SR 99: ALASKAN WAY VIADUCT & SEAWALL REPLACEMENT PROGRAM

Air Quality Discipline Report

SR 99: Battery Street Tunnel Fire and Safety Improvements

SEPA Checklist

October 2008

Air Quality Discipline Report

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Submitted to:

Washington State Department of Transportation
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The SR 99: Alaskan Way Viaduct & Seawall Replacement Program is a joint effort between the Federal Highway Administration (FHWA), the Washington State Department of Transportation (WSDOT), and the City of Seattle. To conduct this project, WSDOT contracted with:

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LIST OF EXHIBITS

ATTACHMENTS

ACRONYMS

μg/m3	micrograms per cubic meter
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration
HOV	high-occupancy vehicle
IRIS	Integrated Risk Information System
MSAT	Mobile Source Air Toxics
MTP	Metropolitan Transportation Plan
NAAQS	National Ambient Air Quality Standards
NO_2	nitrogen dioxide
N_2O	nitrous oxide
NO_x	nitrogen oxides
$PM_{2.5}$	particulate matter less than 2.5 micrometers in size
PM_{10}	particulate matter less than 10 micrometers in size
ppm	parts per million
Project	SR 99: Battery Street Tunnel Fire and Safety Improvements Project
PSCAA	Puget Sound Clean Air Agency
PSRC	Puget Sound Regional Council
SO_2	sulfur dioxide
SR	State Route
TIP	Transportation Improvement Program
VMT	vehicle miles traveled
VOC	volatile organic compound
WAC	Washington Administrative Code
WASIST	Washington State Intersection Screening Tool
WSDOT	Washington State Department of Transportation

Chapter 1 SUMMARY

1.1 Introduction

The Alaskan Way Viaduct and Seawall Replacement Program was initiated by the Federal Highway Administration (FHWA), Washington State Department of Transportation (WSDOT), and the City of Seattle. This program consists of the Alaskan Way Viaduct and Seawall Replacement along the central waterfront, and the Moving Forward projects, which include column safety, electrical line relocation, north-end viaduct improvements, south-end viaduct replacement, and transit enhancements. The Moving Forward projects will repair or replace about half of the seismically vulnerable viaduct and will provide safety improvements to the Battery Street Tunnel.

The Battery Street Tunnel is approximately one-half mile in length and carries two lanes of State Route (SR) 99 in each direction. A center wall separates northbound and southbound lanes. The Battery Street Tunnel on- and off-ramps connect to SR 99 at the south tunnel portal.

This Air Quality Discipline Report is an appendix to the State Environmental Policy Act (SEPA) Checklist for the SR 99: Battery Street Tunnel Fire and Safety Improvements Project (the Project). The purpose of this report is to identify potential air quality effects associated with the Project.

The proposed improvements to the Battery Street Tunnel include upgrading the fire and safety systems, reinforcing the roof beams, removing existing asbestos pipe conduits, and adding a second equipment room and emergency stairwell in the southbound lanes. Accumulated soot on the tunnel's upper walls and ceiling areas would be removed. In addition, the short on- and off-ramps at the south portal of the tunnel at Western Avenue would be converted to emergency access and maintenance use only.

Traffic in the study area would be affected by changes in the number of vehicles, travel speed, and the levels of congestion experienced on local roadways. Air quality, which is a general term used to describe pollutant levels in the atmosphere, can be affected by these traffic changes.

1.2 Study Area

The project limits extend from the sign bridge to be replaced on SR 99 at approximately Virginia Street to the proposed sign bridge on SR 99 at about Ward Street. The study area for this Air Quality Discipline Report encompasses the Project's major construction limits on SR 99 from Denny Way (the north portal of the Battery Street Tunnel) to approximately First

Avenue (the south portal of the Battery Street Tunnel), and also includes nearby transportation facilities that are closely related to or affected by the SR 99 corridor. As shown in Exhibit 1-1, the study area encompasses roughly two blocks on either side of SR 99, bordered by Elliott Avenue to the south and Harrison Street to the north. In addition to the Project's major construction, there would be short-term construction related to the sign structures to the north and south of the tunnel portals. This construction would occur outside of the air quality and transportation study areas, but it is addressed qualitatively in Chapter 6, the Construction Effects and Mitigation section of this report.

The air quality analyses for this Project followed current guidelines developed by the United States Environmental Protection Agency (EPA), FHWA, WSDOT, Washington State Department of Ecology (Ecology), Puget Sound Clean Air Agency (PSCAA), and Puget Sound Regional Council (PSRC).

1.3 Alternatives Studied

1.3.1 No Build Alternative

The No Build Alternative assumes continued operation and maintenance of the existing Battery Street Tunnel. Although this scenario is useful for assessing the Build Alternative's performance and effects relative to the facility in place today, it should be recognized that the current facility was built in 1950 and has not been upgraded since. Its mechanical and electrical systems do not meet modern safety requirements.

1.3.2 Build Alternative

Conversion of the on- and off-ramps at the south end of the Battery Street Tunnel to emergency access and maintenance use only would change traffic patterns in the area and affect air quality levels.

The main construction work would focus on upgrading the mechanical, fire, and safety systems in the Battery Street Tunnel:

- Installation of the new sprinkler pipes, fire alarm system, ventilation fan controls, and lighting.
- Reinforcing the roof beams and adding a second equipment room and emergency exit stairwell in the southbound lanes.
- Removing the existing asbestos pipe conduits.
- Removing accumulated soot on the tunnel upper walls and ceiling areas prior to general construction activity.

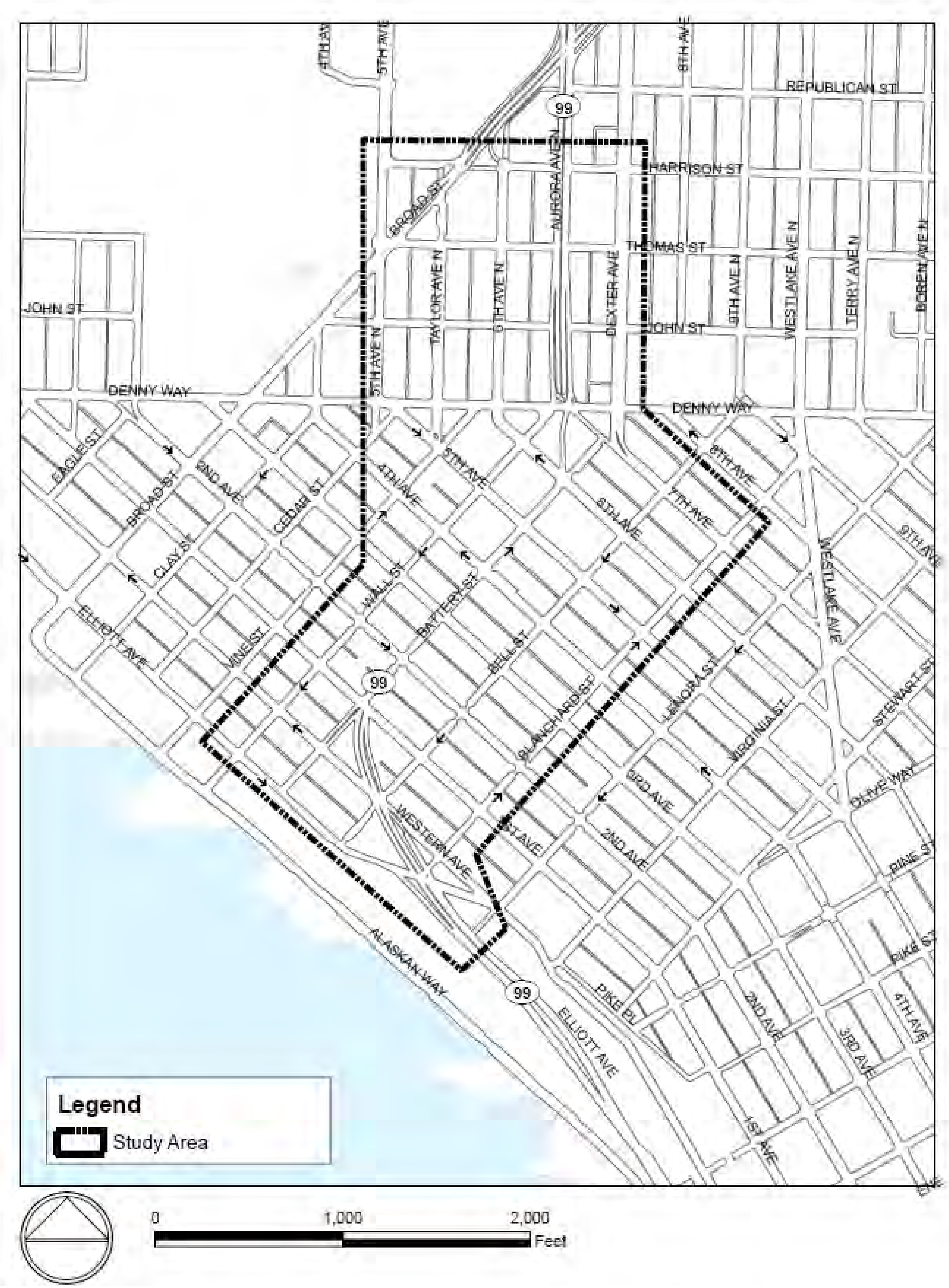

Exhibit 1-1. Study Area

1.4 Affected Environment

EPA identified several air pollutants as being of concern nationwide. These pollutants are known as "criteria pollutants." The sources of these pollutants, their effects on human health and the nation's welfare, and their concentration in the atmosphere vary considerably. Under the Clean Air Act, EPA has established National Ambient Air Quality Standards (NAAQS), which specify maximum allowable concentrations for these criteria pollutants. Areas not in compliance with NAAQS are deemed nonattainment areas. Areas that were once classified as nonattainment but have since demonstrated attainment are classified as maintenance areas. The study area is located in a carbon monoxide (CO) maintenance area.

