INTERSTATE 5 COLUMBIA RIVER CROSSING

Air Quality Technical Report

Columbia River
CROSSING

May 2008

Columbia River CROSSING

TO: Readers of the CRC Technical Reports

FROM: CRC Project Team

SUBJECT: Differences between CRC DEIS and Technical Reports

The I-5 Columbia River Crossing (CRC) Draft Environmental Impact Statement (DEIS) presents information summarized from numerous technical documents. Most of these documents are discipline-specific technical reports (e.g., archeology, noise and vibration, navigation, etc.). These reports include a detailed explanation of the data gathering and analytical methods used by each discipline team. The methodologies were reviewed by federal, state and local agencies before analysis began. The technical reports are longer and more detailed than the DEIS and should be referred to for information beyond that which is presented in the DEIS. For example, findings summarized in the DEIS are supported by analysis in the technical reports and their appendices.

The DEIS organizes the range of alternatives differently than the technical reports. Although the information contained in the DEIS was derived from the analyses documented in the technical reports, this information is organized differently in the DEIS than in the reports. The following explains these differences. The following details the significant differences between how alternatives are described, terminology, and how impacts are organized in the DEIS and in most technical reports so that readers of the DEIS can understand where to look for information in the technical reports. Some technical reports do not exhibit all these differences from the DEIS.

Difference #1: Description of Alternatives

The first difference readers of the technical reports are likely to discover is that the full alternatives are packaged differently than in the DEIS. The primary difference is that the DEIS includes all four transit terminus options (Kiggins Bowl, Lincoln, Clark College Minimum Operable Segment (MOS), and Mill Plain MOS) with each build alternative. In contrast, the alternatives in the technical reports assume a single transit terminus:

- Alternatives 2 and 3 both include the Kiggins Bowl terminus
- Alternatives 4 and 5 both include the Lincoln terminus

In the technical reports, the Clark College MOS and Mill Plain MOS are evaluated and discussed from the standpoint of how they would differ from the full-length Kiggins Bowl and Lincoln terminus options.

Difference #2: Terminology

Several elements of the project alternatives are described using different terms in the DEIS than in the technical reports. The following table shows the major differences in terminology.

DEIS terms	Technical report terms
Kiggins Bowl terminus	I-5 alignment
Lincoln terminus	Vancouver alignment
Efficient transit operations	Standard transit operations
Increased transit operations	Enhanced transit operations

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Difference #3: Analysis of Alternatives

The most significant difference between most of the technical reports and the DEIS is how each structures its discussion of impacts of the alternatives. Both the reports and the DEIS introduce long-term effects of the full alternatives first. However, the technical reports then discuss “segment-level options,” “other project elements,” and “system-level choices.” The technical reports used segment-level analyses to focus on specific and consistent geographic regions. This enabled a robust analysis of the choices on Hayden Island, in downtown Vancouver, etc. The system-level analysis allowed for a comparative evaluation of major project components (replacement versus supplemental bridge, light rail versus bus rapid transit, etc). The key findings of these analyses are summarized in the DEIS; they are simply organized in only two general areas: impacts by each full alternative, and impacts of the individual “components” that comprise the alternatives (e.g. transit mode).

Difference #4: Updates

The draft technical reports were largely completed in late 2007. Some data in these reports have been updated since then and are reflected in the DEIS. However, not all changes have been incorporated into the technical reports. The DEIS reflects more recent public and agency input than is included in the technical reports. Some of the options and potential mitigation measures developed after the technical reports were drafted are included in the DEIS, but not in the technical reports. For example, Chapter 5 of the DEIS (Section 4(f) evaluation) includes a range of potential “minimization measures” that are being considered to reduce impacts to historic and public park and recreation resources. These are generally not included in the technical reports. Also, impacts related to the stacked transit/highway bridge (STHB) design for the replacement river crossing are not discussed in the individual technical reports, but are consolidated into a single technical memorandum.

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Interstate 5 Columbia River Crossing

Air Quality Technical Report:

Submitted By:

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Appendices

ACRONYMS

Acronym	Description
ADA	Americans with Disabilities Act
ADT	Average Daily Traffic
API	Area of Potential Impact
AQMA	Air Quality Maintenance Area
BMP	Best Management Practice
BNSF	Burlington Northern Santa Fe Railroad
BPA	Bonneville Power Administration
BRT	Bus Rapid Transit
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CIR	Color Infrared
CMP	Corrugated Metal Pipe
CO	Carbon Monoxide
COE	U.S. Army Corps of Engineers
CRC	Columbia River Crossing
DEIS	Draft Environmental Impact Statement
DEQ	Oregon Department of Environmental Quality
DOT	U.S. Department of Transportation
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
Ft	feet/foot
HCT	High-Capacity Transit
HGM	Hydrogeomorphic
IRIS	Integrated Risk Information System
HSIS	Hazardous Substance Information Survey
HUC	Hydrological Unit Code
LOS	Level of Service
LRT	Light Rail Transit
MPO	Metropolitan Planning Organization
Mph	Miles per hour
MSAT	Mobile Source Air Toxics
MTIP	Metropolitan Transportation Improvement Plan
MTP	Metropolitan Transportation Plan
NAAQS	National Ambient Air Quality Standards
NATA	National Air Toxics Assessment
NEPA	National Environmental Policy Act
NFA	No Further Action
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration for Fisheries

Acronym	Description
NO_x	Nitrogen Oxides
OAR	Oregon Administrative Rule
ODA	Oregon Department of Agriculture
ODFW	Oregon Department of Fish & Wildlife
ODOT	Oregon Department of Transportation
OHP	Oregon Highway Plan
ORS	Oregon Revised Statutes
PATA	Portland Air Toxics Assessment
PM_{10}	Particulate Matter (10 microns or less in size)
PPM	Parts Per Million
RCW	Revised Code of Washington
ROD	Record of Decision
RTC	Regional Transportation Council
RTP	Regional Transportation Plan
SAAQS	State Ambient Air Quality Standards
SIP	State Implementation Plan
SOV	Single-Occupant Vehicle
STIP	State Transportation Improvement Plan
SWCAA	Southwest Clean Air Agency
TAZ	Transportation Analysis Zone
TDM	Transportation Demand Management
TIP	Transportation Improvement Program
TPR	Transportation Planning Rule
TSP	Transportation System Management
UGA	Urban Growth Area
UGB	Urban Growth Boundary
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
V/C	Volume to Capacity Ratio
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds
WDFW	Washington Department of Fish and Wildlife
WRD	Oregon Department of Water Resources
WSDOT	Washington State Department of Transportation

1. Summary

1.1 Introduction

This Air Quality Technical Report has been prepared in support of the Draft Environmental Impact Statement (DEIS) for the Interstate 5 (I-5) Columbia River Crossing (CRC) project. The purpose of the report is to compare air pollutant emissions of the alternatives, describe the air quality impacts of the alternatives, and address potential mitigation measures for impacts, if needed.

1.2 Description of the Alternatives

The alternatives being considered for the CRC project consist of a diverse range of highway, transit and other transportation choices. Some of these choices – such as the number of traffic lanes across the river – could affect transportation performance and impacts throughout the bridge influence area or beyond. These are referred to as "system-level choices." Other choices – such as whether to run high-capacity transit (HCT) on Washington Street or Washington and Broadway Streets – have little impact beyond the area immediately surrounding that proposed change and no measurable effect on regional impacts or performance. These are called "segment-level choices." This report discusses the impacts from both system- and segment-level choices, as well as "full alternatives." The full alternatives combine system-level and segment-level choices for highway, transit, pedestrian, and bicycle transportation. They are representative examples of how project elements may be combined. Other combinations of specific elements are possible. Analyzing the full alternatives allows us to understand the combined performance and impacts that would result from multimodal improvements spanning the bridge influence area.

Following are brief descriptions of the alternatives being evaluated in this report, which include:

- System-level choices,
- Segment-level choices, and
- Full alternatives.

1.2.1 System-Level Choices

System-level choices have potentially broad influence on the magnitude and type of benefits and impacts produced by this project. These options may influence physical or operational characteristics throughout the project area and can affect transportation and other elements outside the project corridor as well. The system-level choices include:

- River crossing type (replacement or supplemental)
- High-capacity transit mode (bus rapid transit or light rail transit)
- Tolling (no toll, I-5 only, I-5 and I-205, standard toll, higher toll)

This report compares replacement and supplemental river crossing options. A replacement river crossing would remove the existing highway bridge structures across the Columbia River and replace them with three new parallel structures – one for I-5 northbound traffic, another for I-5 southbound traffic, and a third for HCT, bicycles, and pedestrians. A supplemental river crossing would build a new bridge span downstream of the existing I-5 bridge. The new supplemental bridge would carry southbound I-5 traffic and HCT, while the existing I-5 bridge would carry northbound I-5 traffic, bicycles, and pedestrians. The replacement crossing would include three through-lanes and two auxiliary lanes for I-5 traffic in each direction. The supplemental crossing would include three through-lanes and one auxiliary lane in each direction.

Two types of HCT are being considered – bus rapid transit and light rail transit. Both would operate in an exclusive right-of-way through the project area, and are being evaluated for the same alignments and station locations. The HCT mode – LRT or BRT – is evaluated as a system-level choice. Alignment options and station locations are discussed as segment-level choices. BRT would use 60-foot or 80-foot long articulated buses in lanes separated from other traffic. LRT would use one- and two-car trains in an extension of the MAX line that currently ends at the Expo Center in Portland.

Under the efficient operating scenario, LRT trains would run at approximately 7.5-minute headways during the peak periods. BRT would run at headways between 2.5 and 10 minutes depending on the location in the corridor. BRT would need to run at more frequent headways to match the passenger-carrying capacity of the LRT trains. This report also evaluates performance and impacts for an increased operations scenario that would double the number of BRT vehicles or the number of LRT trains during the peak periods.

1.2.2 Segment-Level Choices

1.2.2.1 Transit Alignments

The transit alignment choices are organized into three corridor segments. Within each segment the alignment choices can be selected relatively independently of the choices in the other segments. These alignment variations generally do not affect overall system performance but could have important differences in the impacts and benefits that occur in each segment. The three segments are:

- Segment A1 – Delta Park to South Vancouver
- Segment A2 – South Vancouver to Mill Plain District
- Segment B – Mill Plain District to North Vancouver

In Segment A1 there are two general transit alignment options - offset from, or adjacent to, I-5. An offset HCT guideway would place HCT approximately 450 to 650 feet west of I-5 on Hayden Island. An adjacent HCT guideway across Hayden Island would locate HCT immediately west of I-5. The alignment of I-5, and thus the alignment of an adjacent HCT guideway, on Hayden Island would vary slightly depending upon the river crossing and highway alignment, whereas an offset HCT guideway would retain the same station location regardless of the I-5 bridge alignment.

HCT would touch down in downtown Vancouver at Sixth Street and Washington Street with a replacement river crossing. A supplemental crossing would push the touch down location north to Seventh Street. Once in downtown Vancouver, there are two alignment options for HCT – a two-way guideway on Washington Street or a couplet design that would place southbound HCT on Washington Street and northbound HCT on Broadway. Both options would have stations at Seventh Street, 12th Street, and at the Mill Plain Transit Center between 15th and 16th Streets.

From downtown Vancouver, HCT could either continue north on local streets or turn east and then north adjacent to I-5. Continuing north on local streets, HCT could either use a two-way guideway on Broadway or a couplet on Main Street and Broadway. At 29th Street, both of these options would merge to a two-way guideway on Main Street and end at the Lincoln Park and Ride located at the current WSDOT maintenance facility. Once out of downtown Vancouver, transit has two options if connecting to an I-5 alignment: head east on 16th Street and then through a new tunnel under I-5, or head east on McLoughlin Street and then through the existing underpass beneath I-5. With either option HCT would connect with the Clark College Park and Ride on the east side of I-5, then head north along I-5 to about SR 500 where it would cross back over I-5 to end at the Kiggins Bowl Park and Ride.

There is also an option, referred to as the minimum operable segments (MOS), which would end the HCT line at either the Mill Plain station or Clark College. The MOS options provide a lower cost, lower performance alternative in the event that the full-length HCT lines could not be funded in a single phase of construction and financing.

1.2.2.2 Highway and Bridge Alignments

This analysis divides the highway and bridge options into two corridor segments, including:

- Segment A – Delta Park to Mill Plain District
- Segment B – Mill Plain District to North Vancouver

Segment A has several independent highway and bridge alignment options. Differences in highway alignment in Segment B are caused by transit alignment, and are not treated as independent options.

At the SR 14 interchange there are two basic configurations being considered. A traditional configuration would use ramps looping around both sides of the mainline to provide direct connection between I-5 and SR 14. A less traditional design could reduce right-of-way requirements by using a “left loop” that would stack both ramps on the west side of the I-5 mainline.

1.2.3 Full Alternatives

Full alternatives represent combinations of system-level and segment-level options. These alternatives have been assembled to represent the range of possibilities and total impacts at the project and regional level. Packaging different configurations of highway, transit, river crossing, tolling and other improvements into full alternatives allows project staff to evaluate comprehensive traffic and transit performance, environmental impacts and costs.

Exhibit 1-1 summarizes how the options discussed above have been packaged into representative full alternatives.

Exhibit 1-1. Full Alternatives

	Packaged Options				
Full Alternative	**River Crossing Type**	**HCT Mode**	**Northern Transit Alignment**	**TDM/TSM Type**	**Tolling Method[a]**
1	Existing	None	N/A	Existing	None
2	Replacement	BRT	I-5	Aggressive	Standard Rate
3	Replacement	LRT	I-5	Aggressive	Two options[b]
4	Supplemental	BRT	Vancouver	Very Aggressive	Higher rate
5	Supplemental	LRT	Vancouver	Very Aggressive	Higher rate

[a] In addition to different tolling rates, this report evaluates options that would toll only the I-5 river crossing and options that would toll both the I-5 and the I-205 crossings.

[b] Alternative 3 is evaluated with two different tolling scenarios, tolling and non-tolling.

Modeling software used to assess alternatives' performance does not distinguish between smaller details, such as most segment-level transit alignments. However, the geographic difference between the Vancouver and I-5 transit alignments is significant enough to warrant including this variable in the model. All alternatives include Transportation Demand Management (TDM) and Transportation System Management (TSM) measures designed to improve efficient use of the transportation network and encourage alternative transportation options to commuters such as carpools, flexible work hours, and telecommuting. Alternatives 4 and 5 assume higher funding levels for some of these measures.

Alternative 1: The National Environmental Policy Act (NEPA) requires the evaluation of a No-Build or "No Action" alternative for comparison with the build alternatives. The No-Build analysis includes the same 2030 population and employment projections and the same reasonably foreseeable projects assumed in the build alternatives. It does not include any of the I-5 CRC related improvements. It provides a baseline for comparing the build alternatives, and for understanding what will happen without construction of the I-5 CRC project.

Alternative 2: This alternative would replace the existing I-5 bridge with three new bridge structures downstream of the existing bridge. These new bridge structures would carry Interstate traffic, BRT, bicycles, and pedestrians. There would be three through-lanes and two auxiliary lanes for I-5 traffic in each direction. Transit would include a BRT system that would operate in an exclusive guideway from Kiggins Bowl in Vancouver to the Expo Center station in Portland. Express bus service and local and feeder bus service would increase to serve the added transit capacity. BRT buses would turn around at the existing Expo Station in Portland, where riders could transfer to the MAX Yellow Line.

Alternative 3: This is similar to Alternative 2 except that LRT would be used instead of BRT. This alternative is analyzed both with a toll collected from vehicles crossing the Columbia River on the new I-5 bridge, and with no toll. LRT would use the same transit alignment and station locations. Transit operations, such as headways, would differ, and LRT would connect with the existing MAX Yellow Line without requiring riders to transfer.

