 145 percent as assumed, a combined reduction of 72 percent in the total annual emission rate for the priority MSAT is projected from 1999 to 2050, as shown in Figure 1.

Figure 1: National MSAT Emission Trends 1999 - 2050 for Vehicles Operating On Roadways Using EPA's MOBILE 6.2 Model



Notes:

(1) Annual emissions of polycyclic organic matter are projected to be 561 tons/yr for 1999, decreasing to 373 tons/yr for 2050.

(2) Trends for specific locations may be different, depending on locally derived information representing vehicle-miles travelled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors.
Source: U.S. Environmental Protection Agency. MOBILE6.2 model run 20 August 2009.

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 outcomes as a result of lifetime MSAT exposure remain limited. These limitations impede the ability to evaluate how the potential health risks posed by MSAT exposure should be factored into project-level decision-making within the context of NEPA.

Nonetheless, air toxics concerns continue to be raised on highway projects during the NEPA process. Even as the science emerges, we are duly expected by the public and other agencies to address MSAT impacts in our environmental documents. The FHWA, EPA, the Health Effects Institute, and others have funded and conducted research studies to try to more clearly define potential risks from MSAT emissions associated with highway projects. The FHWA will continue to monitor the developing research in this emerging field.

Unavailable Information for Project Specific MSAT Impact Analysis

The FHWA has prepared guidance for basic analysis of the likely MSAT emission impacts of highway projects. However, available technical tools do not enable us to predict the project-specific health impacts of MSAT emission. Due to these limitations, the following discussion is included in accordance with CEQ regulations (40 CFR 1502.22(b)) regarding incomplete or unavailable information.

In FHWA's view, information is incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with a proposed set of highway alternatives. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process through assumption and speculation rather than any genuine insight into the actual health impacts directly attributable to MSAT exposure associated with a proposed action.

The EPA is responsible for protecting the public health and welfare from any known or anticipated effect of an air pollutant. They are the lead authority for administering the Clean Air Act and its amendments and have specific statutory obligations with respect to hazardous air pollutants and MSAT. The EPA is in the continual process of assessing human health effects, exposures, and risks posed by air pollutants. They maintain the IRIS, which is "a compilation of electronic reports on specific substances found in the environment and their potential to cause human health effects" (EPA, http://www.epa.gov/ncea/iris/index.html). Each report contains assessments of non-cancerous and cancerous effects for individual compounds and quantitative estimates of risk levels from lifetime oral and inhalation exposures with uncertainty spanning perhaps an order of magnitude.

Other organizations are also active in the research and analyses of the human health effects of MSAT, including the Health Effects Institute (HEI). Two HEI studies are summarized in Appendix D of FHWA's Interim Guidance Update on Mobile Source Air Toxic analysis in NEPA Documents. Among the adverse health effects linked to MSAT compounds at high exposures are cancer in humans in occupational settings; cancer in animals; and irritation to the respiratory tract, including the exacerbation of asthma. Less obvious is the adverse human health effects of MSAT compounds at current environmental concentrations (HEI, http://pubs.healtheffects.org/view.php?id=282) or in the future as vehicle emissions substantially decrease (HEI, http://pubs.healtheffects.org/view.php?id=306).

The methodologies for forecasting health impacts include emissions modeling; dispersion modeling; exposure modeling; and then final determination of health impacts - each step in the process building on the model predictions obtained in the previous step. All are encumbered by technical shortcomings or uncertain science that prevents a more complete differentiation of the MSAT health impacts among a set of project alternatives. These difficulties are magnified for lifetime (i.e., 70 year) assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over that time frame, since such information is unavailable. The results produced by the EPA's MOBILE6.2 model, the California EPA's Emfac2007 model, and the EPA's Draft MOVES2009 model in forecasting MSAT emissions are highly inconsistent. Indications from the development of the MOVES model are that MOBILE6.2 significantly underestimates diesel particulate matter (PM) emissions and significantly overestimates benzene emissions.