In addition to the criteria pollutants for which there are NAAQS, EPA also regulates air toxics. Toxic air pollutants are those pollutants known or suspected to cause cancer or other serious health effects. The Clean Air Act identifies 188 air toxics. In 2001 EPA provided a list of 21 Mobile Source Air Toxics (MSAT) and highlighted six of these MSAT as priority MSAT (benzene, acrolein, formaldehyde, 1,3-butadiene, acetaldehyde, and diesel particulate matter/diesel exhaust). However, conformity requirements for MSAT emissions do not yet exist because EPA has not established ambient standards for MSAT levels.

1.5 Operational Effects and Mitigation

The Washington State Intersection Screening Tool (WASIST) was used to estimate CO levels at sensitive receptor sites near heavily congested intersections expected to be affected by the Project under existing and future conditions. The EPA AERMOD regulatory modeling system was used to estimate effects of the traffic emissions generated in the Battery Street Tunnel and released through the exit portals. The analyses showed that the Project would not cause or contribute to any new localized CO violations, increase the frequency or severity of any existing violations, or delay timely attainment of the NAAQS.

In accordance with FHWA guidelines, a qualitative MSAT analysis was conducted. This analysis concluded that the magnitude of the EPA-projected reductions in MSAT emissions is so great (due to cleaner fuels and cleaner engines) that MSAT emissions in the study area are likely to be lower in the future with or without the Project. In addition, the Project is not predicted to affect greenhouse gas levels in the region.

Because the regional MSAT and greenhouse gas emissions are not expected to increase and no exceedances of the NAAQS are anticipated, no substantial adverse air quality effects are expected to result from the Project. Therefore, no operational mitigation measures would be necessary.

1.6 Construction Effects and Mitigation

Air pollutant emissions that result from construction activities were qualitatively assessed for the Project. Fugitive dust emissions would vary from day to day, depending on the level of activity, specific operations, and weather conditions. Larger dust particles would settle near the source, and fine particles would be dispersed over greater distances from the construction site.

Fugitive dust emissions from construction activities could be noticeable, if uncontrolled. In compliance with WSDOT's Memorandum of Agreement with PSCAA, the Project will create a fugitive dust control plan to control dust during construction. The control plan could include measures such as spraying exposed soil with water, covering truck loads and materials as needed, removing particulate matter from roads, routing and scheduling construction trucks to reduce delays, ensuring well-maintained equipment, and implementing other temporary mitigation measures as needed and considered appropriate.

In addition to the fugitive dust control plan, the Project's traffic management plan includes detours and strategic construction planning (like weekend work, parking restrictions, and signal timing enhancements) to continue moving traffic through the area and reduce backups to the traveling public to the extent possible. Construction areas, staging areas, and material transfer sites would be set up in a way that reduces standing wait times for equipment, engine idling, and the need to block the movement of other activities on the site. These strategies would reduce fuel consumption by reducing wait times and ensuring that construction equipment operates efficiently. Due to space constraints at the work site and the benefit of additional emissions reductions, ridesharing and other commute trip reduction efforts may be promoted for employees working on the Project.

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Chapter 2 BACKGROUND, STUDIES, AND COORDINATION

2.1 Air Quality Standards

EPA identified several air pollutants as being of concern nationwide. These pollutants, known as "criteria pollutants," are CO, particulate matter less than 10 micrometers in size (PM_{10}), particulate matter less than 2.5 micrometers in size ($PM_{2.5}$), ozone, sulfur dioxide (SO_2), lead, and nitrogen dioxide (NO_2). The sources of these pollutants, their effects on human health and the nation's welfare, and their concentration in the atmosphere vary considerably. Under the Clean Air Act, EPA has established NAAQS, which specify maximum allowable concentrations for these criteria pollutants. The State of Washington and PSCAA have also adopted these standards. In addition, Washington and PSCAA have a standard for total suspended particulates. The standards applicable to transportation projects are summarized in Exhibit 2-1.

The current $PM_{2.5}$ standards were published in the *Federal Register* on July 30, 2004, and became effective on that date. EPA adopted the current $PM_{2.5}$ standards on October 17, 2006, and they went into effect on December 17, 2006. These standards consist of a stricter 24-hour standard for $PM_{2.5}$ (35 micrograms per cubic meter [$\mu g/m^3$] versus the previous standard of 65 $\mu g/m^3$), but no change was made to the annual $PM_{2.5}$ standard. For PM_{10}, the 24-hour standard remained the same and the annual standard was dropped. EPA will redesignate nonattainment areas for $PM_{2.5}$ based on the new 24-hour $PM_{2.5}$ standard. Compliance with the recently adopted 24-hour $PM_{2.5}$ standard is not required until the designations are assigned.

A violation of the NAAQS may threaten federal funding of a transportation project, and proposed roadway projects requiring federal funding or approval must demonstrate compliance with EPA's Transportation Conformity Rule. Conformity is demonstrated by showing that a project would not cause or contribute to any new violation of any NAAQS, increase the frequency or severity of any existing NAAQS violations, or delay timely attainment of the NAAQS.

Exhibit 2-1. Summary of Ambient Air Quality Standards

Pollutant	National Primary Standard	Washington State Standard	PSCAA Regional Standard
Carbon Monoxide (CO)			
1-Hour Average (not to be exceeded more than once per year)	35 ppm	35 ppm	35 ppm
8-Hour Average (not to be exceeded more than once per year)	9 ppm	9 ppm	9 ppm
PM_{10}			
Annual Arithmetic Mean	N/A	50 µg/m^3	50 µg/m^3
24-Hour Average Concentration	150 µg/m^3	150 µg/m^3	150 µg/m^3
$PM_{2.5}$			
Annual Arithmetic Mean	15 µg/m^3	N/A	N/A
24-Hour Average Concentration (98th percentile)	35 µg/m^3	N/A	N/A
Total Suspended Particulates (TSP)			
Annual Arithmetic Mean	N/A	60 µg/m^3	60 µg/m^3
24-Hour Average Concentration (not to be exceeded more than once per year)	N/A	150 µg/m^3	150 µg/m^3
Ozone			
8-Hour Average (not to be exceeded more than once per year)	0.08 ppm	N/A	N/A
Sulfur Dioxide (SO_2)			
1-Hour Average (not to be exceeded more than twice in 7 days)	N/A	0.25 ppm	0.25 ppm
24-Hour Average Concentration (never to be exceeded)	0.14 ppm	0.1 ppm	0.1 ppm
Annual Arithmetic Mean	0.03 ppm	0.02 ppm	0.02 ppm
Nitrogen Dioxide (NO_2)			
Annual Arithmetic Mean	0.053 ppm	0.053 ppm	0.053 ppm
Lead			
24-Hour Average Concentration (never to be exceeded)	1.5 µg/m^3	1.5 µg/m^3	1.5 µg/m^3

Notes: ppm = parts per million µg/m^3 = micrograms per cubic meter

Sources: Puget Sound Clean Air Agency (PSCAA) Regulation 1 (1994); 40 CFR Part 50 (1997); WAC Chapters 173-470, 173-474, 173-175 (1987).

2.2 Pollutants of Concern

2.2.1 Carbon Monoxide

CO is a colorless gas that interferes with the transfer of oxygen to the brain. CO is emitted almost exclusively from the incomplete combustion of fossil fuels. Prolonged exposure to high levels of CO can cause headaches, drowsiness, loss of equilibrium, or heart disease. CO concentrations can vary greatly over relatively short distances. Relatively high concentrations of CO are typically found near congested intersections, along heavily used roadways carrying slow-moving traffic, and in areas where atmospheric dispersion is inhibited by urban "street canyon" conditions. Consequently, CO concentrations are predicted on a localized, or microscale, basis.

2.2.2 Particulate Matter

Particulate pollution is composed of solid particles or liquid droplets that are small enough to remain suspended in the air. Of particular concern are those particles that are smaller than, or equal to, 10 microns (PM_{10}) or 2.5 microns ($PM_{2.5}$).

PM_{10} consists of very small liquid and solid particles floating in the air, which can include smoke, soot, dust, salts, acids, and metals. It also forms when gases emitted from motor vehicles or industrial sources undergo chemical reactions in the atmosphere. Major sources of PM_{10} include motor vehicles; wood-burning stoves and fireplaces; dust from construction, landfills, and agriculture; wildfires and brush/waste burning; industrial sources; windblown dust from open lands; and atmospheric chemical and photochemical reactions. Suspended particulates produce haze and reduce visibility.