Alternative 4: This alternative would retain the existing I-5 bridge structures for northbound Interstate traffic, bicycles, and pedestrians. A new crossing would carry southbound Interstate traffic and BRT. The existing I-5 bridges would be re-striped to provide two lanes on each structure and allow for an outside safety shoulder for disabled vehicles. A new, wider bicycle and pedestrian facility would be cantilevered from the eastern side of the existing northbound (eastern) bridge. A new downstream supplemental bridge would carry four southbound I-5 lanes (three through-lanes and one auxiliary lane) and BRT. BRT buses would turn around at the existing Expo Station in Portland, where riders could transfer to the MAX Yellow Line. Compared to Alternative 2, increased transit service would provide more frequent service. Express bus service and local and feeder bus service would increase to serve the added transit capacity.

Alternative 5: This is similar to Alternative 4 except that LRT would be used instead of BRT. LRT would have the same alignment options, and similar station locations and requirements. LRT service would be more frequent (approximately 3.5 minute headways during the peak period) compared to 7.5 minutes with Alternative 3. LRT would connect with the existing MAX Yellow Line without requiring riders to transfer.

1.3 Long-Term Effects

The U.S. Environmental Protection Agency (EPA) has developed National Ambient Air Quality Standards (NAAQS) for the six criteria pollutants: carbon monoxide (CO), lead, ozone, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter (PM). Nitrogen oxides (NOx) and volatile organic compounds (VOC) contribute to ozone formation. There are well-developed standards and analysis methods for air quality impacts from criteria pollutants. On recent transportation projects, mobile source air toxic (MSAT) pollutants have caused more concern than criteria pollutants. Despite the concerns, there are no NAAQS for MSAT pollutants or specific regulatory analysis requirements, and the analysis methods are still being developed. An air quality impact would occur with a violation of the NAAQS. Carbon monoxide is the only pollutant of concern for local violations of the NAAQS related to transportation projects in the Portland-Vancouver metropolitan area.

Because the Portland-Vancouver metropolitan area is a maintenance area for CO, the Oregon Department of Environmental Quality (DEQ) and Southwest Clean Air Agency (SWCAA) have State Implementation Plans with regulatory procedures to maintain compliance with the NAAQS. One of the requirements is a conformity determination to verify that transportation projects will not cause or contribute to a violation of the CO NAAQS. In the Portland area, there are two parts to demonstrating conformity:

- The project must be included in a conforming regional transportation plan (RTP) and transportation improvement plan (TIP).
- A hot spot analysis must show that CO at congested intersections will be below the CO NAAQS.

With EPA's finding of adequacy for the Vancouver Second 10-Year Limited Carbon Monoxide Maintenance Plan in December 2007, a regional conformity analysis is no longer required for projects in the Vancouver area.

A conformity analysis must be completed prior to issuance of a record of decision (ROD) for an EIS. A full conformity analysis is not possible for the I-5 CRC project at this time. The conformity determination will be addressed in the Final EIS.

1.3.1 Regional Effects

To provide information useful to the public and decision-makers in analyzing the trade-offs in air quality effects of the project alternatives, an emissions analysis was performed for the four-county region (Multnomah, Clackamas, Washington and Clark Counties), and for four subareas consisting of the I-5 mainline and ramps in the following four segments (a map of the subareas is included in the Long-Terms Effects section of this report):

- NE 99th Street to East 39th Street (Subarea 1)
- East 39th Street to State Route 14 (Subarea 2)
- State Route 14 to Columbia Boulevard (Subarea 3)
- Columbia Boulevard to the Interstate 405 (I-405) junction (Subarea 4)

The results of the emissions analysis showed that for future conditions (No-Build Alternative or any of the build alternatives) emissions are expected to be substantially lower than existing emissions for the region and the subareas for all pollutants. Differences between alternatives are smaller for all pollutants, and generally much smaller than the reduction between existing and future conditions for both the region and the subareas.

The expected regional emissions reductions relative to existing conditions are in the range of 30 percent for CO, 70 percent for NOx, 50 percent for volatile organic compounds (VOC), and 90 percent for PM. Emissions reductions for MSATs track those for VOC and PM with approximately 50 percent reductions in the volatile MSATs benzene, 1,3-butadiene, formaldehyde, and acrolein, an approximate 13 percent reduction in acetaldehyde, and a 90 percent reduction in diesel particulate emissions. On a regional basis, differences between the future 2030 emissions for project alternatives, including the No-Build Alternative, are 1 percent or less, which is not a meaningful difference.

Similar to regional emissions, future emissions in the subareas are expected to be substantially lower than existing emissions for all project alternatives, including the No-Build and no toll. Although there are variations between subareas, the reductions are generally similar to the large reductions estimated for regional emissions. The subareas show more variation in emissions between alternatives than the regional emissions. The no toll alternative would increase emissions in the subareas relative to the No-Build Alternative emissions. The increase for the no toll relative to the No-Build Alternative is most observable in the CO, NOx, and VOC emissions when the absolute quantity and accuracy of the emissions estimates are considered. For these pollutants the difference ranges from 2 to 10 percent in Subareas 1, 2, and 4, and 15 to 23 percent in Subarea 2.

If the no toll alternative is excluded, emissions of VOC and MSATs are reduced by the build alternatives relative to the No-Build Alternative in all the subareas. Emissions of CO and NOx are also reduced relative to the No-Build Alternative in all subareas except Subarea 2. The following differences are seen between the build alternatives (excluding no toll) and the No-Build Alternative in the subareas:

- In Subareas 3 and 4 (south of the bridge crossing) there are fairly substantial (zero to 35 percent, depending on the alternative and pollutant) reductions in emissions for the build alternatives relative to the No-Build Alternative. Construction of the project would have the greatest potential benefit for emissions in these areas.
- Differences between alternatives are more moderate in Subarea 1 (one to four percent decrease relative to No-Build Alternative) and may not be meaningful within the accuracy of the emission estimates.
- Emissions for the replacement bridge alternatives show increases in CO and NOx in Subarea 2 of approximately 2 to 5 percent relative to the No-Build Alternative. Other pollutants either show a reduction or no increase. CO concentrations are not expected to exceed the NAAQS, and NOx emissions are more of a concern for regional ozone formation than for local effects. Consequently, although there are trade-offs, the benefits of reduced VOC and MSAT emissions in relation to increased CO and NOx emissions is probably still a benefit in terms of the overall effects of the project alternatives for this subarea.

To summarize, air pollutant emissions are expected to be substantially lower in the future than under existing conditions. Differences between alternatives are smaller for all pollutants, and generally much smaller, than the reduction between existing and future conditions for both the region and the subareas. On a regional basis, future differences between alternatives are small enough not to be meaningful within the accuracy of the estimation methods.

For the subareas, the build alternatives other than the no toll alternative are either clearly beneficial in reducing emissions, or have trade offs between CO and NOx emissions relative to VOC and MSAT emissions that are probably beneficial relative to emissions for the No-Build Alternative. The no toll alternative would increase emissions in the subareas relative to the No-Build Alternative.

1.3.2 Segment-level Effects

The segment level decisions such as transit alignment choices and park and ride locations will not affect regional or subarea emissions estimates, but can be expected to affect different intersections in the project area at varying levels.

A quantitative analysis of CO concentrations for the alternative expected to yield the worst congestion conditions was performed for three intersections in Vancouver and three intersections in Portland. No violations of the NAAQS were shown for existing conditions, No-Build Alternative, or any of the build alternatives. Therefore, long-term air quality impacts are not expected to occur as a result of the project.

In addition to intersection affects, a system-level choice of BRT would result in HCT vehicles with exhaust emissions. The various alignment choices would affect the location of these emissions. As a result of federal regulations requiring new buses (model year 2007 and later) to meet stringent exhaust emission standards that lower PM and NOx emissions by 90 and 95 percent, respectively, and the proactive approach of the local transit agencies, these potential emissions should be minimized.

1.4 Temporary Effects

Construction for any CRC build alternative will be extensive and will involve demolition, a wide variety of heavy construction equipment and operations, on-road construction activities, and potentially off-site activities such as concrete plants or soil stockpiling operations. Traffic congestion will occur with construction in the project area, and potentially along detour or construction haul routes. Construction impacts will vary in extent and location, depending on the alternative selected and on weather conditions (rain suppresses dust). Construction impacts would logically be lowest with the No-Build Alternative and higher for the build alternatives. Construction activities may cause short-term increases in air pollutant emissions and odors.

The primary impacts of direct construction activities will be the generation of dust from demolition, site clearing, excavating, and grading activities, direct exhaust emissions from construction equipment, and impacts to traffic flow in the project area. Traffic congestion increases idling times and reduces travel speeds, resulting in increased vehicle emission levels. If the construction duration is longer than 5 years, the project conformity analysis will need to include a hot spot analysis for potential construction related congestion. Demolition may involve structures containing lead or asbestos.

Construction of concrete structures or asphalt paving activities may have associated pollutant-emitting sources, such as mixing operations. Stationary sources, such as concrete mix and asphalt plants, are generally required to obtain an air permit from either DEQ or SWCAA and to comply with regulations for controlling dust and other pollutant emissions. Burning of debris from land clearing is prohibited in the project area. Demolition of a structure containing asbestos is regulated by either DEQ or SWCAA.

1.5 Mitigation

Long-term air quality impacts are not expected to occur as a result of the project and mitigation for long-term impacts is not proposed.

Construction mitigation should focus on controlling dust and exhaust emissions from demolition and construction activities and minimizing the effects of traffic congestion. For a project of the magnitude of the I-5 CRC project, the contractor should be required to develop a pollution control plan that includes documentation of operational measures that will be used to reduce emissions. Section 290 of the ODOT, and Section 1-07.5(4) of the WSDOT, standard specifications outline requirements for environmental protection, including air pollution control measures. These control measures are designed to minimize vehicle track-out and fugitive dust and should be included in the project specifications.

Strategies to minimize the occurrence and effect of roadway congestion in the project area will be developed throughout the design phase. Alternatives will be refined, impacts to traffic analyzed, and transportation agencies and experts brought in to develop mitigation plans and solutions. Some of these strategies may consist of:

- Providing alternatives to single-occupant vehicle (SOV) trips.
- Providing incentives to reduce automobile trips and encourage mode shifts to non-SOV types.
- Managing traffic and lane closures to avoid congestion and delay.
- Providing traveler information at key junctions to encourage traffic diversion from the I-5 corridor project area and crossing routes.
- Promoting continuous information campaigns to alert motorists of delay times within the corridor and of upcoming traffic pattern changes and detours.
- Incorporating transit priority measures where feasible.
- Working with employers whose employees must commute through the area to promote alternative work schedules.
- Instituting contractor incentives to shorten construction durations and encourage the use of lower-emitting construction equipment.

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2. Methods

2.1 Introduction

The EPA has developed NAAQS for six criteria pollutants: CO, lead, ozone, NO_2, SO_2, and PM. There are well-developed standards and analysis methods for air quality impacts from criteria pollutants. The states have State Ambient Air Quality Standards (SAAQS) that are at least as stringent as the NAAQS.

On recent transportation projects, MSAT pollutants have caused more concern than criteria pollutants. Despite the concerns, there are no NAAQS for MSAT pollutants, nor are there specific regulatory analysis requirements, and the analysis methods are still being developed.

The methodology used for the project analysis had two goals: 1) to show if potential violations of the NAAQS are expected from project alternatives, and 2) to compare the emissions of the alternatives so that the public and decision-makers have reasonable information about the relative air quality effects of the alternatives even where there are no standards for determining impacts.

2.2 Study Area

Air quality impacts are closely tied to traffic impacts. Regional and subarea emissions estimates were provided by Metro using their software developed for regional conformity analysis and the Portland Air Toxics Assessment (PATA). Air quality was evaluated on a regional emissions basis and a subarea emissions basis. The regional area includes Multnomah, Clackamas, Washington, and Clark Counties. The subarea boundaries extend from NE 99th Street to East 39th Street, East 39th Street to SR 14, SR 14 to Columbia Boulevard, and Columbia Boulevard to the I-405 junction (a map of the subareas is included in the Long-Term Effects section of this report). The subareas to be studied were developed in an interagency process and are discussed in the Columbia River Crossing Air Quality Methods and Data Report (January 2007). Originally, three subareas were proposed for evaluation: the bridge influence area, north of the influence area, and south of the influence area. As the project progressed, the subarea north of the bridge influence area appeared too large to provide useful information to neighborhoods in Vancouver about localized effects. Consequently, four subareas were used in the analysis so that the Vancouver neighborhoods between SR14 and East 39th would have better information for evaluating the alternatives. To evaluate the local effects of the alternatives, CO concentrations were estimated adjacent to poorly performing intersections affected by the project alternatives and compared to the NAAQS for CO.

2.3 Effects Guidelines

An air quality impact would occur with a violation of the NAAQS or SAAQS summarized in Exhibit 2-1. Based on historic monitoring data and future compliance analyses performed by DEQ and SWCAA for State Implementation Plan (SIP) development, CO is the only pollutant of concern for potential violations of the NAAQS or SAAQS related to transportation projects in the Portland-Vancouver metropolitan area.

Exhibit 2-1. State and Federal Ambient Air Quality Standards[a]

Pollutant	Averaging Time	Federal	Oregon	Washington
CO	8-hour[b]	9 ppm	9 ppm	9 ppm
	1-hour[b]	35 ppm	35 ppm	35 ppm
Lead	Calendar Quarter	1.5 μg/m^3	1.5 μg/m^3	1.5 μg/m^3
Ozone	8-hour[c]	0.08 ppm	0.08 ppm	
	1-hour			0.12 ppm
Nitrogen Dioxide	Annual Arithmetic Mean	0.053 ppm	0.053 ppm	0.05 ppm
Sulfur Dioxide	Annual Arithmetic Mean	0.03 ppm	0.02 ppm	0.02 ppm
	24-hour	0.14 ppm	0.10 ppm	0.10 ppm
	3-hour	0.5 ppm	0.50 ppm	-
	1-hour Average (Annual)	-	-	0.4 ppm
	1-hour Average (7 day period)	-	-	0.25 ppm
Total Suspended Particulate (TSP)	Annual Geometric Mean	-	-	60 μg/m^3
	24-hour Average	-	-	150 μg/m^3
PM_{10}	3-year Average of Annual Arithmetic Mean	-	50 μg/m^3	50 μg/m^3
	24-hour Average	150 μg/m^3	150 μg/m^3	150 μg/m^3
$PM_{2.5}$	3-year Average of Annual Arithmetic Mean	15 μg/m^3	-	-
	3-year Average of 98th Percentile of 24-hour concentrations	35 μg/m^3	-	-

Note: ppm = parts per million; μg/m^3 = micrograms per cubic meter; PM_{10} = particulate with an aerodynamic diameter of less than or equal to 10 micrometers; $PM_{2.5}$ = particulate with an aerodynamic diameter of less than or equal to 2.5 micrometers.

[a] Sources: EPA Office of Air Quality Planning and Standards (OAQPS); Oregon Department of Environmental Quality (DEQ); Washington Administrative Code (WAC 173, Sections 470, 474, 475).

[b] Not to be exceeded more than once per year.

[c] The 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm. The federal 1-hour ozone standard was revoked in June 2005. The 8-hour standard is revised to 0.075 ppm effective May 27, 2008.

Geographic areas where concentrations of a pollutant exceed the ambient air quality standards are classified as nonattainment (do not attain standards) areas. Previously designated nonattainment areas now in compliance with air quality standards are classified as maintenance areas. Areas that meet the standards are classified as attainment (attain standards) areas. Federal regulations require states to prepare SIPs that identify emission reduction strategies for nonattainment and maintenance areas. Portland and Vancouver are CO maintenance areas. The Portland-Vancouver metropolitan area is an attainment area for all other pollutants.