Regarding air dispersion modeling, an extensive evaluation of EPA's guideline CAL3QHC model was conducted in a National Cooperative Highway Research Program (NCHRP) study (http://www.epa.gov/scram001/dispersion_alt.htm#hyroad), which documents poor model performance at 10 sites across the country - three where intensive monitoring was conducted plus an additional seven with less intensive monitoring. The study indicates a bias of the CAL3QHC model to overestimate concentrations near highly congested intersections and underestimate concentrations near uncongested intersections. The consequence of this is a tendency to overstate the air quality benefits of mitigating congestion at intersections. Such poor model performance is less difficult to manage for demonstrating compliance with NAAQS for relatively short time frames than it is for forecasting individual exposure over an entire lifetime, especially given that some information needed for estimating 70-year lifetime exposure is unavailable. It is particularly difficult to reliably forecast MSAT exposure near roadways, and to determine the portion of time that people are actually exposed at a specific location.

There are considerable uncertainties associated with the existing estimates of toxicity of the various MSAT, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by HEI (http://pubs.healtheffects.org/view.php?id=282). As a result, there is no national consensus on air dose-response values assumed to protect the public health and welfare for MSAT compounds, and in particular for diesel PM. The EPA (http://www.epa.gov/risk/basicinformation.htm#g) and the HEI (http://pubs.healtheffects.org/getfile.php?u=395) have not established a basis for quantitative risk assessment of diesel PM in ambient settings.

There is also the lack of a national consensus on an acceptable level of risk. The current context is the process used by the EPA as provided by the Clean Air Act to determine whether more stringent controls are required in order to provide an ample margin of safety to protect public health or to prevent an adverse environmental effect for industrial sources subject to the maximum achievable control technology standards, such as benzene emissions from refineries. The decision framework is a two-step process. The first step requires EPA to determine a "safe" or "acceptable" level of risk due to emissions from a source, which is generally no greater than approximately 100 in a million. Additional factors are considered in the second step, the goal of which is to maximize the number of people with risks less than 1 in a million due to emissions from a source. The results of this statutory two-step process do not guarantee that cancer risks from exposure to air toxics are less than 1 in a million; in some cases, the residual risk determination could result in maximum individual cancer risks that are as high as approximately 100 in a million. In a June 2008 decision, the U.S. Court of Appeals for the District of Columbia Circuit upheld EPA's approach to addressing risk in its two step decision framework. Information is incomplete or unavailable to establish that even the largest of highway projects would result in levels of risk greater than safe or acceptable.

Because of the limitations in the methodologies for forecasting health impacts described, any predicted difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with predicting the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against project benefits, such as reducing traffic congestion, accident rates, and fatalities plus improved access for emergency response, that are better suited for quantitative analysis.

Qualitative MSAT Analysis

The FHWA was consulted to determine the appropriate level of MSAT analysis for the proposed roadway improvements. This consultation resulted in the following response:

> *Although the projected 2030 ADT on I-494 exceeds the 140,000 to 150,000 ADT threshold outlined in FHWA guidance that would [require] a quantitative assessment, the anticipated scope of work appears to (1) primarily improve highway operations without adding substantial new capacity, and (2) result in a facility that is not likely to meaningfully increase MSAT emissions.*

As such, it was concluded that a qualitative MSAT analysis is adequate for the proposed roadway improvements in the Minneapolis-St. Paul International Airport 2020 Improvements EA.

For each alternative in the Minneapolis-St. Paul International Airport 2020 Improvements EA, the amount of MSAT emitted would be proportional to the average daily traffic, or ADT, assuming that other variables such as fleet mix are the same for each alternative. The ADT estimated for the Build Alternative is the same as that for the No Build Alternative, because the proposed improvements provide operational benefits but are not expected to reroute trips from elsewhere in the transportation network. As a result, MSAT emissions are not expected to differ substantially between alternatives. MSAT emissions may, in fact, be expected to decrease somewhat due to increased speeds; according to EPA's MOBILE6.2 model, emissions of all of the priority MSAT except for diesel particulate matter decrease as speed increases. The extent to which these speed-related emissions decreases affect total emissions increases cannot be reliably projected due to the inherent deficiencies of technical models. Because the estimated VMT under each of the Alternatives are the same, it is expected there would be no appreciable difference in overall MSAT emissions among the various alternatives. Also, regardless of the alternative chosen, emissions will likely be lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce annual MSAT emissions by 72 percent between 1999 and 2050. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be lower in the future in nearly all cases.

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