PM_{10} poses a greater health risk than larger-sized particles. When inhaled, these tiny particles can penetrate the human respiratory system's natural defenses and damage the respiratory tract. PM_{10} can increase the number and severity of asthma attacks, cause or aggravate bronchitis and other lung diseases, and reduce the body's ability to fight infections.

$PM_{2.5}$ results from fuel combustion (from motor vehicles, power generation, and industrial facilities), residential fireplaces, and wood stoves. In addition, $PM_{2.5}$ can be formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds (VOCs). The main health effects of airborne $PM_{2.5}$ are on the respiratory system. Like PM_{10}, $PM_{2.5}$ can penetrate the human respiratory system's natural defenses and damage the respiratory tract when inhaled. Whereas particles 2.5 to 10 microns in diameter tend to collect in the upper portion of the respiratory system, particles 2.5 microns or less in diameter are so tiny that they can penetrate deeper into the lungs and damage lung tissues.

2.2.3 Ozone

Ozone (O_3) is a colorless toxic gas that enters the blood stream and interferes with the transfer of oxygen, depriving sensitive tissues in the heart and brain of oxygen. Ozone also damages plants by inhibiting their growth. Although ozone is not directly emitted, it forms in the atmosphere through a chemical reaction between reactive organic gases and nitrogen oxides, which are emitted from industrial sources and automobiles. Substantial ozone formations generally require a stable atmosphere with strong sunlight.

2.2.4 Nitrogen Dioxide

NO_2 is a brownish gas that irritates the lungs. It can cause breathing difficulties at high concentrations. Like ozone, NO_2 is not directly emitted but is formed through a reaction between nitrous oxide (N_2O) and atmospheric oxygen. N_2O and NO_2 are collectively referred to as nitrogen oxides (NO_x) and are major contributors to ozone formation. NO_2 also contributes to the formation of PM_{10}. At atmospheric concentrations, NO_2 is only potentially irritating. In high concentrations, the result is a brownish-red cast to the atmosphere and reduced visibility. There is some indication of a relationship between NO_2 and chronic pulmonary fibrosis. Some increase in bronchitis in children (2 and 3 years old) has also been observed at concentrations below 0.3 parts per million (ppm).

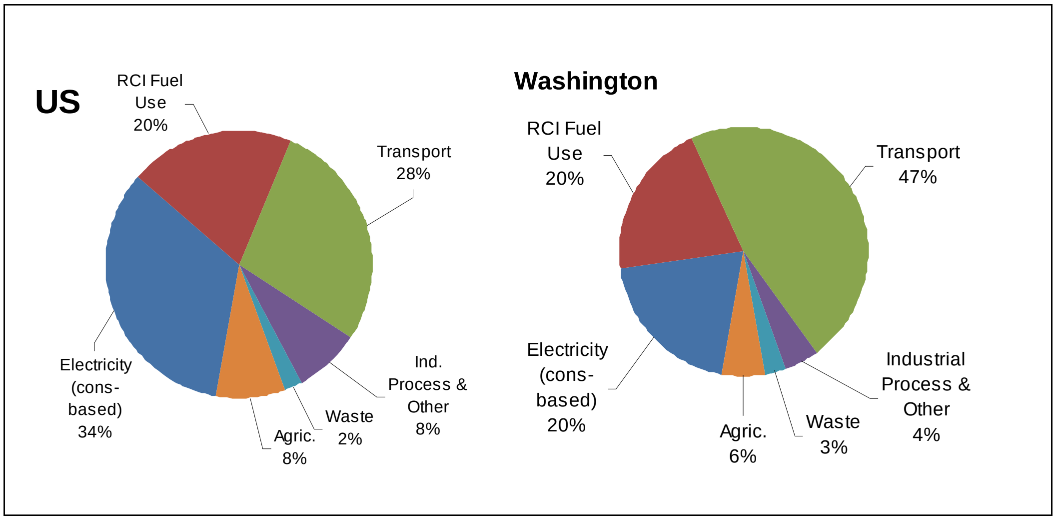
2.2.5 Lead

Lead (Pb) is a stable element that persists and accumulates in the environment and in animals, including humans. Its principal effects in humans are on the blood-forming, nervous, and renal systems. Lead levels in the urban environment from mobile sources, such as automobiles, have substantially decreased since the federally mandated switch to unleaded gasoline.

2.2.6 Greenhouse Gases

Climate-changing greenhouse gases come in several forms. The gases associated with transportation are water vapor, carbon dioxide (CO_2), methane (also known as marsh gas), and nitrous oxide (found in dentists' offices as laughing gas). CO_2 makes up the bulk of the emissions from transportation and is the focus of this evaluation. Any process that burns fossil fuel releases CO_2 into the air. Vehicles are a prominent source of greenhouse gas emissions and contribute to global warming, primarily through the burning of gasoline and diesel fuels.

National estimates show that the transportation sector (including on-road, construction, airplanes, and boats) accounts for almost 30 percent of total domestic CO_2 emissions.[1] However, in Washington State, transportation accounts for nearly half of greenhouse gas emissions because the state relies heavily on hydropower for electricity generation, unlike other states that rely on fossil fuels such as coal, petroleum, and natural gas to generate electricity. The next largest contributors to total gross greenhouse gas emissions in Washington are fossil fuel combustion in the residential, commercial, and industrial (RCI) sectors at 20 percent and in electricity generation facilities, also 20 percent.



Source: Ecology, 2008

Exhibit 2-2. Greenhouse Gas Emissions by Sector, 2005, US and Washington State

2.2.7 Mobile Source Air Toxics

In addition to the criteria pollutants for which there are NAAQS, EPA also regulates air toxics. Toxic air pollutants are those pollutants known or suspected to cause cancer or other serious health effects. Most air toxics originate from human-made sources, including vehicles, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners), and stationary sources (e.g., factories or refineries). The Clean Air Act identifies 188 air toxics. In 2001 EPA provided a list of 21 MSAT and highlighted six of these MSAT as priority MSAT. Since 2001, EPA has conducted an extensive review

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[1] This percentage is based on 2004 data from the International Energy Administration and is consistent with 1996 guidelines on greenhouse gas emissions calculations issued by the Intergovernmental Panel on Climate Change (IPCC).

of the literature to produce a list of the compounds identified in the exhaust or evaporative emissions from on-road and non-road equipment as well as alternative fuels. This list currently includes approximately 1,000 compounds, many emitted in trace amounts.

In February 2007, EPA finalized a rule to reduce hazardous air pollutants from mobile sources (Control of Hazardous Air Pollutants from Mobile Sources, February 9, 2007). The rule limits the benzene content of gasoline and reduces toxic emissions from passenger vehicles and gas cans. EPA estimates that in 2030 this rule will reduce total MSAT emissions by 330,000 tons and VOC emissions (precursors to ozone and $PM_{2.5}$) by over 1 million tons.

By 2011, EPA's existing programs will reduce MSAT emissions by over 1 million tons from 1999 levels. In addition to controlling pollutants such as hydrocarbons, particulate matter, and nitrogen oxides, EPA's recent regulations controlling emissions from highway vehicles and non-road equipment will result in large air toxic reductions. Furthermore, EPA has programs under development that would provide additional benefits from further controls for small non-road gasoline engines and diesel locomotive and marine engines. Finally, EPA has developed a variety of programs to reduce risk in communities, such as Clean School Bus USA, Voluntary Diesel Retrofit Program, Best Workplaces for Commuters, and National Clean Diesel Campaign.

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

- **Benzene** is characterized as a known human carcinogen.
- The potential carcinogenicity of **acrolein** cannot be determined because the existing data are inadequate for an assessment of human carcinogenic potential for either the oral or inhalation route of exposure.
- **Formaldehyde** is a probable human carcinogen based on limited evidence in humans and sufficient evidence in animals.

- **1,3-Butadiene** is characterized as carcinogenic to humans by inhalation.
- **Acetaldehyde** is a probable human carcinogen based on increased incidence of nasal tumors in male and female rats and laryngeal tumors in male and female hamsters after inhalation exposure.
- **Diesel exhaust** is likely to be carcinogenic to humans by inhalation from environmental exposures. Diesel exhaust, which is the combination of diesel particulate matter and diesel exhaust organic gases, also causes chronic respiratory effects, possibly the primary noncancer hazard from MSAT. Prolonged exposures may impair pulmonary function and could produce symptoms such as cough, phlegm, and chronic bronchitis. Exposure relationships have not been developed from these studies.

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Chapter 3 METHODOLOGY

3.1 Traffic Data

Detailed traffic analyses were completed for existing (2005) conditions and conditions for the year of opening (2011) and project design year (2030) with the No Build and Build Alternatives to evaluate how the transportation system would function under each of these scenarios. The transportation study area includes the portion of the city of Seattle where traffic patterns would most likely be affected by the Project. The results of this analysis are documented in the Transportation Discipline Report prepared for the Project. The evaluation of air quality effects was based on the data and findings of the transportation analysis.