The transportation conformity regulations establish criteria and procedures for determining conformity (compliance) with SIPs. This rule covers transportation plans, programs, and projects in Oregon and Washington that are developed, funded, or approved by the United States Department of Transportation (DOT) and by metropolitan planning organizations (MPOs) or other recipients of funds under Title 23 of the U.S. Code (USC) or the federal transit laws. The Oregon Department of Environmental Quality (DEQ) and SWCAA have identified control strategies in their SIPs for compliance with the ambient air quality standards and the maintenance of healthy air quality in the Portland-Vancouver metropolitan area.

DEQ and SWCAA cooperate on management of air quality in the Portland-Vancouver metropolitan area. DEQ updated its CO Maintenance Plan SIP in 2004 and prepared an 8-hour Ozone Maintenance Plan in early 2007. The Portland-Vancouver AQMA is an attainment area for ozone, but a maintenance plan is in place to prevent backsliding in air quality conditions. SWCAA updated their CO Maintenance Plan and prepared an 8-hour Ozone Maintenance Plan in 2006.

To demonstrate conformity for a project in the Portland area, the project must be included in a conforming Regional Transportation Plan (RTP) and Metropolitan Transportation Improvement Plan (MTIP), and a hot spot analysis must be performed to analyze potential CO impacts at intersections where traffic volumes would be affected by the proposed project. With the finding of adequacy for the Vancouver Air Quality Maintenance Area Second 10-Year Limited Carbon Monoxide Maintenance Plan by EPA in December 2007, regional conformity demonstration is no longer required for projects in Vancouver. A hot spot analysis will still be required. The conformity analysis must be completed before the ROD for a National Environmental Protection Act (NEPA) project.

In the Portland area, Metro performs the regional conformity analyses of all transportation projects included in the RTP and MTIP to address long-term impacts. Total CO emissions associated with all planned projects are evaluated to determine if the projects will cumulatively exceed the emissions budget for on-road mobile sources in the air quality SIP. If the emissions are within the CO emissions budget, then no regional adverse air quality impacts would occur as a result of the planned projects, and the RTP and TIP are found to conform. Additional requirements for the conformity determination include an interagency process, the use of the latest planning assumptions and emissions model, and demonstration that transportation control measures are being implemented in a timely manner.

In addition to NAAQS compliance and conformity requirements, there are a number of air quality regulations that may apply to the project directly or indirectly. These regulations include:

- SWCAA requires permitting of non-road engines that remain at "any single site at a building, structure, or installation" for more than 12 consecutive months. This regulation could affect construction equipment in Washington and requires dispersion modeling of emissions. The regulation excludes mobile cranes and pile drivers.

- Asbestos regulations administered by DEQ and SWCAA could affect demolition activities for the project. Notification and use of certified contractors is required.
- Although there is not a specific air quality regulation, except for compliance with the NAAQS, that governs emissions of lead from demolition activities on the project, control of potential lead emissions should be required by the construction contracts for the CRC project.

2.4 Data Collection Methods

Potential cumulative effects from this project are evaluated in the Cumulative Effects Technical Report. Please refer to this report for an evaluation of possible cumulative effects.

The air quality analysis uses secondary data (traffic information) and assumptions about the local vehicle fleet to estimate regional and project subarea pollutant emissions and local CO concentrations. Pollutant emissions data were produced by Metro for regional and subarea analyses using the MOBILE6.2 model. The calculation methods used by Metro staff were consistent with those used in current conformity analysis work and in the PATA. These regional studies are developed in coordination with DEQ, SWCAA, and the Southwest Washington Regional Transportation Council (RTC). Local CO concentrations were predicted using the MOBILE6.2 and CAL3QHC models. Input assumptions used were those established in the CRC Air Quality Methods report. Assumptions used in the CAL3QHC model are shown in Exhibit 2-2. Assumptions used in the MOBILE6.2 model are shown in Appendix A.

Exhibit 2-2. Summary of CAL3QHC Input Command Options

Meteorological Variables	
Averaging Time	60 minutes
Surface Roughness	175.00 (City land-use - “Office” category)
Wind Speed	1 meter/second
Wind Angle	0 to 360 degrees in 10 degree increments
Stability Class	4 (D)
Mixing Height	1,000 meters
Persistence Factor (1-hour to 8-hour)	0.70 in Vancouver 0.76 in Portland
Ambient Background Concentration	3.0 ppm
Site Variables	
Receptor Coordinates	At least 3 meters from each traveled roadway on both sides of the street[a], at distances of 3 meters, 25 meters, and 50 meters from the cross street. Height 1.8 meters.

[a] Distances are measured 3 meters from the queue line and 3 meters from the lane edge. All receptor locations will be verified to ensure that none are placed in the roadway.

2.5 Analysis Methods

The operational impacts analysis provides information to the public and decision makers on pollutant emissions for the alternatives and expected impacts. The analysis evaluates the regional and subarea pollutant emissions differences between the build alternatives, the No-Build Alternative, and existing conditions and compares the emissions to the emissions basis used in the PATA. This comparison will show the broad effects of the proposed alternatives and allow a general link to information regarding potential health risks. The methods used in the analysis are consistent with the methods proposed in the CRC Air Quality Methods and Data Report.

2.5.1 Criteria Pollutants

CO is the only pollutant subject to specific regulatory analysis requirements because it is subject to the transportation conformity regulation analysis requirements. Local CO impacts were evaluated by performing hot spot analyses at three intersections in Vancouver and three intersections in Portland. The hot spot analyses include existing (2005) conditions and design year (2030) conditions, but do not include an interim year; therefore, they will not meet full local conformity analysis requirements. Conformity level hot spot analyses will not be completed until the Final Environmental Impact Statement (FEIS).

Vehicles are the primary source of VOCs and NO_X emissions in the Portland-Vancouver metropolitan area. Both VOC and NO_X contribute to ozone formation. The public has expressed concern regarding emissions of particulates, lead and air toxic pollutants. To address public concern, and provide information on the relative effects of the project alternatives, regional and subarea emission estimates are provided for CO, VOCs, NO_X, PM_{10}, and $PM_{2.5}$ for the project alternatives. Vehicle lead emissions are no longer a concern since the use of lead in gasoline was phased out. Lead is not included in the emissions analysis, although it is discussed in the context of construction effects. The criteria pollutant estimates use model assumptions consistent with those used in transportation conformity planning, or in the PATA, depending on the pollutant.

2.5.2 Air Toxic Pollutants

Based on information in the EPA mobile source toxics rulemanking, FHWA has identified six priority MSATs: diesel particulate emissions, benzene, formaldehyde, 1,3-butadiene, acrolein, and acetaldehyde. Emission estimates for the MSATs were developed on a regional and subarea basis for each of the project alternatives. The subareas include the I-5 mainline and ramps in the following segments:

- NE 99th Street to East 39th Street (Subarea 1)
- East 39th Street to State Route 14 (Subarea 2)
- State Route 14 to Columbia Boulevard (Subarea 3)
- Columbia Boulevard to the Interstate 405 (I-405) junction (Subarea 4)

Estimates were provided by Metro using the models and methods developed for the PATA (Metro 2002). They compare emissions for the project alternatives to the emissions used as the basis for concentration and health-related analyses published in the PATA. PATA results used state-of-the-art dispersion techniques and provide a useful planning tool for DEQ and the public to identify general levels of health risk and the sources of associated pollutants. However, the methods used in the study are not accurate enough to evaluate the potential health risks associated with individual transportation projects. Issues that affect the accuracy of the health risks reported in PATA as they relate to individual projects include:

- Acrolein and diesel particulates were not measured for the study; therefore, could not be compared to modeled concentrations.
- Acrolein was found to be the primary pollutant contributing to non-cancer health risks based on modeling.
- Diesel particulate was found to be the primary pollutant contributing to cancer risk based on modeling.
- Benzene and acetaldehyde measured concentrations varied by a factor of 2 or 3 from modeled levels.
- More than 80 percent of the samples for 1,3-butadiene were below the minimum quantification levels.
- The general uncertainty estimated in the PATA for unit risk concentrations and reference concentrations used to calculate health risks "spans perhaps an order of magnitude" (page 72 of PATA study).

These general issues regarding accuracy do not negate the usefulness of the PATA as a planning tool, but should be considered when reviewing the data in the context of emissions from individual projects.

2.5.2.1 Unavailable Information for Project-Specific MSAT Impact Analysis

This subsection provides a basic discussion of the issues associated with MSAT emission impact analysis for projects such as the CRC. Available technical tools do not enable prediction of the project-specific health impacts resulting from the emission changes associated with the I-5 CRC project. Due to these limitations, the following discussion is included in accordance with the Council on Environmental Quality (CEQ) regulations (40 CFR 1502.22(b)) regarding incomplete or unavailable information.

2.5.2.2 Unavailable or Incomplete Information

Evaluating the environmental and health impacts from MSATs on a proposed highway project involves several key elements, which include emissions modeling, dispersion modeling to estimate resulting ambient concentrations, exposure modeling to estimate human exposure to the estimated concentrations, and a final determination of health impacts based on the estimated exposure. Each of these steps is encumbered by technical shortcomings or uncertain science that prevents a more complete determination of the MSAT health impacts of this project.

2.5.2.2.1 Emissions

EPA tools for estimating MSAT emissions from motor vehicles are not sensitive to key variables in the context of highway projects. While MOBILE 6.2 is used to predict emissions at a regional level, it has limited applicability at the project level since it is a trip-based model that predicts emissions based on a typical trip of 7.5 miles and on average speeds for this typical trip. This means that MOBILE 6.2 does not have the ability to predict emission factors for a specific vehicle operating condition at a specific location at a specific time. Because of this limitation, MOBILE 6.2 can only approximate operating speeds and levels of congestion likely to be present on the largest-scale projects and cannot adequately capture emissions effects of smaller projects. For PM, the model results are not sensitive to average trip speed, although the other MSAT emission rates do change with changes in trip speed. In its discussions of PM under the conformity rule, EPA has identified problems with MOBILE 6.2 as an obstacle to quantitative analysis.

These deficiencies compromise the capability of MOBILE 6.2 to estimate MSAT emissions. Although MOBILE 6.2 is an adequate tool for projecting emissions trends and performing relative analyses between alternatives for very large projects, it is not sensitive enough to capture the effects of travel changes tied to smaller projects or to predict emissions near specific roadside locations.

2.5.2.2.2 Dispersion Models

Tools to predict how MSATs disperse are also limited. EPA's current regulatory models, CALINE3 and CAL3QHC, were developed and validated more than a decade ago for the purpose of predicting episodic concentrations of CO to determine compliance with the NAAQS. The performance of dispersion models is more accurate for predicting maximum concentrations that can occur at "some" time at "some" location within a geographic area. This limitation makes it difficult to predict accurate exposure patterns at specific times at specific highway project locations across an urban area to assess potential health risk.

2.5.2.2.3 Exposure Levels and Health Effects

Even if emission levels and concentrations of MSATs could be accurately predicted, shortcomings in current techniques for exposure assessment and risk analysis preclude reaching meaningful conclusions about project-specific health impacts. Exposure assessments are difficult to perform because it is difficult to accurately calculate annual concentrations of MSATs near roadways, and to determine the portion of a year that people are actually exposed to those concentrations at a specific location. These difficulties are magnified for 70-year cancer assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over a 70-year period.

There are also considerable uncertainties associated with the existing estimates of toxicity of the various MSATs because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population. Because of these shortcomings, any calculated difference in health impacts among alternatives or design options is likely to be much smaller than the uncertainties associated with calculating the impacts.

Consequently, the results of such assessments would not be useful to decision-makers, who would need to weigh this information against other project impacts that are better suited for quantitative analysis.

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

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

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

The 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 found in the environment. The IRIS database can be accessed at http://www.epa.gov/iris.

The following toxicity information for the six prioritized MSATs was taken from the Weight-of-Evidence characterization summaries in the IRIS database. This information is taken verbatim from the IRIS database and represents the EPA's most current evaluations of the potential hazards and toxicology of these chemicals or mixtures.

- Benzene is characterized as a known human carcinogen.
- The potential carcinogenicity of acrolein cannot be determined because the existing data are inadequate for an assessment of human carcinogenic potential for either the oral or inhalation route of exposure.
- Formaldehyde is a probable human carcinogen, based on limited evidence in humans, and sufficient evidence in animals.
- 1,3-butadiene is characterized as carcinogenic to humans by inhalation.
- Acetaldehyde is a probable human carcinogen based on increased incidence of nasal tumors in male and female rats and laryngeal tumors in male and female hamsters after inhalation exposure.
- Diesel exhaust (DE) is likely to be carcinogenic to humans by inhalation from environmental exposures. DE as reviewed in this document is the combination of diesel particulate matter and DE organic gases.
- DE also represents chronic respiratory effects, possibly the primary noncancer hazard from MSATs. 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.

Other studies have addressed MSAT health impacts in proximity to roadways. The Health Effects Institute (a nonprofit organization funded by EPA, FHWA, and industry) has undertaken a major series of studies to research near-roadway MSAT hot spots, the health implications of the entire mix of mobile source pollutants, and other topics. The final summary of the series is not expected for several years.

Some recent studies have reported that proximity to roadways is related to adverse health outcomes, particularly respiratory problems.[1] Much of this research is not specific to MSATs, instead surveying the full spectrum of both criteria and other pollutants. The FHWA cannot evaluate the validity of these studies, but more important, the studies do not provide information that would lessen the uncertainties listed above and make it possible to perform a more comprehensive evaluation of the health impacts specific to this project.

It is also worth noting that previous MSAT analyses on transportation projects have forecasted large declines in emissions over time irrespective of the alternative chosen. Reduced emissions are projected to result from cleaner fuels and new combustion and emission control technologies in use in future years. Emissions analyses using MOBILE6.2 along with projected increases in vehicle travel typically show a 50 to 80 percent decline in study area emissions between the base year and the design year, and then some small incremental change between the build alternatives and the No-Build Alternative. Given this well-documented trend, using dispersion models and other advanced techniques alternatives, with their associated uncertainties, would not be expected to add information of value to the decision-making process.

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

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3. Coordination

The air quality analysis methodology was developed with input from the CRC Interstate Collaborative Environmental Process (InterCEP) group. InterCEP is a group of state and federal resource agencies that are likely to have permitting authority or approval over one or more elements of the CRC project. The CRC project team worked with InterCEP agencies early in the development of the project to form an agreement that establishes an approach for close coordination between these agencies and the project team. This agreement specifies project milestones at which InterCEP agencies are asked for formal concurrence and/or comment that inform the project team whether any decisions being made could ultimately result in a project that would be difficult for an InterCEP to permit or approve. The primary tenet of the InterCEP group is early and continual communication with resource agencies to ensure decisions about the transportation improvements evaluated by the CRC project are well informed of the applicable environmental regulations. InterCEP includes the following agencies:

- U.S. Army Corp of Engineers (COE)
- U.S. Environmental Protection Agency (EPA)
- National Oceanic and Atmospheric Administration (NOAA) Fisheries
- U.S. Fish and Wildlife Service (USFWS)
- Oregon Department of Fish and Wildlife (ODFW)
- Oregon Department of Land Conservation and Development (DLCD)
- Oregon Department of Environmental Quality (DEQ)
- Oregon Department of State Lands (OR DSL)
- Oregon State Historic Preservation Office (SHPO)
- Washington Department of Fish and Wildlife (WDFW)
- Washington Department of Ecology
- Washington Department of Archaeology and Historic Preservation (DAHP)

In addition to coordination through InterCEP, contact was made with the following agencies to obtain data, or coordinate specific aspects of the air quality analysis:

- Metro
- DEQ
- Southwest Washington Regional Transportation Council (RTC)
- Southwest Washington Clean Air Agency (SWCAA)

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4. Affected Environment

4.1 Introduction

The I-5 CRC project is located within the Portland and Vancouver CO maintenance areas and the Portland-Vancouver Air Quality Maintenance Area (AQMA). In the Portland-Vancouver metropolitan area, the primary pollutants of concern for transportation projects are NOx, VOC, and CO. Other pollutants of concern for transportation projects can be PM_{10}, $PM_{2.5}$ and MSATs.