3.2 Analysis Years

The following years were considered for analysis: existing (2005) conditions, the Project's opening year (2011), and the project's design year (2030). Typically, the existing conditions year is established a few years back to be consistent with available data. Please see the Transportation Discipline Report for more information on the determination of the year 2005 traffic data. It is anticipated that traffic volumes and patterns developed for the existing conditions did not change substantially in the study area from the last complete year.

3.3 Analysis Periods

3.3.1 Microscale Analysis

Afternoon and morning peak-period traffic data were used to estimate maximum 1-hour and 8-hour CO concentrations for the local (microscale) analysis. The afternoon peak is the highest traffic-volume period of the day in downtown Seattle.

3.3.2 Tunnel Portal Analysis

Hourly emission rates for the tunnel portal analysis were developed based on hour-by-hour traffic conditions over a 24-hour period. These emission rates were then used to estimate 1-hour and 8-hour CO concentrations associated with emissions generated within the tunnel and released through the exit portals.

3.4 Air Quality Analysis Locations

3.4.1 Mobile Source Analysis Sites

Analysis sites include critical roadway links and heavily congested intersections, connecting bus routes, locations adjacent to sensitive land uses, and representative locations throughout the study area that may be affected by the Project. To select sites for analysis, major signalized intersections that may be affected by the Project were identified. These intersections were then evaluated for traffic volumes and levels of service with the Project for the design year 2030 and ranked according to the results. Those sites where air quality levels were most likely to be substantially affected by the Project were selected for analysis following accepted PSRC procedures.

Thirty intersections were considered for analysis of existing (2005) and 2011 and 2030 No Build and Build Alternative conditions. Intersections were ranked and prioritized based on the total approach volume and intersection delay for the 2030 Build Alternative conditions, with the highest ranked intersections selected for analysis. Exhibit 3-1 provides information about each of the sites selected for analysis. The potential of the Project to create localized CO concentrations that would exceed the NAAQS at these locations was estimated, and the locations are shown in Exhibit 3-2.

Exhibit 3-1. Mobile Source Analysis Sites

Intersection	Volume	Delay (Seconds)	Peak Period (AM or PM)	Reasons for Selection
Denny Way & Dexter Avenue	3,735	85	PM	High Volume
Denny Way & Dexter Avenue	3,330	73	AM	High Volume
Denny Way & Aurora Avenue NB	3,645	98	PM	High Delay & Volume
Battery Street & Sixth Avenue	2,304	110	PM	High Delay
Fifth Avenue & Broad Street	2,757	97	AM	High Delay

Note: Volumes and delay for the 2030 Build Alternative conditions.
NB = northbound

Battery Street Tunnel Fire & Safety Improvements Project

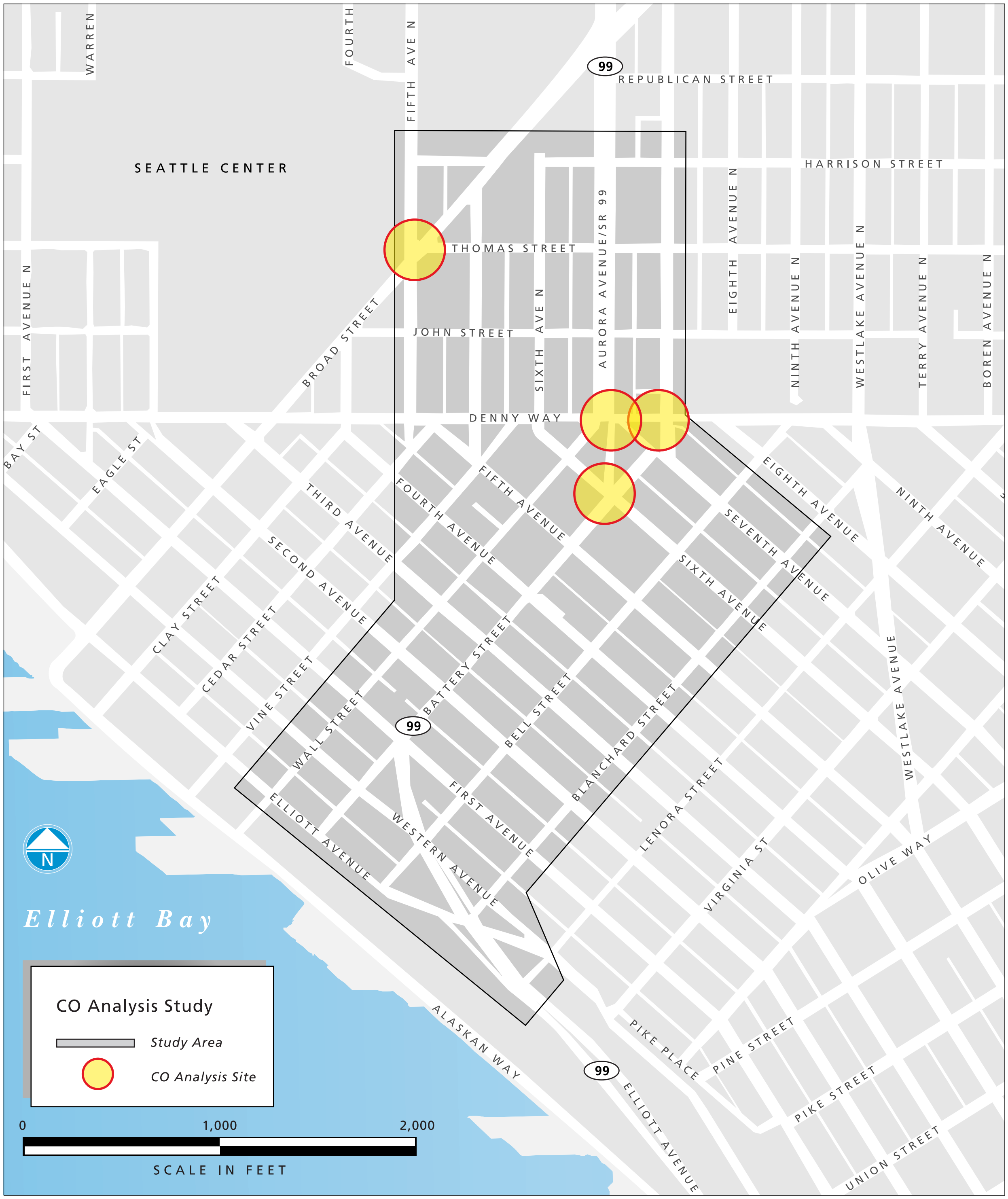

Exhibit 3-2
CO Analysis Locations

3.4.2 Analysis Sites Near Tunnel Portals

Air quality levels at sensitive land uses located near the exit portals of the Battery Street Tunnel were estimated. Receptors were placed along sidewalks accessible to the general public and buildings with windows or doorways that opened towards the roadway. The exact number of receptors considered near each analysis site was determined based on the configuration and complexity of the site. The following types of receptor sites were employed:

- Locations near the portals where the public would have access that are at least 10 feet (3 meters) from either side of the travelway.
- Both ground-level and elevated receptors (e.g., operable windows, air intake ducts) on nearby buildings.

3.5 Background CO Concentrations

Microscale modeling analyses estimate concentrations resulting from motor vehicle emissions on the roadways immediately adjacent to the receptor locations. To estimate total pollutant concentrations at a prediction site, background concentrations should be added to these values to account for pollution entering the area from other sources upwind.

3.5.1 Mobile Source Background CO Concentrations

The WASIST, which was used in all mobile source analyses, uses a background concentration of 3 ppm for determining worst-case 1-hour and 8-hour CO concentrations at signalized intersections throughout the State of Washington.

3.5.2 Background CO Concentrations for Tunnel Portals

The CO background concentrations that were used in this analysis were estimated using the monitoring data for the latest three years (2005–2007) at the Beacon Hill Reservoir station. The highest second-highest levels were selected. The calculated 1-hour CO background concentration is 2.7 ppm and the 8-hour CO background concentration is 1.9 ppm. These values were added to the results of the modeling analyses to estimate total pollutant concentrations, which were then compared to the NAAQS.

3.6 Vehicular Emissions

3.6.1 CO Emissions

Pollutant emissions from motor vehicles are affected by many factors, including travel speed; temperature; operating mode; and the age, type, and condition of the vehicle. Emission models calculate emission factors for average vehicles operating under specific parameters, such as speed, vehicle (which is a composite of automobiles, light trucks, heavy trucks, sport-utility vehicles [SUVs], etc.), age, and local emission control requirements.

Emission factors for CO from vehicles in Seattle traveling on an arterial or highway were estimated using the latest version of EPA's emission factor algorithm (MOBILE6.2.03). The data inputs provided by PSRC are based on implementation of Washington State's enhanced inspection and maintenance and anti-tampering programs, which require annual inspections of automobiles and light trucks to determine if emissions from the vehicles' exhaust systems are below strict emission standards. Vehicles failing the emissions test must undergo maintenance and pass a retest or receive a waiver to be registered in Washington State.

MOBILE6.2.03 emission factors were developed for the Project's year of opening (2011) and its design year (2030). Emission factors were developed for wintertime conditions, which provide worst-case CO estimates. Emission factors generally decrease over time as a result of the gradual replacement of older vehicles with newer, less-polluting vehicles. All vehicles traveling on the elevated roadway and within the tunnels were assumed to be operating in the hot stabilized mode.

3.6.2 Emissions of Greenhouse Gases

In February 2007, the Governor issued Executive Order 07-02 requiring state agencies to find ways to reduce greenhouse gas emissions and adapt to the future that climate change may create.

On May 3, 2007, the Washington State Legislature passed Senate Bill 6001, which among other things, adopted Governor Gregoire's climate change goals into state law. The law aims to achieve 1990 greenhouse gas levels by 2020, a 25 percent reduction below 1990 levels by 2035, and a 50 percent reduction by 2050.

WSDOT is part of the solution. We are aggressively pursuing strategies to address climate change, and we recognize our responsibility to support the Governor's initiative. While the goals are clear, we also recognize that technical guidance and regulations to implement these goals are currently in development and will not be sufficiently determined before environmental documentation is completed for this Project.

At this time, the main way to reduce greenhouse gas emissions from transportation is to reduce the amount of fuel consumed by drivers. This can be achieved by three means:

- Create more efficient driving conditions (for example, reduced traffic congestion).
- Introduce more fuel-efficient vehicles.
- Reduce the amount of driving (for example, telecommuting, transit, carpooling, more efficient movement of goods and services).

As a state, we have made some progress towards each of the three efforts. The Governor and Legislature passed a new transportation revenue package to fund a 16-year plan to meet Washington State's most critical transportation needs. WSDOT and our transportation partners, including city, county, and transit agencies, are in various stages of development on a specific list of projects selected by the Legislature to help with better movement of people and goods. The revenue is invested in a three-tiered strategy designed to maximize the efficiency of the transportation system:

- **Tier 1** – Low-cost/high-return investments in active traffic management, ramp metering, and incident response combined with transportation demand management (including commute trip reduction, park-and-ride, and local land use planning).
- **Tier 2** – Moderate- to higher-cost road network improvements, such as adding short lanes to connect interchanges, direct access ramps for transit and high-occupancy vehicles (HOVs), and center turn lanes to allow better traffic flow.
- **Tier 3** – Higher-cost/corridorwide benefit from major investments in HOV lanes, high-occupancy tolled (HOT) lanes, transit, commuter rail, general-purpose roadway lanes, interchange modifications, and bus access.

Many of our local, regional, and statewide transportation system improvements and ongoing programs will help to reduce the number of miles that vehicles need to travel each year (typically referred to as vehicle miles traveled or VMT).[2] In addition, the Governor and Legislature are actively working toward related improvements in land use decision making and more

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[2] VMT is typically defined as the number of miles that an average vehicle is estimated to drive each year. However, for transportation projects with set boundaries, VMT can also refer to the aggregate number of miles that all the vehicles travel using the specific roadway within the specific project area. Per person (or per capita) VMT in Washington has been stable at 9,000 miles per person since the 1980s, meaning the number of vehicle miles has grown at roughly the same pace as the number of new residents. Methods of reducing VMT typically target transferring trips from single-occupant vehicles to multiple-occupant vehicles like carpools, vanpools, and transit.

efficient transportation technology. In 2005 and 2007, the State Legislature mandated that vehicles sold in Washington starting with 2009 model years meet updated California emission standards. The new vehicle standards will reduce greenhouse gas emissions and help reduce CO and ozone pollutants. Researchers are also working to reduce the carbon content of motor fuel for the future.

A qualitative analysis was conducted to evaluate the Project's effect on greenhouse gases.

3.7 Dispersion Models

The mathematical expressions and formulations that compose the various air quality dispersion models attempt to describe an extremely complex physical phenomenon as closely as possible. However, because all models contain simplifications and approximations of actual conditions and interactions, the dispersion models themselves are designed to yield conservative results.

3.7.1 Mobile Source Models

The WASIST, which was used in all mobile source analyses, is a Windows-based screening model used for determining worst-case 1-hour and 8-hour CO concentrations at signalized intersections throughout the State of Washington. Results are based on the latest version of EPA's emission factor algorithm (MOBILE6.2.03) and EPA's CAL3QHC mobile source dispersions model. The CAL3QHC algorithm is used to calculate the CO concentrations in WASIST based on the intersection geometry, user inputs, and worst-case assumptions. CO emission factors are determined for each approaching leg of traffic and for vehicles in idle mode.

WASIST uses readily available data in a user-friendly application to make a conservative estimate of project CO levels. This is done by using a combination of worst-case conditions that, when occurring simultaneously, produce the highest levels of CO. The purpose of the model is to allow the user to conservatively estimate the highest CO concentrations that would be found at an intersection without having to perform a more time-consuming detailed analysis. If the results from WASIST do not violate the NAAQS for CO, the effect from any other combination of conditions would also be below the standards, and no further modeling is required.

3.7.2 Stationary Source Models

Stationary source models are the basic analytical tools used to estimate pollutant concentrations resulting from one or more localized emission sources. Stationary source models are used in this analysis to estimate the effects of releases from ventilation buildings and tunnel portals on surrounding land uses. Three types of stationary sources were considered for this analysis: point sources, area sources, and volume sources.

- A point source refers to a condition where emissions are released through a limited opening such as a stack or vent. The emissions released through the exhaust stacks located on the roofs of the ventilation buildings were considered as point sources.
- An area source refers to a two-dimensional area from which pollutants are emitted, usually from or near ground level. The emissions released through jets of air created by the vehicles exiting the tunnel portals and ramps (before they reach sensitive land uses) were considered as either area or volume sources.
- A volume source refers to a three-dimensional source of pollutants such as a coal pile of a chemical processing plant. The emissions released through the jets of air created by the vehicles exiting the tunnel portals for the sections of roadway that are at-grade were considered as volume sources.

The EPA AERMOD model was used to estimate pollutant concentrations near the tunnel's portals and ventilation buildings. The basis of the AERMOD model, which can be used to estimate the combined effects from multiple emissions sources, is the straight-line, steady state Gaussian plume equation. The model is used to estimate effects from simple point source emissions from stacks, emissions from stacks that experience the effects of aerodynamic downwash due to nearby buildings, isolated vents, multiple vents, storage piles, conveyor belts, and the like. The volume and area source options may also be used to simulate line sources.

AERMOD accepts actual hourly meteorological observations and is able to directly estimate concentrations over short-term (e.g., 1-hour, 3-hour, 8-hour) and long-term (e.g., annual) periods. Five years of the atmospheric meteorological data (2002 to 2006) collected at Seattle-Tacoma International Airport were used in this analysis. Urban algorithms were used for all analyses. Surface characteristics and surface roughness factors were determined based on local land uses.

3.8 Air Quality Modeling Methodology

3.8.1 Roadways and Intersections

A microscale modeling analysis was conducted that estimated CO levels at sensitive receptor sites located near heavily congested intersections that are anticipated to be affected by the Project under existing conditions and future conditions with the No Build and Build Alternatives.

Afternoon peak-period traffic data were used to estimate maximum 1-hour and 8-hour CO concentrations. The afternoon peak is the highest traffic-volume period of the day in downtown Seattle. All mobile source analyses were conducted using the WASIST model.

3.8.2 Tunnel Portals

The potential air quality effects of emissions released from the tunnel portals were estimated using normal (i.e., not emergency or breakdown) operating conditions during this peak period. During a fire in the tunnel or other emergency condition, pollutant concentrations may exceed the NAAQS at nearby receptors, but are not expected to exceed acutely harmful levels during the time it would take to evacuate adjacent areas.

CO concentrations were estimated at sensitive land uses located near the tunnel portals using a method specifically developed for this type of emissions source based on wind tunnel test data developed for several similar projects and procedures that were accepted by regulatory agencies in the United States and elsewhere. This analysis was conducted using data regarding emissions released through the tunnel portals, as supplied by the Project's mechanical ventilation engineers.

Total pollutant levels estimated at each receptor location considered were assumed to be affected by the following components:

- Emissions exhausted out of the tunnel portals.
- Emissions from the vehicles traveling on roadways immediately downstream of the tunnel portals.
- Emissions (where applicable, depending on the portal and receptor locations, and the critical wind angles) from the traffic on the adjacent surface roadways.
- Background levels appropriate for the area.

The total pollutant levels estimated at the nearby receptors from all of these sources combined were compared with the appropriate air quality standards. The methods used to estimate the potential effects from each of the previously mentioned sources are discussed separately.

Releases from Tunnel Portals

The approach that was used for the analysis of tunnel portal releases is based on the assumption that the jet of air exiting a tunnel portal maintains its integrity (i.e., maintains a uniform set of conditions from which pollutants disperse) for a finite distance along the roadway after exiting the portal. This assumption is based on observations made by researchers that show that air emitted from a vehicular tunnel portal forms a plume that is both pushed out of the tunnel by vehicles prior to their exiting the tunnel (and, if applicable, mechanical ventilation systems) and dragged out of the portal by these same vehicles as they move downstream of the portal. Also, the stream of moving cars exiting a tunnel portal creates a continuous source of momentum that maintains a jet of air with a finite length, width, and height, and the individual cars in the stream create a mechanical turbulence that mixes the air uniformly within this region.