The Portland-Vancouver metropolitan area has a relatively mild climate with temperatures ranging from an average minimum monthly temperature of 35^{o}F in January to an average maximum monthly temperature of 80^{o}F in August. The winters are the wettest part of the year with approximately 75 percent of the annual precipitation falling between October and March, according to the Western Regional Climate Center.

The area experiences winter inversion conditions that lead to higher concentrations of CO and PM as emissions accumulate from vehicles and home heating, particularly wood-burning. Extended periods of high summer temperatures can lead to high ozone levels with emissions of VOC and NOx from vehicles and industrial sources contributing substantially. A brief discussion of the human health issues associated with CO, ozone (NOx and VOC are ozone precursors), and PM follows. The potential health affects associated with MSATs are discussed in greater detail in the methodology section.

Carbon monoxide is a colorless, odorless gas. In the body, CO binds tightly to hemoglobin (the red pigment in blood that transports oxygen from the lungs to the rest of the body). Once hemoglobin is bound to CO, it can no longer carry oxygen. Carbon monoxide reduces the oxygen-carrying capacity of the blood and can result in adverse health effects. High concentrations of CO strongly impair the functions of oxygen-dependent tissues, including brain, heart, and muscle. Prolonged exposure to low levels of CO aggravates existing conditions in people with heart disease or circulatory disorders. There is a correlation between CO exposure and increased hospitalization and death among such patients. Even in otherwise healthy adults, CO exposure has been linked to increased heart disease, decreased athletic performance, and diminished mental capacity. High CO levels also affect newborn and unborn children and are associated with low birth weights and increased infant mortality.

Ozone (a component of smog) is a pungent, toxic, highly reactive form of oxygen. A new eight-hour standard protects the public against lower level exposures over a longer time period, which has been found to be more detrimental than shorter peak levels. The long-term exposure effects cause breathing problems, such as loss of lung capacity and increased severity of both childhood and adult asthma. Ozone causes irritation of the nose, throat, and lungs. Exposure to ozone can cause increased airway resistance and decreased efficiency of the respiratory system. In individuals involved in strenuous physical activity and in people with pre-existing respiratory disease, ozone can cause sore throats, chest pains, coughing, and headaches.

Fine particulate matter (PM_{10} and $PM_{2.5}$) consists of solid particles or liquid droplets that are less than 10 microns in diameter or less than 2.5 microns in diameter. Particles in these size ranges are of great concern because they can be inhaled deeply into the lungs where they can remain for years. The health effects of particulate matter vary with the size, concentration, and chemical composition of the particles. Relationships have been shown between exposure to high concentrations of PM and increased hospital admissions for respiratory infections, heart disease, bronchitis, asthma, emphysema, and similar diseases.

4.2 Monitoring Data

Exhibit 4-1 shows locations in the general vicinity of the project where pollutants either are currently measured or where a monitoring station has been located in the past. The trends and patterns shown by air pollutant data collected at these locations is discussed in the following report sections.

4.2.1 Air Quality Trends

During the 1970s, pollutant concentrations in the Portland-Vancouver metropolitan area exceeded the standards for CO on one out of every three days, and ozone levels were often as high as 50 percent over the federal standard. Programs and regulations put into effect to control air pollutant emissions have been effective, and air quality in the area has improved. The area was redesignated from a nonattainment area to a maintenance area in 1997. In general, most pollutants have shown continuing patterns of reductions in recent years. Exhibits 4-2, 4-3, and 4-4 depict air quality trends for PM_{10}, CO, and ozone (NOx and VOC are precursors for ozone formation). The data for CO and PM_{10} are the highest concentrations from Portland area monitoring stations. Monitoring stations in Vancouver show similar trends with slightly higher (but still well below the NAAQS) concentrations for CO and somewhat lower concentrations for PM_{10}. Ozone data are from Carus, Oregon, which has the highest ozone concentrations in the Portland-Vancouver metropolitan area. The Department of Environmental Quality and SWCAA have only collected $PM_{2.5}$ data since 1999, and no trend was apparent in the collected data. Insufficient data are available to chart individual MSAT trends. However, MSATs are generally a subset of VOC and PM_{10} emissions.

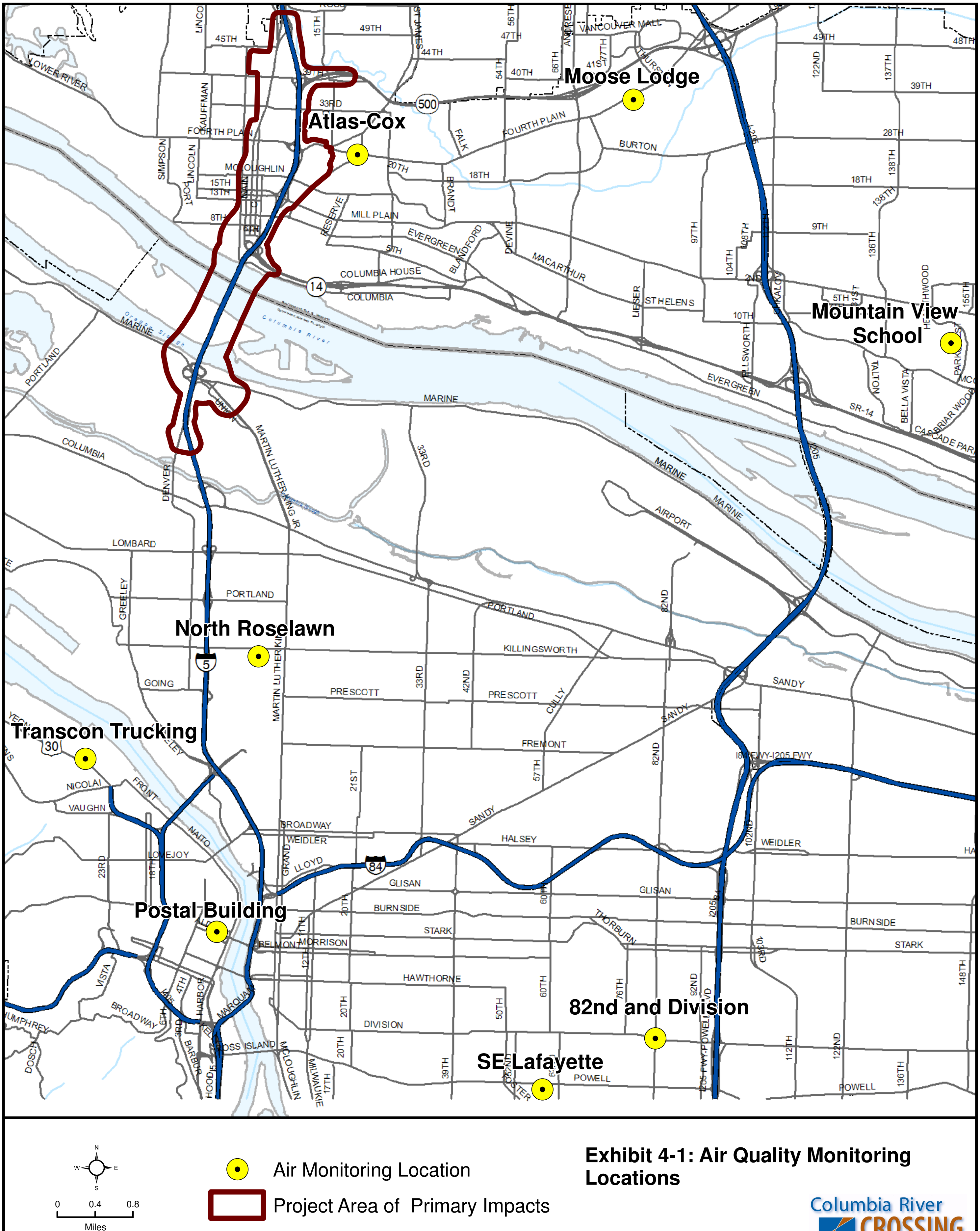


Exhibit 4-1: Air Quality Monitoring Locations

Columbia River CROSSING

Exhibit 4-2. Particulate Matter Trends

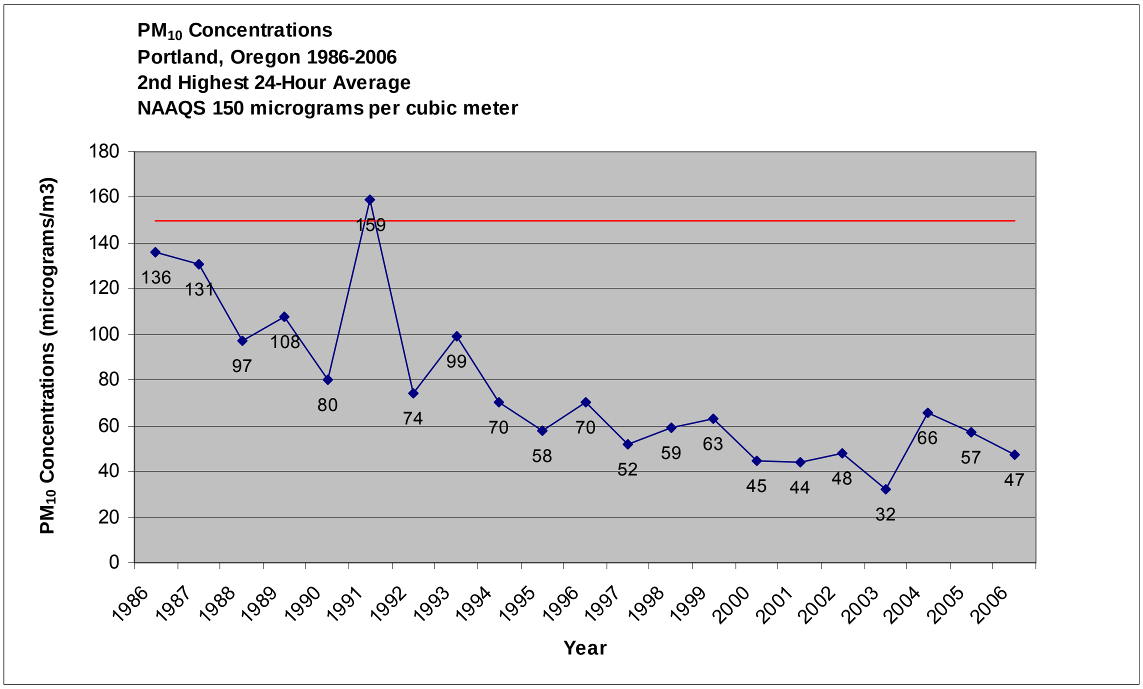


Exhibit 4-3. Carbon Monoxide Trends

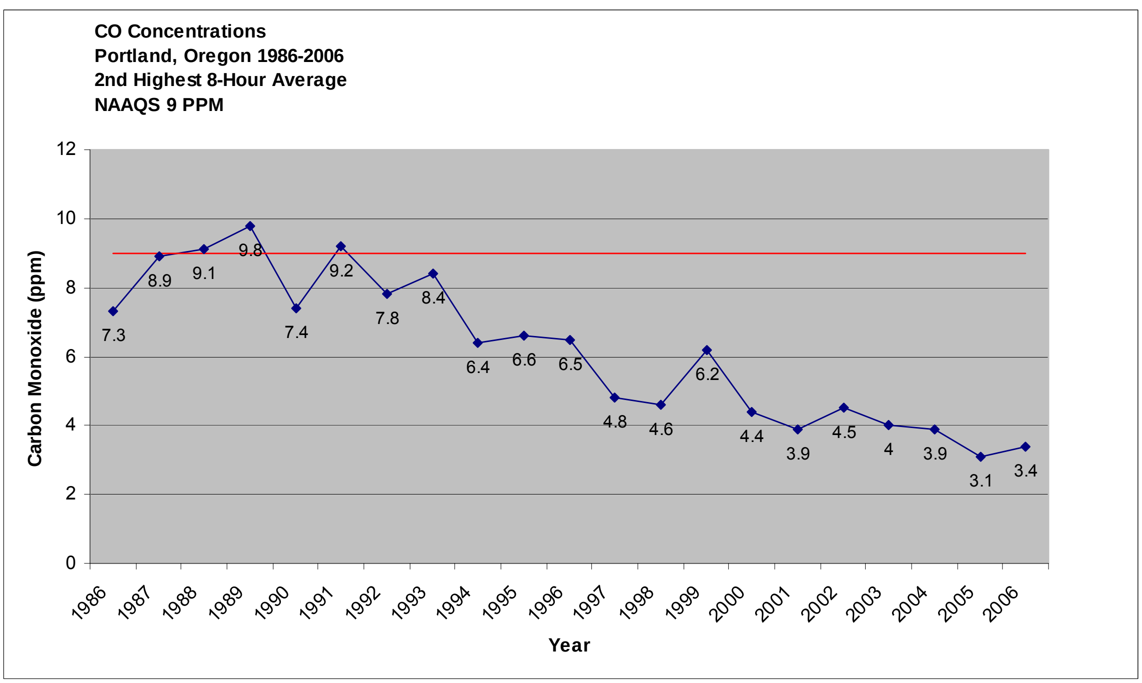
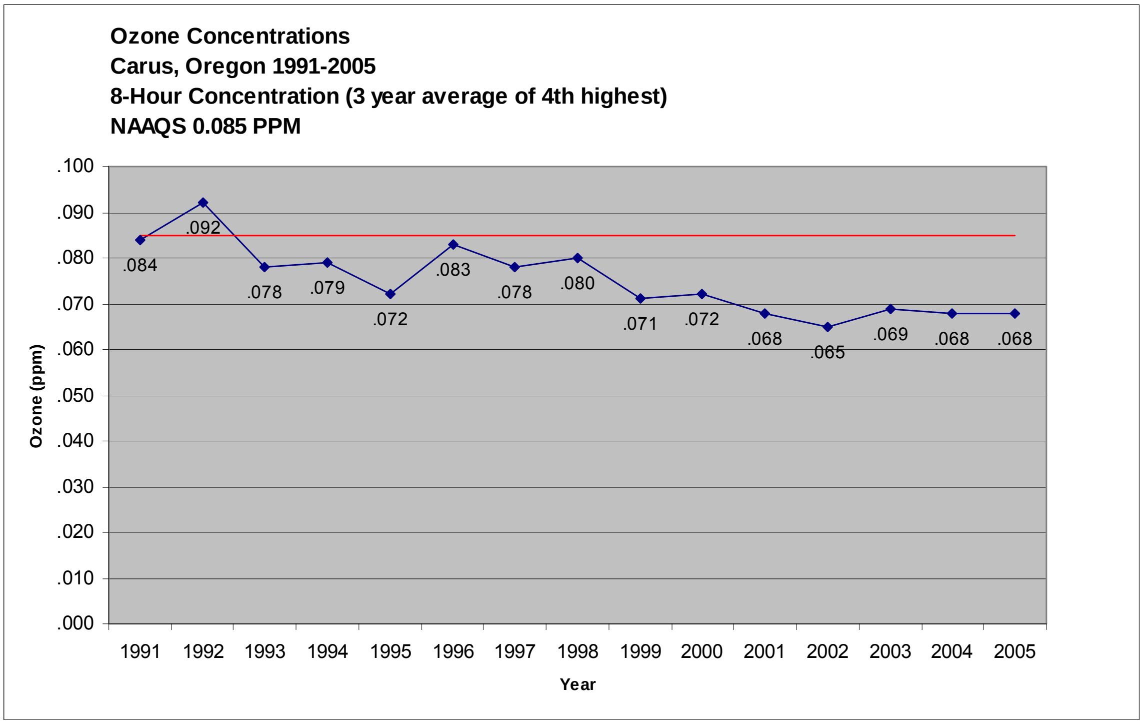


Exhibit 4-4. Ozone Trends



Starting in the early 1970s, EPA promulgated numerous regulations to control air pollutant emissions from motor vehicles. Recent regulations promulgated in the early 2000s, and most recently in February 2007, adopted controls on heavy-duty diesel on-road and off-road vehicles, sulfur in fuels, and air toxic emissions from mobile sources through control of fuel formulations. The gasoline reformulation rules are expected to substantially reduce benzene emissions. While these standards will not apply directly to the project alternatives, they apply to all vehicles on the highway system and are the regulatory controls responsible for substantial reductions in vehicle emissions since the 1970s and additional projected vehicle emissions reductions over the next 25 to 30 years.