Although there is no method currently available for mathematically estimating the configuration of the jet or its concentration gradients, several factors were used to estimate its size and shape. These include the speed of the vehicles passing through the tunnel, atmospheric wind speed and direction, the topography of the area immediately surrounding the tunnel portal, the type of the portal (i.e., whether it is one-way or two-way), the geometry of the portal (i.e., its height and physical configuration, and whether there would be a wall between directional roadways), and the type of ventilation used in the tunnel (i.e., natural or mechanical and, if mechanical, either longitudinal or transverse). In general, the greater the tunnel exhaust velocity (either from a naturally or mechanically ventilated tunnel) and the lower the atmospheric wind speed in the direction opposite the traffic flow, the longer the length of the jet. In addition, the faster the speed of the vehicles exiting the portals, the higher the tunnel exhaust velocity.

On the basis of wind tunnel studies conducted for similar tunnel portals, a scenario that divides the overall jet into separate finite regions, with each region having its own unique (and uniform) set of emission rates, was developed for each analysis. The portal jet properties that were assumed for estimating the effects of the Project's No Build and Build Alternatives were based on the following assumptions:

- The number of lanes of traffic exiting each portal.
- Whether the entrance and exit portals are physically separated.
- For jets located in depressed sections of roadway downstream of the tunnel portals, the emissions from these jets would disperse through the top portion of the exiting lanes of the depressed roadways. (Each of these jets was modeled as an area source that has the width of the exiting roadway. The relative height of receptor sites located at sidewalks immediately over a portal was raised above the area source to account for the vertical distances between these receptors and the height of the emission sources. The length of each jet was estimated based on vehicular speeds, portal release exit flow rates, and the geometrical alignment of the portal area.)

- For jets from the south portal of the Battery Street Tunnel, the roadway was elevated on a structure downstream of the tunnel portals.
- Based on a review of wind tunnel studies, it was assumed that the total emissions released through the tunnel portals would be dispersed into the atmosphere via three jet sections of equal length. The lengths of each jet section and percent of total portal emissions in each section were based on the configuration of the tunnel portal and the downstream roadway.

Effects were estimated using AERMOD, with each jet section assumed to be an area source.

Roadway Emissions from Downstream Traffic

Emissions from the traffic immediately downstream of each portal were also modeled (using AERMOD) as area sources with uniform emission rates that are located along the top of the depressed roadway section. The width of the area source was the width of the roadway. The length of the area source was estimated based on the proposed configuration of the roadway. Hourly emission rates were developed based on hour-by-hour traffic conditions over a 24-hour period.

Roadway Emissions from Local Traffic

Effects from traffic emissions on local streets near the portals were estimated as line sources using AERMOD. Peak-period hourly emission rates were used.

Total Concentrations near Tunnel Portals

The total CO concentrations at each of the receptor locations were estimated by adding the effects of all of these sources to the appropriate background values. The maximum levels estimated at each receptor location near each portal were compared with the NAAQS.

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Chapter 4 AFFECTED ENVIRONMENT

4.1 Study Area Characteristics

The Project would make safety improvements to the SR 99 facility in the project area. The project limits extend from the sign bridge to be replaced on SR 99 at approximately Virginia Street to the proposed sign bridge on SR 99 at about Ward Street. The majority of the improvements would involve the Battery Street Tunnel itself. The air quality study area, shown in Exhibit 1-1, encompasses the Project's major construction limits on SR 99 and nearby transportation facilities that are closely related to or affected by the SR 99 corridor. This area is roughly bordered by Elliott Avenue, Blanchard Street, Seventh Avenue, Dexter Avenue, Harrison Street, Fifth Avenue N., and Vine Street. In addition to the Project's major construction, there will be short-term construction related to the sign structures to the north and south of the tunnel portals. This construction would occur outside of the air quality and transportation study areas, but is addressed qualitatively in Chapter 6, the Construction Effects and Mitigation section of this report.

The air quality study area is located in the Belltown neighborhood, just north of the retail district in downtown Seattle. This is a dense urban area, and land use in the area ranges from light industrial to residential buildings.

4.2 Regulatory Status of the Study Area

Air quality in the study area is regulated by EPA, Ecology, and PSCAA. Section 107 of the 1977 Clean Air Act Amendments requires EPA to publish a list of all geographic areas in compliance with the NAAQS, as well as those not attaining the NAAQS. Areas not in compliance with the NAAQS are deemed nonattainment areas. Areas that were once classified as nonattainment but have since demonstrated attainment are classified as maintenance areas. The designation of an area is based on the data collected by the state monitoring network on a pollutant-by-pollutant basis.

The Project is entirely located in a CO maintenance area, as shown in Exhibit 4-1. This area was designated as nonattainment for CO and classified as moderate upon enactment of the Clean Air Act Amendments of 1990. The state submitted a CO maintenance plan on August 23, 1999, which was approved by EPA on March 13, 2001. The plan relies on control of residential wood smoke, fugitive dust, industrial emissions, open burning, and diesel exhaust. Because these maintenance areas would be affected by the Project, the Project must demonstrate compliance with the Transportation Conformity Rule found in 40 CFR Part 93.

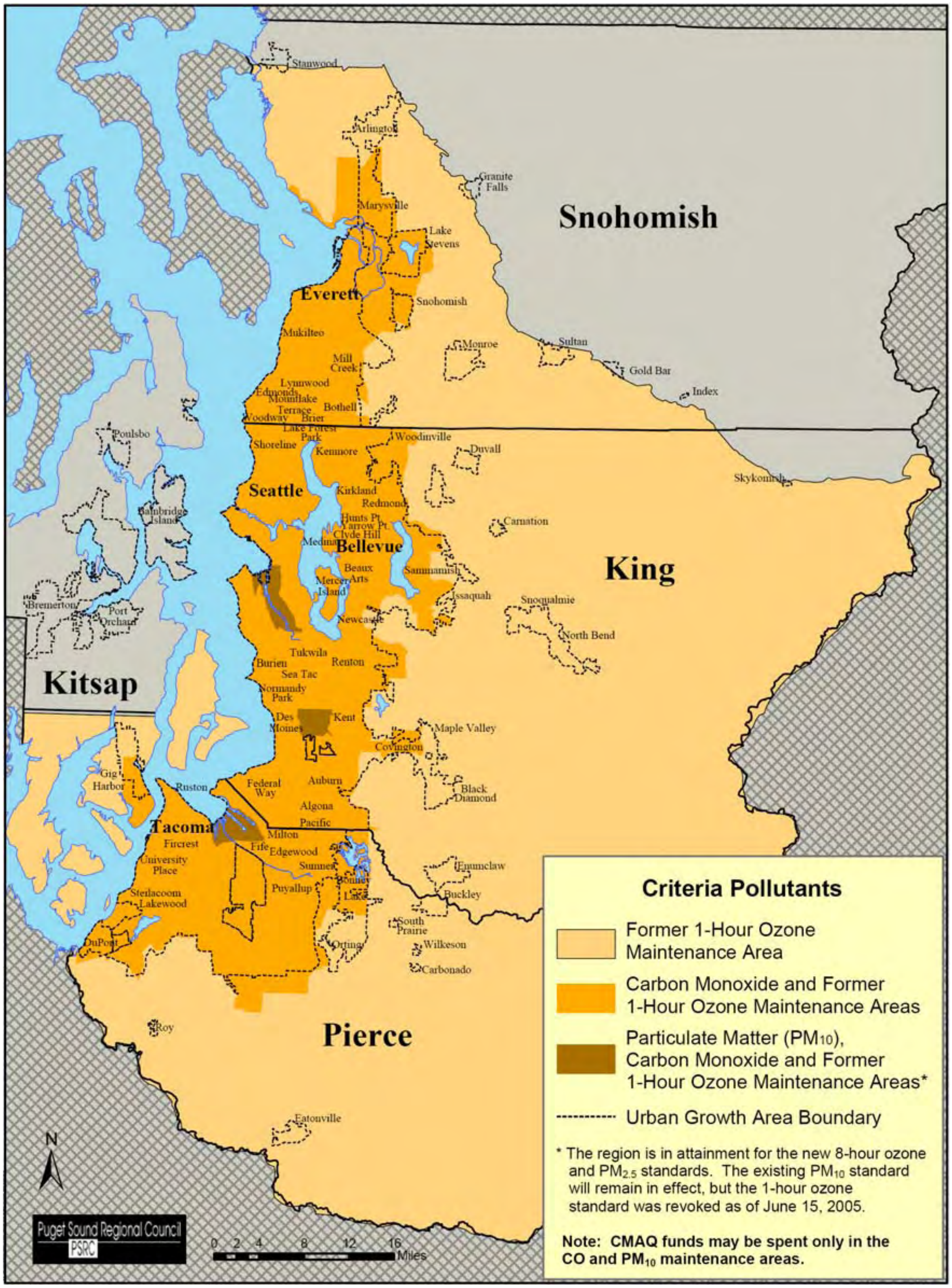


Exhibit 4-1. CO and PM_{10} Maintenance Areas

4.3 Air Pollution Trends

Regional air pollutant trends have generally followed national patterns over the last 20 years. While the average weekday VMT in the central Puget Sound region has increased from 30 million miles in 1981 to 65 million miles in 1999 (PSRC 2000), pollutant emissions associated with transportation sources have decreased. CO is the criteria pollutant most closely tied to transportation, with over 90 percent of the CO emissions in the Puget Sound urban areas coming from transportation sources. Regionally, the maximum measured CO concentrations have decreased considerably over the past 20 years. Other transportation-related pollutants have followed similar but less pronounced trends.