4.2.2 Portland Air Toxics Assessment (PATA)

The Portland Air Toxics Assessment (PATA) is a computer modeling project designed to estimate and assess the risk from 12 air toxics in the Portland area including the six MSATs. It is the first local-scale air toxics modeling project conducted in Oregon as part of the developing state air toxics program. It is based on the 1999 air emissions inventory for the Portland area. The purpose of the assessment is to provide more refined estimates of the most significant air toxics in the Portland area. Such estimates will enable DEQ to better characterize the risks from air toxics, to better understand local patterns of air toxics exposure, and to identify locations with elevated risk. Finally, DEQ can measure changes in emissions and develop emission reduction strategies from the information provided by PATA.

The PATA results identify diesel exhaust, motor vehicles, and burning as important sources of air toxics in Portland. In general, the assessment shows widespread risks from three MSATs—benzene, formaldehyde, and diesel exhaust—throughout the Portland-Vancouver region. Higher risks for some pollutants (benzene and formaldehyde) appeared to align to some degree with major highway corridors.

Exhibit 4-5 shows the distribution of health risk associated with benzene emissions at the 90th percentile cancer risk level from the PATA study. The 90th percentile represents the range of exposure for the mix of people and activities in a given census tract. At this level, 90 percent of the population would have lower exposures and 10 percent would have higher exposures.

Exhibit 4-6 shows the risk associated with formaldehyde emissions at the 90th percentile cancer risk level from the PATA study. DEQ did not prepare a figure for diesel particulate because the higher risk level covered the entire Portland area.

Exhibit 4-5. Distribution of Health Risk Associated with Benzene Emissions

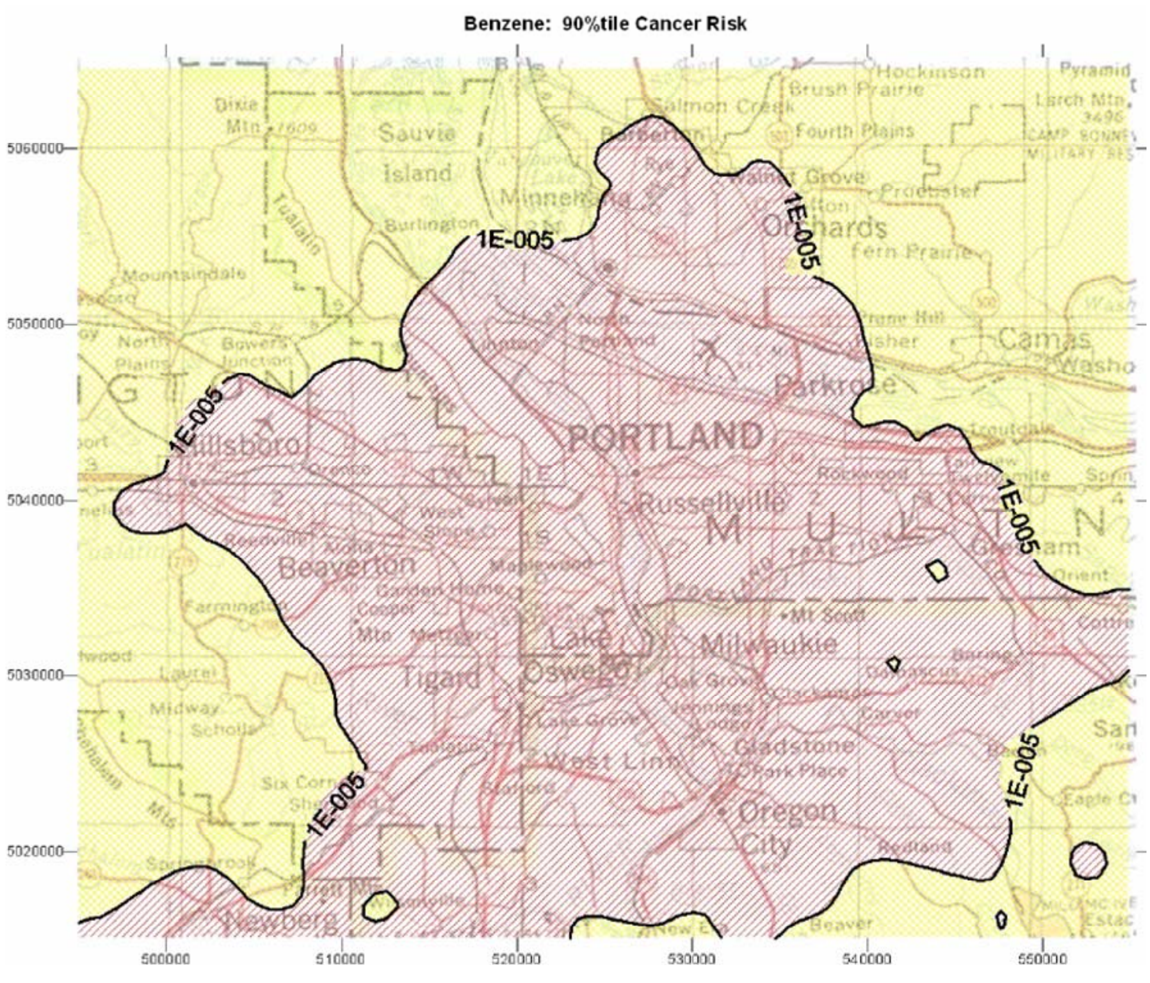
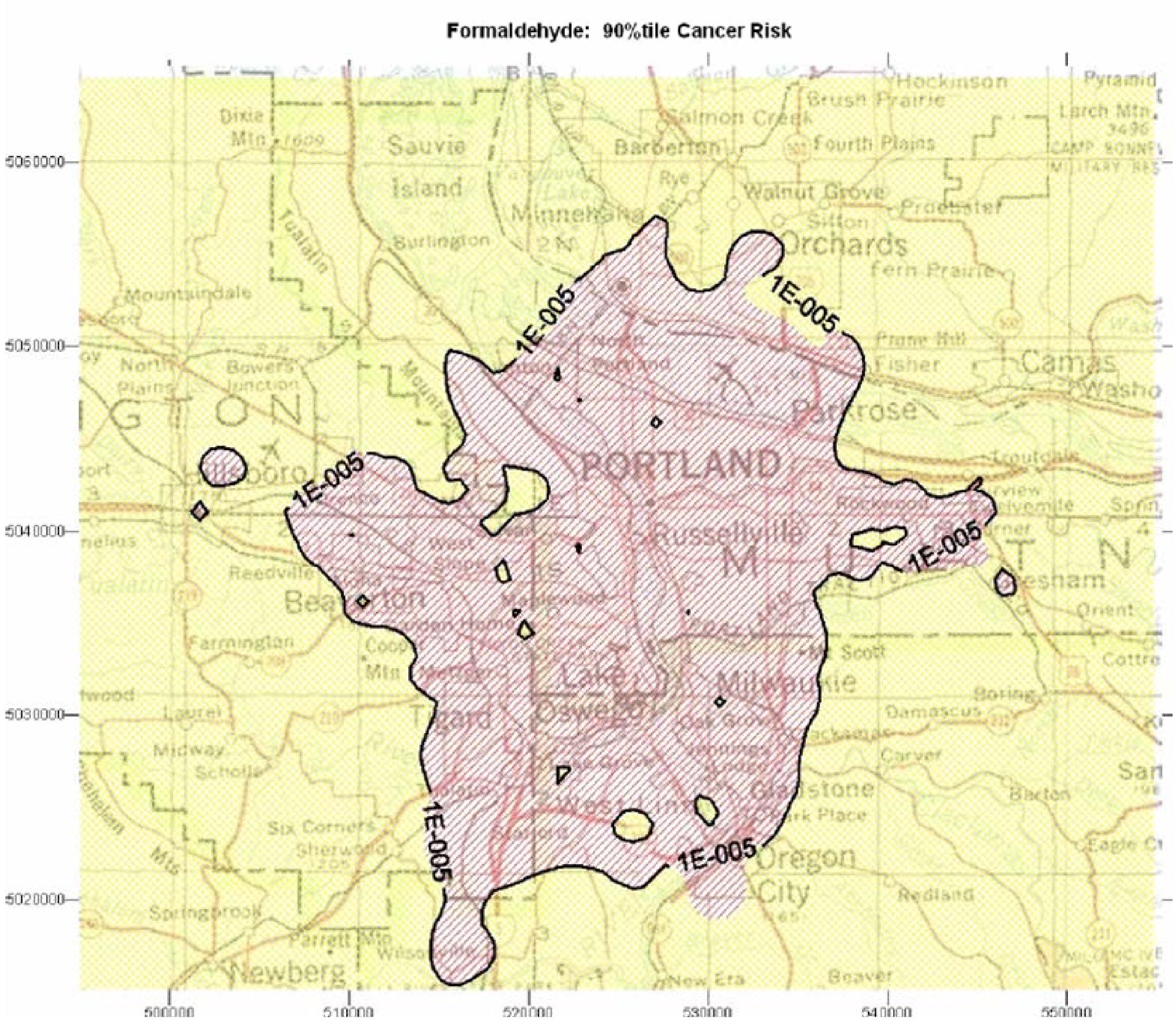


Exhibit 4-6. Distribution of Health Risk Associated With Formaldehyde Emissions



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5. Long-Term Effects

5.1 How is this section organized?

This chapter describes the long-term impacts that would be expected from the I-5 CRC Project alternatives and options. Impacts from the four full alternatives and the No-Build Alternative, which include specific highway, transit, bicycle, pedestrian and other elements and the No-Build Alternative are addressed first. This discussion focuses on how each of these comprehensive alternatives would affect corridor and regional impacts and performance. The focus then shifts to a discussion of the impacts that would occur with various design options such as HCT alignment.

The traffic data used in the analysis is based on regional models for land use and employment and includes traffic from all sources and potential induced growth as a result of the alternatives. Consequently, the results analyzed and discussed in this section include both direct and indirect effects.

MSAT emissions from the PATA study are listed for comparison to the existing conditions and the project alternatives. Although the same methods were used to estimate MSAT emissions for the project as were used for the PATA study, a direct comparison of the emissions should not be made as the PATA study had differences in some underlying inputs and assumptions. The two studies allocated emissions for some pollutants (benzene and 1,3-butadiene) differently. In PATA, a portion of the emissions of these pollutants were allocated to modeling zones instead of highway links. Because zones are not being used for the CRC analysis, the total benzene and 1,3-butadiene emissions were reported. The underlying regional models for employment and land use have also been updated since the PATA study was performed. However, the health risk discussion included in the PATA documentation can be used for a general understanding of the potential health risks based on the relative pollutant emission levels.

5.2 Impacts from Full Alternatives

This section describes the impacts from five full alternatives and the No-Build Alternative. These are combinations of highway, river crossing, transit, and pedestrian/bicycle alternatives and options covering all of the CRC segments. They represent the range of system-level choices that most affect overall performance, impacts, and costs. The full alternatives are most useful for understanding the regional impacts, performance, and total costs associated with the I-5 CRC project. The following sections summarize the major design elements associated with each alternative. In addition to the full alternatives listed in Section 1, a replacement crossing with LRT and I-5 high toll was analyzed, so that the effects of the replacement bridge versus the supplemental bridge could be isolated and analyzed. The supplemental crossing with BRT and I-5 high toll was not specifically modeled because it is expected to be similar to the difference between Alternatives 2 and 3 (replacement with BRT vs. LRT and standard toll).

5.2.1 Regional Effects

Estimated emissions of CO, NO_X, VOC, PM_{10}, and $PM_{2.5}$ for the four-county region are listed in Exhibit 5-1. Estimated regional emissions of the six MSATs are shown in Exhibit 5-2. The results of the emissions analysis showed that for future conditions (no-build or build) emissions are expected to be substantially lower than exiting emissions for the region for all pollutants. The expected emissions reductions are in the range of 30 percent for CO, 70 percent for NOx, 50 percent for volatile organic compounds (VOC), and 90 percent for both PM_{10} and $PM_{2.5}$. Emissions reductions for MSATs track those for VOC and PM with approximately 50 percent reductions in the volatile MSATs benzene, 1,3-butadiene, formaldehyde, and acrolein, and a 95 percent reduction in diesel particulate emissions. Emissions reductions for acetaldehyde are estimated to be approximately 10 percent. On a regional basis, differences between the future 2030 emissions for project alternatives, including the No-Build Alternative, are one percent or less, which is not a meaningful difference. Tolling may have a potential effect on regional emissions with no toll having slightly higher emissions than any tolling scheme.

Exhibit 5-1. Regional NAAQS Emissions (tons per summer day)

Alternative	CO	NO_X	VOC	PM_{10}	$PM_{2.5}$
Existing	550.4	86.0	50.5	1.2	1.1
No-Build	385.7	22.7	23.0	0.1	0.1
Replacement Crossing with LRT and I-5 Standard Toll	387.0	22.8	23.1	0.1	0.1
Replacement Crossing with BRT and I-5 Standard Toll	386.9	22.8	23.0	0.1	0.1
Replacement Crossing with LRT and No Toll	388.4	22.9	23.1	0.1	0.1
Replacement Crossing with LRT and High Toll	386.7	22.8	23.0	0.1	0.1
Supplemental Crossing with LRT and I-5 High Toll	386.9	22.8	23.0	0.1	0.1

Analysis years are 2005 for existing conditions and 2030 for the No-Build Alternative and all build alternatives.

Exhibit 5-2. Regional MSAT Emissions (pounds per summer day)

Alternative	Ben-zene	1,3-Buta-diene	Formal-dehyde	Acetal-dehyde	Acro-lein	Diesel PM
PATA[a]	2,486	251	2,041	1,044	90	3,403
Existing	3,661	412	1,017	440	50	2,144
No-Build	1,610	198	544	382	25	114
Replacement Crossing with LRT and I-5 Standard Toll	1,614	198	544	383	25	115
Replacement Crossing with BRT and I-5 Standard Toll	1,613	198	544	382	25	115
Replacement Crossing with LRT and No Toll	1,620	199	546	384	25	115
Replacement Crossing with LRT and High Toll	1,612	198	544	382	25	115
Supplemental Crossing with LRT and I-5 High Toll	1,613	198	544	382	25	115

Analysis years are 1999 for PATA, 2005 for existing conditions and 2030 for the No-Build Alternative and all build alternatives.

[a] Direct comparison between PATA results and CRC emissions should not be made.

Emissions for the LRT and BRT system level choices were found to be approximately equal within the accuracy of the estimation methods. The Supplemental Crossing with BRT and I-5 High Toll alternative was not specifically modeled. However, the difference in emissions between the LRT and BRT alternatives for the replacement crossing is expected to be similar to the difference between BRT and LRT for the supplemental crossing with virtually no difference in emissions.

5.3 Subarea Effects

To give an indication of whether emissions are expected to be affected directly adjacent to I-5 in different neighborhoods along the project alignment, emissions were analyzed separately in four subareas consisting of only the I-5 mainline and ramps. The emissions are listed in pounds per day as the model results reported them so that the differences in alternatives and the level of emissions can be seen. However, please note that the emissions estimates are not accurate to the nearest pound, and the estimates should be used comparatively.

The subareas analyzed are shown in Exhibit 5-3.

Exhibits 5-4 and 5-5 list NAAQS and MSAT emissions for the I-5 mainline and ramps in subarea 1. Emissions in Subarea 1 show a substantial reduction in the future relative to existing conditions. The reductions are similar to the regional reductions, but show somewhat lower reductions for CO (approximately 20 percent versus 30 percent). Acetaldehyde shows no reduction in the tables, but this is likely due to rounding and accuracy as the overall amounts of the MSAT emissions are small (less than 20 pounds per day for future cases). There is more difference between alternatives shown at the subarea level than for regional emissions. In Subarea 1, emissions for all build alternatives except the no toll alternative are lower than the No-Build Alternative. The no toll alternative shows emissions varying from no increase to 20 percent (the magnitude of this increase is likely due to rounding in relatively small numbers for formaldehyde) higher than the No-Build Alternative depending on the alternative and the pollutant.

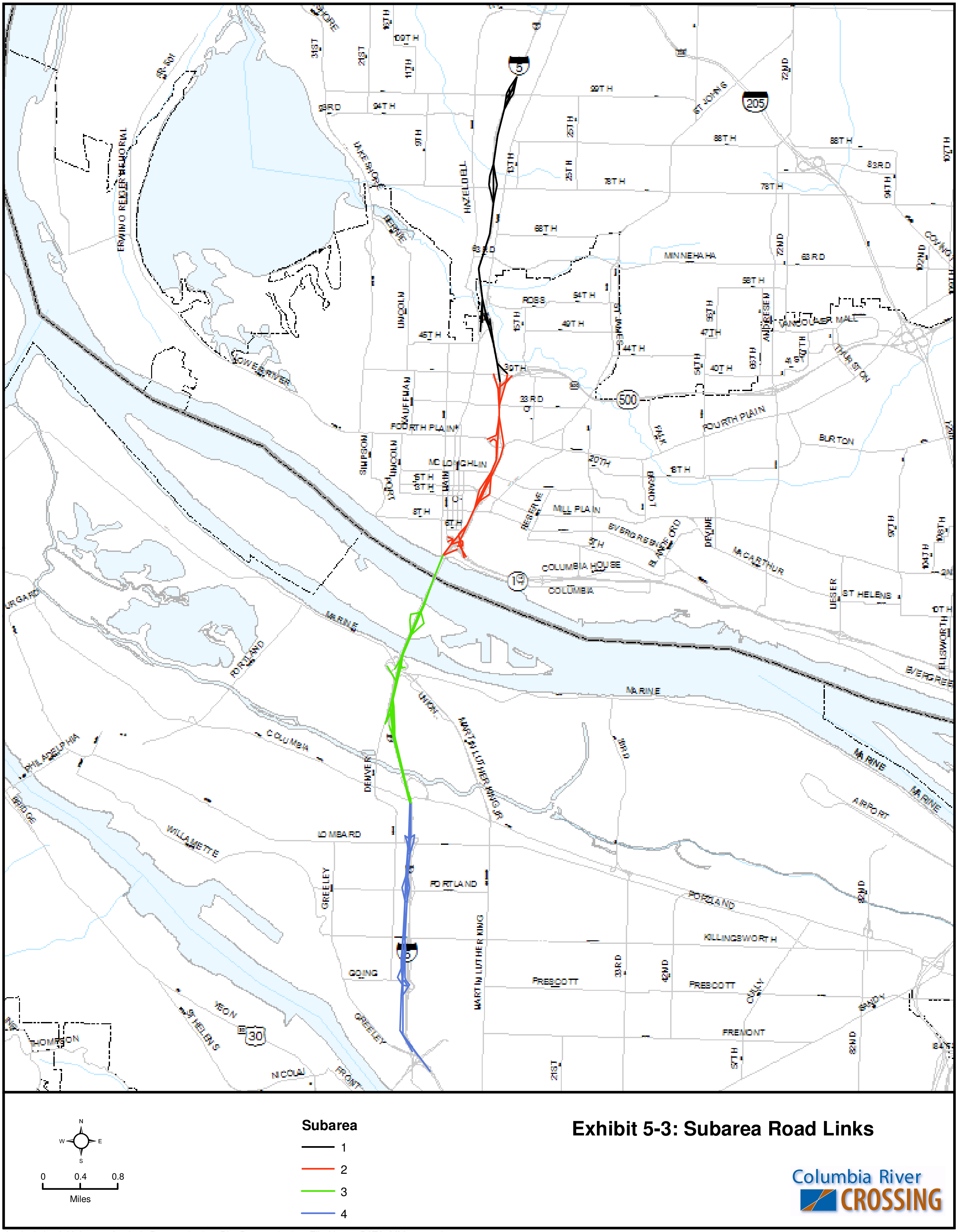

Exhibit 5-3: Subarea Road Links

Subarea
- 1
- 2
- 3
- 4

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: 11/19/07; Plot Date: 11/19/07; File Name: PATA_MM112.mxd

Exhibit 5-4. Subarea 1 NAAQS Emissions (pounds per summer day)

Alternative	CO	NO_X	VOC	PM_{10}	$PM_{2.5}$
Existing	11,315	1,675	970	21	20
No-Build	8,682	524	493	2	2
Replacement Crossing with LRT and I-5 Standard Toll	8,487	512	486	2	2
Replacement Crossing with BRT and I-5 Standard Toll	8,400	507	480	2	2
Replacement Crossing with LRT and No Toll	9,345	564	538	2	2
Replacement Crossing with LRT and High Toll	8,382	506	479	2	2
Supplemental Crossing with LRT and I-5 High Toll	8,336	504	477	2	2

Analysis years are 2005 for existing conditions and 2030 for the No-Build Alternative and all build alternatives.

Exhibit 5-5. Subarea 1 MSAT Emissions (pounds per summer day)

Alternative	Benzene	1,3-Buta-diene	Formal-dehyde	Acetal-dehyde	Acrolein	Diesel PM
PATA[a]	25	3	20	10	1	33
Existing	35	4	9	4	0	20
No-Build	17	2	5	4	0	2
Replacement Crossing with LRT and I-5 Standard Toll	17	2	5	4	0	2
Replacement Crossing with BRT and I-5 Standard Toll	17	2	5	4	0	2
Replacement Crossing with LRT and No Toll	19	2	6	4	0	2
Replacement Crossing with LRT and High Toll	17	2	5	4	0	2
Supplemental Crossing with LRT and I-5 High Toll	17	2	5	4	0	2

Analysis years are 1999 for PATA, 2005 for existing conditions and 2030 for the No-Build Alternative and all build alternatives.

[a] Direct comparison between PATA results and CRC emissions should not be made.

Exhibits 5-6 and 5-7 list NAAQS and MSAT emissions for the I-5 mainline and ramps in subarea 2. Emissions in Subarea 2 show a substantial reduction in the future relative to existing conditions. The reductions are similar to the regional reductions. Emissions for Subarea 2 show the greatest variation between alternatives of all of the subareas. With the exception of the no toll alternative VOC, PM, and MSAT emissions either show no change, or a reduction for the build alternatives relative to the No-Build Alternative. There is more variation for CO and NOx with the replacement bridge alternatives showing small (2 to 5 percent) increases in emissions relative to the No-Build Alternative when the no toll alternative is excluded. The supplemental bridge alternatives have CO and NOx emissions similar to the No-Build Alternative. The no toll alternative shows emissions varying from no increase to 25 percent higher than the No-Build Alternative depending on the alternative and the pollutant.

Exhibit 5-6. Subarea 2 NAAQS Emissions (pounds per summer day)

Alternative	CO	NO_X	VOC	PM_{10}	$PM_{2.5}$
Existing	9,797	1,398	851	18	17
No-Build	6,430	384	379	2	2
Replacement Crossing with LRT and I-5 Standard Toll	6,729	400	366	2	2
Replacement Crossing with BRT and I-5 Standard Toll	6,680	397	363	2	2
Replacement Crossing with LRT and No Toll	7,939	472	435	2	2
Replacement Crossing with LRT and High Toll	6,574	391	357	2	2
Supplemental Crossing with LRT and I-5 High Toll	6,404	380	354	2	2

Analysis years are 2005 for existing conditions and 2030 for the No-Build and all build alternatives.

Exhibit 5-7. Subarea 2 MSAT Emissions (pounds per summer day)

Alternative	Benzene	1,3-Buta-diene	Formal-dehyde	Acetal-dehyde	Acrolein	Diesel PM
PATA[a]	23	2	18	9	1	28
Existing	31	3	8	4	0	17
No-Build	13	2	4	3	0	2
Replacement Crossing with LRT and I-5 Standard Toll	13	2	4	3	0	2
Replacement Crossing with BRT and I-5 Standard Toll	13	2	4	3	0	2
Replacement Crossing with LRT and No Toll	15	2	5	3	0	2
Replacement Crossing with LRT and High Toll	13	2	4	3	0	2
Supplemental Crossing with LRT and I-5 High Toll	12	2	4	3	0	2

Analysis years are 1999 for PATA, 2005 for existing conditions and 2030 for the No-Build and all build alternatives.

[a] Direct comparison between PATA results and CRC emissions should not be made.

Exhibits 5-8 and 5-9 list NAAQS and MSAT emissions for the I-5 mainline and ramps in Subarea 3. Emissions in Subarea 3 show a substantial reduction in the future relative to existing conditions. The reductions are similar to the regional reductions. Emissions for Subarea 3 show the greatest reductions in emissions for the build alternatives relative to the No-Build Alternative. With the exception of the no toll alternative emissions of all pollutants either show no change, or a reduction for the build alternatives relative to the No-Build Alternative with emissions reductions for CO, NOx, VOC, and benzene ranging from 18 to 35 percent. The no toll alternative shows emissions varying from no increase to 10 percent higher than the No-Build Alternative depending on the alternative and the pollutant.

Exhibit 5-8. Subarea 3 NAAQS Emissions (pounds per summer day)

Alternative	CO	NO_X	VOC	PM_{10}	$PM_{2.5}$
Existing	11,504	1,727	1,055	23	22
No-Build	7,789	459	497	2	2
Replacement Crossing with LRT and I-5 Standard Toll	6,336	375	360	2	2
Replacement Crossing with BRT and I-5 Standard Toll	6,298	373	358	2	2
Replacement Crossing with LRT and No Toll	8,513	507	507	2	2
Replacement Crossing with LRT and High Toll	6,064	359	342	2	2
Supplemental Crossing with LRT and I-5 High Toll	5,781	342	325	2	2

Analysis years are 2005 for existing conditions and 2030 for the No-Build and all build alternatives.

Exhibit 5-9. Subarea 3 MSAT Emissions (pounds per summer day)

Alternative	Benzene	1,3-Buta-diene	Formal-dehyde	Acetal-dehyde	Acrolein	Diesel PM
PATA[a]	41	4	27	14	1	37
Existing	38	4	10	5	0	22
No-Build	17	2	6	4	0	2
Replacement Crossing with LRT and I-5 Standard Toll	13	2	4	3	0	2
Replacement Crossing with BRT and I-5 Standard Toll	13	2	4	3	0	2
Replacement Crossing with LRT and No Toll	18	2	6	4	0	2
Replacement Crossing with LRT and High Toll	12	1	4	3	0	2
Supplemental Crossing with LRT and I-5 High Toll	11	1	4	3	0	2

Analysis years are 1999 for PATA, 2005 for existing conditions and 2030 for the No-Build Alternative and all build alternatives.

[a] Direct comparison between PATA results and CRC emissions should not be made.

Exhibits 5-10 and 5-11 list NAAQS and MSAT emissions for the I-5 mainline and ramps in Subarea 4. Emissions in Subarea 4 show a substantial reduction in the future relative to existing conditions. The reductions are slightly greater than the regional reductions. With the exception of the no toll alternative, emissions for Subarea 4 show reductions in emissions for the build alternatives relative to the No-Build Alternative. Emissions reductions for CO, NOx, VOC, and benzene range from 7 to 14 percent. The no toll alternative shows emissions varying from no increase to 7 percent higher than the No-Build Alternative depending on the alternative and the pollutant.

Exhibit 5-10. Subarea 4 NAAQS Emissions (pounds per summer day)

Alternative	CO	NO_X	VOC	PM_{10}	$PM_{2.5}$
Existing	12,270	1,933	1,083	25	24
No-Build	7,052	414	404	2	1
Replacement Crossing with LRT and I-5 Standard Toll	6,378	373	360	2	1
Replacement Crossing with BRT and I-5 Standard Toll	6,366	372	359	2	1
Replacement Crossing with LRT and No Toll	7,321	432	429	2	1
Replacement Crossing with LRT and High Toll	6,285	367	352	2	1
Supplemental Crossing with LRT and I-5 High Toll	6,258	365	349	2	1

Analysis years are 2005 for existing conditions and 2030 for the No-Build Alternative and all build alternatives.

Exhibit 5-11. Subarea 4 MSAT Emissions (pounds per summer day)

Alternative	Benzene	1,3-Buta-diene	Formal-dehyde	Acetal-dehyde	Acrolein	Diesel PM
PATA[a]	31	3	26	13	1	42
Existing	39	4	11	5	1	24
No-Build	14	2	5	3	0	1
Replacement Crossing with LRT and I-5 Standard Toll	13	2	4	3	0	1
Replacement Crossing with BRT and I-5 Standard Toll	13	2	4	3	0	1
Replacement Crossing with LRT and No Toll	15	2	5	3	0	1
Replacement Crossing with LRT and High Toll	13	2	4	3	0	1
Supplemental Crossing with LRT and I-5 High Toll	12	2	4	3	0	1

Analysis years are 1999 for PATA, 2005 for existing conditions and 2030 for the No-Build Alternative and all build alternatives.

[a] Direct comparison between PATA results and CRC emissions should not be made.

Similar to regional emissions, future emissions in the subareas are expected to be substantially lower than existing emissions for all project alternatives, including the No-Build and no toll. Although there are variations between subareas, the reductions are generally similar to the large reductions estimated for regional emissions. The subareas show more variation in emissions between alternatives than the regional emissions. The no toll alternative increases emissions in the subareas relative to the No-Build Alternative emissions. The increase for the no toll relative to the No-Build Alternative is most observable in the CO, NOx, and VOC emissions when the absolute quantity and accuracy of the emissions estimates are considered and for these pollutants the difference ranges from 2 to 10 percent in Subareas 1, 2, and 4 and 15 to 23 percent in Subarea 2.

If the no toll alternative is excluded, emissions of VOC and MSATs are reduced by the build alternatives relative to the No-Build Alternative in all the subareas. Emissions of CO and NOx are also reduced relative to the No-Build Alternative in all subareas except Subarea 2. The following differences are seen between the build alternatives and the No-Build Alternative in the subareas:

- In Subareas 3 and 4 (south of the bridge crossing) there are fairly substantial (0 to 35 percent depending on the alternative and pollutant) reductions in emissions for the build alternatives relative to the No-Build Alternative and construction of the project would have the greatest potential benefit for emissions in these areas.

- Differences between alternatives are more moderate in Subarea 1 (1 to 4 percent decrease relative to the No-Build Alternative) and may not be meaningful within the accuracy of the emission estimates.
- Emissions for the replacement bridge alternatives show increases in CO and NOx in Subarea 2 relative to the No-Build Alternative. Other pollutants either show a reduction or no increase. Carbon Monoxide concentrations are not expected to exceed the NAAQS, and NOx emissions are more of a concern for regional ozone formation than for local effects. Consequently, although there are trade-offs, the benefits of reduced VOC and MSAT emissions in relation to increased CO and NOx emissions is probably still a benefit in terms of the overall effects of the project alternatives for this subarea.

Summary tables of the estimated emissions and percent change in emissions for each pollutant for the region and subareas are included in Appendix B.

5.4 Local Effects

There are a number of design options referred to as segment-level choices. A summary of the options follow.