4.4 Monitored Air Quality Concentrations

Air quality data were compiled using Ecology and EPA AirData databases for 2006, the latest calendar year for which these data are available. The highest recorded ambient air quality levels from representative sites within or near the study area at which these data were monitored are shown in Exhibit 4-2. Monitored levels for the criteria pollutants do not exceed national and state ambient air quality standards in the study area.

Exhibit 4-2. Monitored Ambient Air Quality Levels (2006)

Pollutant	Location (County)*	Averaging Time	Value	NAAQS
Carbon Monoxide	Fourth Avenue & Pike Street (King)	8 hour	2.0 ppm	9 ppm
		1 hour	2.8 ppm	35 ppm
Nitrogen Dioxide	Beacon Hill Reservoir (King)	Annual	0.018 ppm	0.053 ppm
Ozone	Lake Sammamish (King)	8 hour	0.070 ppm	0.08 ppm
Sulfur Dioxide	Casino Drive (Skagit)	Annual	0.001 ppm	0.03 ppm
		24 hour	0.003 ppm	0.14 ppm
		3 hour	0.011 ppm	0.5 ppm
$PM_{2.5}$	E. Marginal Way S. (King)	Annual	12.1 μg/m^3	15 μg/m^3
		24 hour	33 μg/m^3	35 μg/m^3
PM_{10}	E. Marginal Way S. (King)	Annual	22 μg/m^3	N/A
		24 hour	51 μg/m^3	150 μg/m^3

Source: EPA AirData (http://www.epa.gov/air/data/geosel.html) and Ecology

Notes: Values shown correspond to NAAQS time periods.
If data are available from more than one monitoring station in a county, the highest values are provided.

4.5 Estimated Existing Air Pollutant Conditions

4.5.1 Mobile Source Analysis

The results of the screening-level mobile source analysis that was conducted using the WASIST model are shown in Exhibit 4-3. The values provided are the highest 1-hour and 8-hour CO concentrations predicted at any of the receptor sites near the selected intersections for 2005 conditions. The estimated CO concentrations are all below the 1-hour and 8-hour NAAQS of 35 and 9 ppm, respectively.

Exhibit 4-3. 2005 Maximum Predicted CO Concentrations (ppm)

Intersection	Peak Period (AM or PM)	2005 (Existing)	
		1 hr	8 hr
Denny Way & Dexter Avenue	AM	8.5	6.8
Denny Way & Dexter Avenue	PM	8.8	7.1
Denny Way & Aurora Avenue NB	PM	8.3	6.7
Battery Street & Sixth Avenue	PM	8.1	6.6
Fifth Avenue & Broad Street	AM	8.4	6.8

Notes: All values include a conservative background concentration of 3 ppm.
The 1-hour NAAQS is 35 ppm; the 8-hour NAAQS is 9 ppm.
NB = Northbound

Chapter 5 OPERATIONAL EFFECTS AND MITIGATION

5.1 Operational Effects

5.1.1 Mobile Source Analysis

The results of the screening-level mobile source analysis that was conducted using the WASIST model are shown in Exhibit 5-1. The values provided are the highest 1-hour and 8-hour CO concentrations predicted at any of the receptor sites near the selected intersections for 2011 Year of Opening and 2030 Design Year conditions. The estimated CO concentrations for both the No Build and Build Alternatives are all below the 1-hour and 8-hour NAAQS of 35 and 9 ppm, respectively. Because the predicted results were all below the NAAQS, the results of this analysis indicate that a more in-depth mobile source air quality analysis is not required.

Exhibit 5-1. Opening and Design Year Maximum Predicted CO Concentrations (ppm)

Intersection	Peak Period (AM or PM)	2011 No Build	2011 Build	2030 No Build	2030 Build
		1 hr/8 hr	1 hr/8 hr	1 hr/8 hr	1 hr/8 hr
Denny Way & Dexter Avenue	AM	6.9/5.7	5.3/4.6	6.9/5.7	5.4/4.7
Denny Way & Dexter Avenue	PM	7.0/5.8	5.4/4.7	7.1/5.9	5.5/4.8
Denny Way & Aurora Avenue NB	PM	6.6/5.5	5.1/4.5	6.8/5.7	5.2/4.5
Battery Street & Sixth Avenue	PM	6.6/5.5	5.4/4.7	7.0/5.8	5.5/4.8
Fifth Avenue & Broad Street	AM	6.7/5.6	5.2/4.5	6.7/5.6	5.3/4.6

Notes: 2011 is the opening year and 2030 is the design year.
All values include a background concentration of 3 ppm.
The 1-hour NAAQS is 35 ppm; the 8-hour NAAQS is 9 ppm.
NB = Northbound

5.1.2 Tunnel Portal Analysis

The results of the tunnel portal analysis that was conducted using the AERMOD model are shown in Exhibit 5-2. The values provided are the highest 1-hour and 8-hour CO concentrations predicted at any of the receptor sites located near the Battery Street Tunnel portals under 2011 and 2030 Build Alternative conditions. The estimated CO concentrations are all below the 1-hour and 8-hour NAAQS of 35 and 9 ppm, respectively.

Exhibit 5-2. Maximum Predicted 1-Hour and 8-Hour CO Concentrations (ppm) near the Battery Street Tunnel Portals

Portal	Analysis Year			
	2011		2030	
	1 hour	8 hour	1 hour	8 hour
North Portal	18.3	6.5	18.0	6.3
South Portal	13.3	5.5	13.9	5.6

Notes:

One-hour levels include a background concentration of 2.7 ppm; 8-hour levels include a background concentration of 1.9 ppm.
The 1-hour NAAQS is 35 ppm; the 8-hour NAAQS is 9 ppm.

5.1.3 Mobile Source Air Toxics Analysis

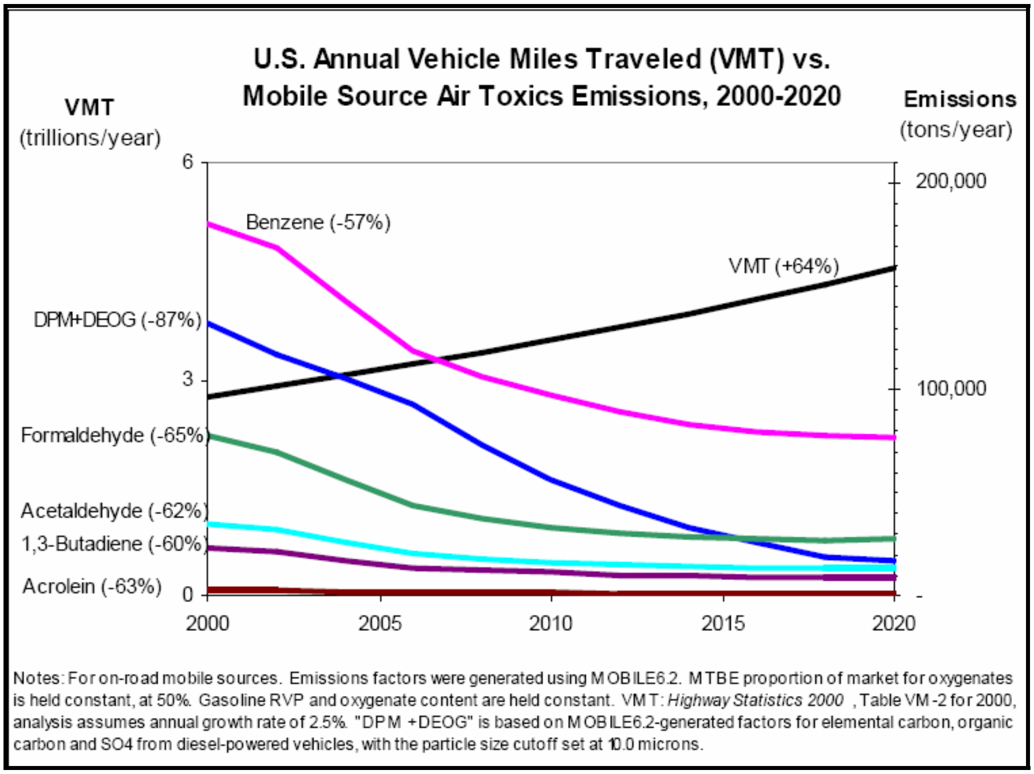
Future Conditions with the No Build Alternative

EPA has issued a number of regulations that will dramatically decrease MSAT emissions through cleaner fuels and cleaner engines. Between 2000 and 2020, FHWA projects that even with a 64 percent increase in VMT, these programs will reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 57 to 65 percent and diesel particulate matter by 87 percent, as illustrated in Exhibit 5-3.