5.4.1 Segment A: Delta Park to Mill Plain District - Highway Alternatives

There are three location options for the bridge crossing:

- Downstream replacement crossing
- Supplemental crossing

5.4.2 Segment B: Mill Plain District to North Vancouver - Highway Alternatives

In the segment from the Mill Plain District to North Vancouver, two highway alignments are being considered:

- I-5 western alignment (with replacement bridge). This alignment shifts I-5 to the west to accommodate LRT or BRT on the east side of I-5
- I-5 current alignment (with replacement bridge). This widens I-5 without shifting its basic location

5.4.3 Segment A1: Delta Park to South Vancouver - Transit Alternatives

There are two potential alignments on Hayden Island for HCT, LRT or BRT. The alignments are:

- Adjacent to I-5
- Offset from I-5

5.4.4 Segment A2: South Vancouver to Mill Plain District - Transit Alternatives

In the South Vancouver to Mill Plain District there are four location options for HCT, LRT or BRT. The options include different combinations for station locations and park and ride lot and structure locations. The options are:

- Two-way HCT on Washington Street
- Couplet on Columbia and Washington Street
- Couplet on Main Street and Washington Street
- Two-way on Broadway

5.4.5 Segment B: Mill Plain District to North Vancouver - Transit Alternatives

North of the Mill Plain District, there are two HCT alignment options, LRT or BRT. With efficient or increased transit operations, either alignment could be used. Each combination of LRT or BRT has different combinations of station locations and park and ride lot and structure locations. The alignments are:

- McLoughlin Avenue and I-5
- 16th Avenue and I-5

Segment level choices would potentially affect air quality in two ways. If the BRT system level choice is implemented, individual HCT vehicles will have exhaust emissions. The segment level choices would affect the location of these emissions. Segment-level choices will also affect the location of emissions as sources of traffic congestion shift between intersections. Park and ride lots and operations of HCT in different areas will affect or generate traffic.

The potential effects of BRT on local streets are discussed qualitatively in the following paragraph. The potential effects of localized congestion are addressed through an estimation of CO levels near the intersections expected to have the worst congestion conditions as a result of project alternatives. This is referred to as a hot spot analysis.

If the BRT system level choice is selected, BRT vehicles would be owned by C-TRAN or TriMet. It is possible that BRT vehicles operating on local streets would include older diesel buses without state-of the-art emissions controls. However, this is unlikely. Regulations have required all on-road diesel fuel to be ultra-low sulfur fuel. All buses manufactured in 2007 or later must meet the new stringent emission standards that reduce PM and NOx emissions by 90 and 95 percent relative to older technology. C-TRAN is in the process of retrofitting its entire fleet of older buses with particulate control. Both C-TRAN and TriMet currently use a 5 percent biodiesel blend and both agencies are in the process of moving to a 20 percent biodiesel blend. As part of a pilot project, C-TRAN has one bus running on 100 percent biodiesel and has purchased some diesel-electric hybrid buses. As a result, it is likely that the potential effects of the BRT location alternatives would be minimized because of the implementation of federal regulations and the proactive approach of the local transit agencies.

To determine if local congestion is likely to cause air quality impacts, a hot spot analysis was performed at the three worst performing intersections in both Portland and Vancouver for the replacement bridge with LRT on Vancouver alignment and standard tolling on I-5. Existing conditions, no-build conditions, and build conditions were analyzed. A qualitative analysis by the CRC traffic team indicates that this build alternative would have congestion conditions either approximately the same or worse than other alternatives, because BRT would have less signal pre-emption than LRT, resulting in slightly better intersection operations. The I-5 HCT alignment is expected to cause lower intersection congestion, and the supplemental bridge would generally reduce traffic volumes. Consequently, the effects of other alternatives are expected to be similar or less severe.

The results of the hot spot analysis are shown in Exhibits 5-12 and 5-13. The 1-hour and 8-hour CO concentrations were forecast and compared with 1-hour and 8-hour standards. No violations of the NAAQS were shown for existing conditions, the no-build condition, or the build conditions. Therefore, long-term air quality impacts are not expected to occur as a result of the project. Because interim year traffic data are not available at this time, a full conformity analysis could not be performed and will be completed during the Final EIS analysis. Exhibit 5-14 shows the intersections analyzed for local CO impacts. The intersection ranking tables are included in Appendix C.

Exhibit 5-12. Maximum One-Hour Carbon Monoxide Concentrations (ppm)

Intersections	Existing 2005	No-Build 2030	Alternative 3 2030
Vancouver			
East 39th Street at Main Street	6.4	5.1	5.0
Fourth Plain Blvd. at Main Street	5.6	4.7	4.7
Mill Plain Blvd. at Main Street	4.9	4.5	4.5
Portland			
Lombard Street at Interstate Avenue	6.8	4.8	5.0
Rosa Parks Blvd. at Interstate Avenue	6.7	4.4	4.5
Going Street at Interstate Avenue	8.4	5.2	5.2

The one hour CO standard is 35 ppm. A background concentration of 3.0 ppm is added to modeled concentrations to calculate the results shown.

Exhibit 5-13. Maximum Eight-Hour Carbon Monoxide Concentrations (ppm)

Intersections	Existing 2005	No-Build 2030	Alternative 3 2030
Vancouver			
East 39th Street at Main Street	5.4	4.5	4.4
Fourth Plain Blvd. at Main Street	4.8	4.2	4.2
Mill Plain Blvd. at Main Street	4.3	4.1	4.1
Portland			
Lombard Street at Interstate Avenue	5.9	4.4	4.5
Rosa Parks Blvd. at Interstate Avenue	5.8	4.1	4.1
Going Street at Interstate Avenue	7.1	4.7	4.7

The eight hour CO standard is 9 ppm. A background concentration of 3.0 ppm is added to modeled concentrations to calculate the results shown.

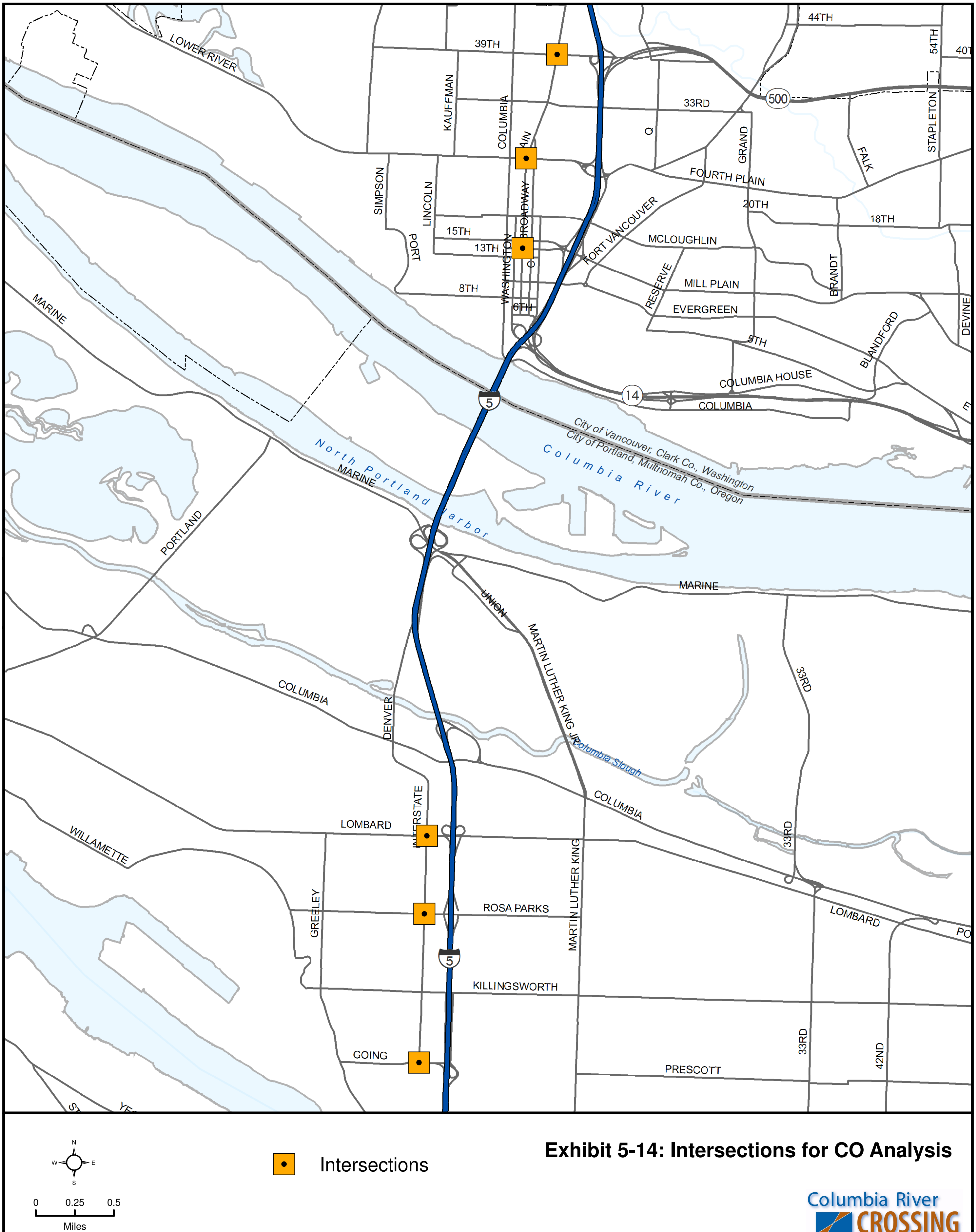

Exhibit 5-14: Intersections for CO Analysis

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: 11/19/07; Plot Date: 11/19/07; File Name: Exhibit1_3_LH131.mxd

5.5 Impacts from Other Project Elements

5.5.1 Minimum Operable Segments

Implementation of a Minimum Operable Segment (Clark College or Mill Plain) is not likely to substantially affect regional emissions, but could potentially affect emissions in subareas and congestion at intersections.

5.5.2 Maintenance Base Operations

Maintenance of LRT or BRT vehicles would occur at existing facilities and could require an expansion of the facilities. Stationary sources such as bus and LRT maintenance facilities are subject to the permitting regulations of either DEQ or SWCAA. The existing permitting regulations are designed to protect the health of the public. Consequently, no impacts are expected as a result of maintenance base operations.

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6. Temporary Effects

6.1 Introduction

Insufficient information is currently available to quantify the potential air quality effects of construction for the I-5 CRC project alternatives. The following qualitative discussion gives an indication of the potential air quality effects of construction. The construction duration, methods, and staging will affect the quantity and types of emissions. If the construction duration is longer than 5 years, the project conformity analysis will need to include a hot spot analysis for potential construction related congestion.

6.2 Construction Activities

Construction methods and techniques will not vary significantly between the alternatives. A wide variety of construction equipment will be in use for the duration of the construction, both on land and on the river. Much of the construction equipment is likely to be diesel driven. The EPA promulgated the Non-road Diesel Rule in May 2004. The rule requires ultra-low sulfur levels (15 ppm) in most non-road diesel fuel starting in 2010. The ultra-low sulfur limits will become applicable to locomotive and marine diesel fuel in 2012. New construction equipment will become subject to exhaust emission standards similar to those imposed on on-road diesel engines in a phased schedule between 2008 and 2015, with most larger equipment affected by the standards between 2012 and 2015. Consequently, by the time construction is expected to start on the I-5 CRC project, ultra-low sulfur fuel would be in use for almost all construction equipment that would potentially be used. Because the new equipment exhaust emission standards would be phased in during the expected CRC construction timing, only a portion of the equipment would likely be new and the percentage of the overall equipment fleet affected would be low in the early years of implementation and higher in later years.

Existing transportation corridors consisting of highways and arterials will be the major routes into and out of the construction areas. Most transport of goods and services associated with the project will use trucks. I-5, SR 14, SR 500, Martin Luther King Jr. Boulevard, and Marine Drive will serve as the major corridors into and out of the construction areas. Fourth Plain and Mill Plain Boulevards will serve important roles, but they are not expected to be as heavily used. Borrow sources and the Port of Vancouver lie west of the Washington side of the project, and West Fourth Plan and West Mill Plain (SR 501) could experience higher use depending on material source sites and the potential use of Port property. Road networks in Vancouver and on Hayden Island will provide access to individual work areas and provide circulation for construction vehicles. Columbia Way parallels SR 14 and becomes the main access into the industrial area that could be used for various staging purposes. As such, it could become a heavier used haul route than envisioned for the other local roads. In addition, Columbia Way could be used as a detour route which would compound construction related issues. Trucks used on highways would be subject to the Heavy-Duty Engine and Vehicle Standards and

Highway Diesel Fuel Sulfur Control Requirement Rules. Ultra-low sulfur fuel would be used in all highway trucks. In addition, new trucks with 2007 and later model years are subject to stringent exhaust emissions standards. The standards reduce PM and NOx emissions by 90 and 95 percent respectively, relative to older technology.

Construction will include demolition of structures and may include the removal of structures containing lead or asbestos.

6.3 Temporary Effects

Construction for any CRC build alternative will be extensive and will involve demolition, a wide variety of heavy construction equipment and operations, on-road construction vehicle activities, and potentially off-site activities such as concrete plants or borrow operations. Traffic congestion will occur with construction in the construction area, and potentially along detour or construction haul routes. Construction impacts will vary in extent and location, depending on the alternative selected and on weather conditions (rain suppresses dust). Construction impacts would logically be lowest with the No-Build Alternative and higher for the build alternatives. Construction activities may cause short-term increases in air pollutant emissions and odors.

The primary impacts of direct construction activities will be the generation of dust from demolition, site clearing, excavating, and grading activities, direct exhaust emissions from construction equipment, and impacts to traffic flow in the project area. Traffic congestion increases idling times and reduces travel speeds, resulting in increased vehicle emission levels. Demolition may involve structures containing lead or asbestos.

Construction of concrete structures or asphalt paving activities may have associated pollutant-emitting sources, such as mixing operations. Stationary sources, such as concrete mix and asphalt plants, are generally required to obtain an Air Contaminant Discharge Permit from either DEQ or SWCAA and to comply with regulations for controlling dust and other pollutant emissions. Burning debris from of land clearing is prohibited in the project area. Demolition of a structure containing asbestos is regulated by either DEQ or SWCAA.

7. Mitigation for Long-Term Effects

Air pollutant emissions are expected to be substantially lower in the future than under existing conditions. Differences between alternatives are smaller for all pollutants, and generally much smaller, than the reduction between existing and future conditions for both the region and the subareas. On a regional basis, future differences between alternatives are small enough not to be meaningful within the accuracy of the estimation methods.

For the subareas, the build alternatives, other than the no toll alternative, are either clearly beneficial in reducing emissions, or have trade-offs between CO and NOx emissions relative to VOC and MSAT emissions that are probably beneficial relative to emissions for the No-Build Alternative. The no toll alternative would increase emissions in the subareas relative to the No-Build Alternative.

A quantitative analysis of CO concentrations for the alternative expected to yield the worst congestion conditions was performed for three intersections in Vancouver and three intersections in Portland. No violations of the NAAQS were shown for existing conditions, the no-build condition, or the build conditions.

Long-term air quality impacts are not expected to occur as a result of the project, and mitigation for long-term impacts is not proposed.

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8. Mitigation for Temporary Effects

Construction mitigation should focus on controlling dust and exhaust emissions from demolition and construction activities, and minimizing the effects of traffic congestion. For a project of the magnitude of the I-5 CRC project, the contractor should be required to develop a pollution control plan that includes documentation of operational measures that will be used to reduce emissions. Section 290 of the ODOT standard specifies requirements for environmental protection, including air pollution control measures. These control measures are designed to minimize vehicle track-out and fugitive dust and should be included in the project specifications.

Stationary sources such as concrete and asphalt mix plants are generally required to obtain air permits from DEQ or SWCAA and to comply with regulations to control dust and other pollutant emissions. As a result, their operations are typically well controlled and do not require project specific mitigation measures. This would also be true for demolition of asbestos containing structures, as this activity is regulated.