Future Conditions with the Build Alternative

With the Build Alternative, the amount of MSATs emitted would be proportional to the VMT. Because the estimated VMT with the Build Alternative is only slightly different than with the No Build Alternative, no appreciable difference in overall MSAT emissions is expected between the Build and No Build Alternatives. Also, future year emissions will likely be lower than present levels with or without the Project as a result of EPA's national control programs, which are projected to reduce MSAT emissions.

Local conditions may differ from 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 with the proposed Project.



Source: FHWA 2006

Exhibit 5-3. Vehicle Miles Traveled vs. Mobile Source Air Toxics

5.1.4 Greenhouse Gas Analysis

Quantitative modeling tools to evaluate greenhouse gas emissions at the project level are limited at this time, but better tools are under development and will be available from EPA within the next several years.[3]

This Project would provide fire and safety improvements to the Battery Street Tunnel and close the on- and off-ramps at the south portal to general-purpose traffic. The Project would have minimal effects on regional greenhouse emissions. The traffic volumes would be slightly redistributed because of the ramp closure, and the levels of service at the local intersections would not be

[3] Some projects have applied an EPA equation that is based on fuel consumed to operate a vehicle and the amount of CO_2 that would be emitted during combustion of a gallon of fuel. This equation does not take into account the speed of vehicles on the roadway and is not a recommended analysis method for transportation projects. Light duty vehicles are most efficient at moderate speeds in the range of 40 to 55 miles per hour. Current modeling systems available in Washington State are not able to account for speed. The result is that we are unable to show the effect of this improvement in traffic flow on emissions until future EPA tailpipe emission models are issued.

substantially affected under the Build Alternative. Therefore, VMT would not be substantially affected on a regional scale, and the Project is not predicted to affect greenhouse gas levels.

5.2 Operational Mitigation

Because regional (mesoscale) MSAT emissions are not expected to be substantially affected by the Project, any effects on the climate-changing greenhouse gases are expected to be minimal. In addition, no exceedances of the NAAQS are anticipated. As such, no substantial adverse air quality effects are expected from the Project. Therefore, no mitigation measures would be necessary.

Chapter 6 CONSTRUCTION EFFECTS AND MITIGATION

Construction of the Project is expected to occur over a duration of approximately 24 months. Construction is planned to begin in fall 2009 and end by late spring 2011 and would comprise three stages of traffic revisions.

6.1 Construction Effects

Fugitive PM_{10} emissions are associated with demolition, land clearing, ground excavation, grading, cut-and-fill operations, and structure erection. PM_{10} emissions would vary from day to day, depending on the level of activity, specific operations, and weather conditions. Emission rates would depend on soil moisture, silt content of soil, wind speed, and the amount and type of operating equipment associated with project construction. Larger dust particles would settle near the source, and fine particles would be dispersed over greater distances from the construction site.

Fugitive PM_{10} emissions from construction activities could be noticeable, if uncontrolled. Mud and particulates from trucks would also be noticeable if construction trucks would be routed through residential neighborhoods. WSDOT's Memorandum of Agreement with PSCAA requiring fugitive dust control planning on its projects will be implemented to comply with the PSCAA regulations that require dust control during construction and to prevent the deposition of mud on paved streets (PSCAA Regulation 1, Article 9). Measures to reduce the deposition of mud and emissions of particulates are listed in Section 6.2, Construction Mitigation.

In addition to PM_{10} emissions, heavy trucks and construction equipment powered by gasoline and diesel engines would generate $PM_{2.5}$, CO, and NO_x in exhaust emissions. If construction traffic and lane closures were to increase congestion and reduce the speed of other vehicles in the area, emissions from traffic would increase temporarily while those vehicles are delayed. These emissions would be temporary and limited to the immediate area where the congestion is occurring. Battery Street Tunnel closures would occur on weeknight evenings (8 p.m. to 6 a.m.) and on two or fewer weekends each month during construction. Congested conditions are most likely to occur during the weekend closures.

Some construction phases (particularly during paving operations using asphalt) would result in short-term odors. These odors might be detectable to some people near the site, and would be diluted as distance from the site increases.

In addition to the Project's major construction, there would be improvements related to the sign structures located on SR 99 near Valley Street, Thomas Street, and Virginia Street. Temporary evening disruptions to mainline SR 99 traffic due to overhead sign bridge construction and installation have been identified by the project team as minor events associated with the larger Battery Street Tunnel construction/closure effort. Congestion impacts to mainline SR 99 traffic, the Seneca Street off-ramp, and affected downtown intersections would likely be minor, as the sign bridge work would occur during the low-demand evening periods and would last less than 2 weeks.

While the old signs at Thomas and Virginia Streets are removed and new signs are installed over the roadway at Thomas, Virginia, and Ward Streets, all lanes under the signs would need to be closed. These closures are expected to take up to three nights per sign.

6.2 Construction Mitigation

PSCAA would regulate particulate emissions (in the form of fugitive dust) during construction activities. WSDOT would take reasonable precautions to prevent these emissions from becoming airborne and would have to maintain and operate the source to minimize emissions.

A Memorandum of Understanding is in place between WSDOT and PSCAA to help eliminate, confine, or reduce construction-related emissions for WSDOT projects. WSDOT will create a fugitive dust control plan to control dust during construction. This fugitive dust control plan would reduce air pollutant emissions near the construction site, including residences located along Battery Street adjacent to the open grates.

The Project's traffic management plan includes detours and strategic construction planning (like weekend work, parking restrictions, and signal timing enhancements) to continue moving traffic through the area and reduce backups to the traveling public to the extent possible. Construction areas, staging areas, and material transfer sites would be set up in a way that reduces standing wait times for equipment, engine idling, and the need to block the movement of other activities on the site. These strategies would reduce fuel consumption by reducing wait times and ensuring that construction equipment operates efficiently. Due to space constraints at the work site and the benefit of additional emissions reductions, ridesharing and other commute trip reduction efforts may be promoted for employees working on the Project.

In addition to the strategies detailed above, other possible air pollutant emission control measures to reduce emissions near the construction site include (Associated General Contractors of Washington 1997):

- Spraying exposed soil with water or other dust palliatives to reduce emissions of PM_{10} and deposition of particulate matter.
- Covering all trucks transporting materials, wetting materials in trucks, or providing adequate freeboard (space from the top of the material to the top of the truck) to reduce particulate emissions during transportation.
- Removing particulate matter deposited on paved public roads to reduce mud and resultant windblown dust on area roadways.
- Requiring appropriate emission-control devices (e.g., diesel oxygen catalyst, diesel particulate filters, and particulate traps) on large pieces of diesel-fueled equipment to reduce CO, NO_x, and particulate emissions in vehicular exhaust.
- Using electrical equipment as feasible.
- Using relatively new, well-maintained equipment to reduce CO and NO_x emissions.
- Routing construction trucks away from residential and business areas to minimize annoyance from dust.
- Requiring the use of low or ultra-low sulfur fuels in construction equipment to allow for the use of effective particulate-emission control devices on diesel vehicles.
- Coordinating construction activities with other projects in the area to reduce the cumulative effects of concurrent construction projects.

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Chapter 7 INDIRECT AND CUMULATIVE EFFECTS

7.1 Indirect Effects

Indirect effects are reasonably foreseeable effects of an action that occur later in time or are farther removed in distance from the direct effects of a project. Generally, these effects are induced by the initial action. Indirect effects for this Project are considered to be unlikely, and any effects would be limited because the Project would not increase capacity compared to existing conditions.

7.2 Cumulative Effects

Cumulative effects are additive effects of a project with other developments or actions in the past, present, or reasonably foreseeable future. The air quality analysis for this Project evaluated the effects of projected traffic volumes and delays resulting from the planned development in the study area. Therefore, the air quality analysis includes the cumulative effects of the Project and other traffic growth that may be associated with the Project. No substantial adverse air quality effects are expected from the Project. Therefore, the Project would not be adding to an air quality cumulative effect issue.

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Chapter 8 REGULATORY COMPLIANCE

8.1 Compliance With NAAQS

Maximum predicted 1-hour and 8-hour CO concentrations for 2011 and 2030 are shown in Exhibits 5-1 and 5-2. The values presented are the highest values obtained at each of the analysis sites using methods presented in this report. Estimated pollutant concentrations at all analysis sites are below the NAAQS. No significant adverse air quality effects are anticipated for the Project.

8.2 Conformity

The study area for the Project is within a CO maintenance area. Projects located in maintenance areas must comply with the project-level and regional conformity criteria described in the EPA Conformity Rule (40 CFR 93) and with WAC Chapter 173-420. Because this Project would not cause or exacerbate an exceedance of the NAAQS, it meets project-level conformity requirements per 40 CFR 93.123.

The Project is not yet included in the Metropolitan Transportation Plan (MTP) or the Transportation Improvement Program (TIP). The Project must be included in the MTP and TIP to show that it conforms to the Puget Sound region's Air Quality Maintenance Plans and would not cause or contribute to exceedances of the NAAQS at the regional level. Once it is included in the MTP and TIP, the Project will meet all requirements of 40 CFR Part 93 and WAC 173-420 and will demonstrate regional conformity.

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ATTACHMENT A

WASIST Output Tables

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