Construction contractors are required to comply with Division 208 of OAR 340 in Oregon which addresses visible emissions and nuisance requirements. Subsection 210 of OAR 340-208 and WAC 173-400-040 place limits on fugitive dust that causes a nuisance or violates other regulations. [Insert discussion of the WOC fugitive dust regs]Violations of the regulations can result in enforcement action and fines. The OAR regulation provides a list of reasonable precautions to be taken to avoid dust emissions:

- Use of water or chemicals where possible for the control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land;
- Application of asphalt, oil, water, or other suitable chemicals on unpaved roads, materials stockpiles, and other surfaces that can create airborne dusts;
- Full or partial enclosure of materials stockpiles in cases where application of oil, water, or chemicals is not sufficient to prevent particulate matter from becoming airborne;
- Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials;
- Adequate containment during sandblasting or other similar operations;
- When in motion, always covering open-bodied trucks transporting materials likely to become airborne; and
- The prompt removal from paved streets of earth or other material that does or may become airborne.

Strategies to minimize the occurrence and effect of roadway congestion in the project area will be developed throughout the design phase. Alternatives will be refined, impacts to traffic analyzed, and transportation agencies and experts brought in to develop mitigation plans and solutions. Some of these strategies may consist of:

- Providing alternatives to single-occupant vehicle (SOV) trips.
- Providing incentives to reduce automobile trips and encourage mode shifts to non-SOV types.
- Managing traffic and lane closures to avoid congestion and delay.
- Providing traveler information at key junctions to encourage traffic diversion from the I-5 corridor project area and crossing routes.
- Promoting continuous information campaigns to alert motorists of delay times within the corridor and of upcoming traffic pattern changes and detours.
- Incorporating transit priority measures where feasible.
- Working with employers whose employees must commute through the area to promote alternative work schedules.
- Instituting contractor incentives to shorten construction durations and encourage the use of lower-emitting construction equipment.

9. Permits and Approvals

The primary approval required for the project is a finding that the project is in conformance with the SIP. Sufficient information is not available to complete the conformity analysis at this time. The conformity analysis will be completed for the final EIS.

Air quality permits may be required for construction sources. Both DEQ and SWCAA require permitting of stationary sources such as concrete batch plants, and notification of asbestos demolition or removal activities. SWCAA requires permitting of non-road engines that remain at “any single site at a building, structure, or installation” for more than 12 consecutive months. This regulation could affect construction equipment in Washington, and requires dispersion modeling of emissions. The regulation excludes mobile cranes and pile drivers.

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10. References

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APPENDIX A

MOBIE6.2 Model Assumptions

Appendix A

Table A-1. Summary of MOBILE6.2 Input Command Options for Use in the Air Quality Analysis

Input Command Options	Comment	Used for this Analysis?
MOBILE6 INPUT FILE	Required	Y
RUN DATA	Required	Y
SCENARIO RECORD : South Corridor	Required; scenario name	Y
END OF RUN	Required	Y
User Manual Section 2.8.3 All Output Commands		
POLLUTANT: CO	CO only	Y
NO REFUELING	Not pertinent to CO EFs	N
User Manual Section 2.8.4 Descriptive Output Commands		
REPORT FILE	Designate output file name if different from input file name	N
EXPAND BUS EFs	Not needed because default M6 provides 8 vehicle categories used in M5	N
EXPAND HDDV EFs		
EXPAND HDGV EFs		
EXPAND LDT EFs		
EXPAND EXHAUST	Default is composite EFs only	N
EXPAND EVAPORATIVE	Not needed for CO	N
User Manual Section 2.8.5 Database Output Commands		
User Manual Section 2.8.6 External Condition Commands		
CALENDAR YEAR	Analysis years	Y, existing (2005), design year (2030)
EVALUATION MONTH	January is default	N, default
MIN/MAX TEMPERATURE	Required	Y, 31.5 and 44.1
HOURLY TEMPERATURES	Not required if Min/Max provided	N
ALTITUDE	Low is default	N
ABSOLUTE HUMIDITY	75 grains per lb is default	Y, 30.9
CLOUD COVER	0 is default	N
PEAK SUN	10am to 4pm is default	N
SUNRISE/ SUNSET	6am, 9pm are defaults	N
User Manual Section 2.8.7 Vehicle Fleet Characteristic Commands		
REG DIST	Option to provide distribution for each of 16 composite vehicle types	Y, use external file, R02PDX2.d provided by DEQ for all analysis years
DIESEL FRACTIONS	Option to use locality specific diesel fractions for 14 of 16 vehicle types	N, use M6 defaults
MILE ACCUM RATE	Option to supply mileage accumulation rates by vehicle age	N, use M6 defaults
NGV FRACTION	Option to indicate % of natural gas vehicles	N
NGV EF	Only needed if NGV FRACTION is used	N
User Manual Section 2.8.8 Activity Commands		
VMT FRACTIONS	Option to allocate VMT to specific vehicle types	N, use M6 defaults

Input Command Options	Comment	Used for this Analysis?
VMT BY FACILITY	Option to allocate VMT to roadway types by vehicle class	N, use M6 defaults
VMT BY HOUR	Option to allocate fraction of the VMT by hour of the day	N, use M6 defaults
SPEED VMT	Option to allocate VMT by average speed on fwys or arterials	N, use M6 defaults
AVERAGE SPEED	Option to designate a single average speed to use for the entire day on specific roadway type	Y, see Note 1
STARTS PER DAY	Option to specify starts per day for specific classes for weekdays/weekends	N, use nostarts.d file
START DIST	Option to allocate engine starts by hour of day	N, use M6 defaults
SOAK DISTRIBUTION	Option to enter vehicle soak duration distribution	N, use M6 defaults
HOT SOAK ACTIVITY	Option to specify a hot soak duration distribution for each of 14 daily time periods	N (not used for CO)
DIURN SOAK ACTIVITY	Option to specify a diurnal soak time distribution for each of 18 daily time periods	N (not used for CO)
WE DA TRI LEN DI	Option to specify the fraction of weekday VMT occurring during trips of various durations at each hour of the day	N
WE EN TRI LEN DI	Option to specify the fraction of weekend VMT that occurs during trips of various durations at each hour of the day	N
WE VEH US	Option to apply weekend activity information in emissions calculations	N, use M6 default
User Manual Section 2.8.9 State Programs		
STAGE II REFUELING	Option to include Stage II vapor recovery system requirements	N (not used for CO)
ANTI-TAMP PROG	Option to include an anti-tampering program. Year program started, earliest model year to be covered, final model year covered by program, 14 vehicle types subject to ATP (toggle: 1=no, 2=yes); ATP benefit discontinued; ATP inspection frequency; program compliance rate; 8 inspections ATP will conduct (air pump system disabled, catalyst removal, fuel inlet restrictor disabled, tailpipe lead deposit test, EGR disabled, evaporative system disabled, PCV system disabled, missing gas cap.	Y 75, 75, 95, 22222 (light-duty gasoline vehicle classes), 22222222 (heavy-duty gasoline vehicle classes), 1 (gasoline buses not included), 12 (ATP benefit is not discontinued and ATP inspection frequency is every 2 years), 090.0 (90% compliance), 22212221 (all inspection types conducted except tailpipe lead deposit test and missing gas cap)
2.8.9.4 I/M Program Commands	Option to include an I/M program	Y
2.8.9.4.a I/M Options	I/M Options: program number, IM program start yr, end year (in our case the end year = the analysis year), frequency, program type, inspection test type	1, 1975, 1995, 2 (biennial), T/O, 2500/IDLE (basic exhaust test) 2, 1996, 2030, 2, T/O, OBD I/M (for the on-board diagnostics test for vehicles 1996 or newer)
2.8.9.4.b I/M MODEL YEARS	Required if I/M selected; I/M program number used in 2.8.9.4a, first model year covered by I/M program, last model year	1 1975 1995 2 1996 2030
2.8.9.4.c I/M VEHICLES	Required– indicate which of the 14 vehicle classes are subject to testing	Gasoline vehicle classes subject to I/M.

Input Command Options	Comment	Used for this Analysis?
		(only gasoline-fueled vehicles can be modeled for I/M in MOBILE
2.8.9.4.d I/M STRINGENCY	Required- defines the expected exhaust inspection failure rate for pre-1981 model year vehicles covered by the I/M program	37.4%
2.8.9.4.e I/M COMPLIANCE	Required- percentage of fleet subject to I/M that actually goes through the entire I/M process to receive a "pass."	90%
2.8.9.4.f I/M WAIVER RATES	Required- vehicles that fail an initial I/M test and do not pass a retest but receive a certificate of compliance	0% (waiver rate for the pre-1981 model year vehicles) 0% (waiver rate for 1981 and later model year vehicles)
2.8.9.4.g I/M CUTPOINTS	Not Required	N
2.8.9.4.h EXEMPTION AGE	Optional- the age at which vehicles become exempt from the I/M program. Default is 25 years; MOBILE6 does not calculate emissions for vehicles older than 25 years.	N
2.8.9.4.i I/M GRACE PERIOD	Optional- age at which vehicles first become subject to I/M testing	Y 4 years for OBD and ASM 2525/5015 FINAL Programs, N for 2500/IDLE Program
2.8.9.4.j NO I/M TTC CREDITS	Optional- eliminates I/M credit that the model assigns to a technical training program	N default is full I/M credit for technician training
2.8.9.4.k I/M EFFECTIVENESS	Optional- correction factor that reduces the exhaust I/M credit for test and repair programs by a specified amount	N (default is 100% or full credit assigned to all I/M program types)
2.8.9.4.l I/M DESC FILE	Optional	N
User Manual Section 2.8.10 Fuel Commands		
FUEL PROGRAM	Option to specify an RFG program, Tier 2 sulfur phase-in schedules, or to specify sulfur content of gasoline after 1999	N (no program, standard Tier2 phase in schedule is default)
SULFUR CONTENT	Option to enter sulfur content of fuels up to 1999 year	N
OXYGENATED FUELS	Option to include oxygenated gasoline	N
FUEL RVP	Required	Y, 15
SEASON	Default is winter when January is used	N
NO CLEAN AIR ACT	Option to model vehicle emissions as if 1990 Amendments had not been implemented	N
NO DEFEAT DEVICE	Option to turn off the effects of the HDDV NOx off-cycle emission effects	N (not used for CO)
NO NOX PULL AHEAD	Option to turn off the effects of the Pull Ahead mitigation program	N (not used for CO)
NO REBUILD	Option to turn off effects of the Rebuild mitigation program	N (not used for CO)
REBUILD EFFECTS	Option to change the Rebuild program effectiveness rate	N (not used for CO)
Tier 2 Emission Standards and Fuel Requirements	Option to override the defaults	N

Input Command Options	Comment	Used for this Analysis?
94+ LDG IMP	Option to override default certification standard phase-in schedule for Tier 1, NLEV and Tier 2 programs	N
NO 2007 HDDV RULE	Option to override default settings for 2007 HDDV emission standards	N

Note 1: The AVERAGE SPEED command will be used to model the emission factors for the speeds required for CAL3QHC input. Those speeds will include 2.5 miles per hour (mph) for the calculation of an idle emission factor and the other speeds shown in the CAL3QHC guidance document (27 mph for collectors, and 33 and 40 mph for arterials) as determined by the intersections that are ranked for the analysis.

APPENDIX B

Summary Tables of Emission Estimates

Columbia River Crossing
Air Quality Technical Report
Regional Emissions (summer day)

Alternative	Tons per Day					Pounds per Day					
	CO	NO_X	VOC	PM_{10}	$PM_{2.5}$	Ben-zene	1,3-Buta-diene	Formal-dehyde	Acetal-dehyde	Acro-lein	Diesel PM
Existing	550.4	86	50.5	1.2	1.1	3,661	412	1,017	440	50	2,144
No-Build	385.7	22.7	23	0.1	0.1	1,610	198	544	382	25	114
Replacement Crossing with LRT and I-5 Standard Toll	387	22.8	23.1	0.1	0.1	1,614	198	544	383	25	115
Replacement Crossing with LRT and No Toll	388.4	22.9	23.1	0.1	0.1	1,620	199	546	384	25	115
Replacement Crossing with LRT and High Toll	386.7	22.8	23	0.1	0.1	1,612	198	544	382	25	115
Replacement Crossing with BRT and I-5 Standard Toll	386.9	22.8	23	0.1	0.1	1,613	198	544	382	25	115
Supplemental Crossing with LRT and I-5 High Toll	386.9	22.8	23	0.1	0.1	1,613	198	544	382	25	115

Change - Existing to No Build	30%	74%	54%	92%	91%	56%	52%	47%	13%	50%	95%
Change - No Toll to No Build	-1%	-1%	0%	0%	0%	-1%	-1%	0%	-1%	0%	-1%

Columbia River Crossing
Air Quality Technical Report
Subarea 1 Emissions (pounds per summer day)

Alternative	CO	NO_X	VOC	PM_{10}	$PM_{2.5}$	Ben-zene	1,3-Buta-diene	Formal-dehyde	Acetal-dehyde	Acro-lein	Diesel PM
Existing	11315	1675	970	21	20	35	4	9	4	0	20
No-Build	8682	524	493	2	2	17	2	5	4	0	2
Replacement Crossing with LRT and I-5 Standard Toll	8487	512	486	2	2	17	2	5	4	0	2
Replacement Crossing with LRT and No Toll	9345	564	538	2	2	19	2	6	4	0	2
Replacement Crossing with LRT and High Toll	8382	506	479	2	2	17	2	5	4	0	2
Replacement Crossing with BRT and I-5 Standard Toll	8400	507	480	2	2	17	2	5	4	0	2
Supplemental Crossing with LRT and I-5 High Toll	8336	504	477	2	2	17	2	5	4	0	2

Change - Existing to No Build	23%	69%	49%	90%	90%	51%	50%	44%	0%	0%	90%
Change - Replacement w LRT and Std Toll to NB	2%	2%	1%	0%	0%	0%	0%	0%	0%	0%	0%
Change - Replacement W LRT and No Toll to NB	-8%	-8%	-9%	0%	0%	-12%	0%	-20%	0%	0%	0%
Change - Replacement W LRT and High Toll to NB	3%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Change - Replacement w BRT and Std Toll to NB	3%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Change - Supplemental w LRT and High Toll to NB	4%	4%	3%	0%	0%	0%	0%	0%	0%	0%	0%

Columbia River Crossing
Air Quality Technical Report
Subarea 2 Emissions (pounds per summer day)

Alternative	CO	NO_X	VOC	PM_{10}	$PM_{2.5}$	Ben-zene	1,3-Buta-diene	Formal-dehyde	Acetal-dehyde	Acro-lein	Diesel PM
Existing	9,797	1,398	851	18	17	31	3	8	4	0	17
No-Build	6,430	384	379	2	2	13	2	4	3	0	2
Replacement Crossing with LRT and I-5 Standard Toll	6,729	400	366	2	2	13	2	4	3	0	2
Replacement Crossing with LRT and No Toll	7,939	472	435	2	2	15	2	5	3	0	2
Replacement Crossing with LRT and High Toll	6,574	391	357	2	2	13	2	4	3	0	2
Replacement Crossing with BRT and I-5 Standard Toll	6,680	397	363	2	2	13	2	4	3	0	2
Supplemental Crossing with LRT and I-5 High Toll	6,404	380	354	2	2	12	2	4	3	0	2

Change - Existing to No Build	34%	73%	55%	89%	88%	58%	33%	50%	25%	0%	88%
Change - Replacement w LRT and Std Toll to NB	-5%	-4%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Change - Replacement W LRT and No Toll to NB	-23%	-23%	-15%	0%	0%	-15%	0%	-25%	0%	0%	0%
Change - Replacement W LRT and High Toll to NB	-2%	-2%	6%	0%	0%	0%	0%	0%	0%	0%	0%
Change - Replacement w BRT and Std Toll to NB	-4%	-3%	4%	0%	0%	0%	0%	0%	0%	0%	0%
Change - Supplemental w LRT and High Toll to NB	0%	1%	7%	0%	0%	8%	0%	0%	0%	0%	0%

Columbia River Crossing
Air Quality Technical Report
Subarea 3 Emissions (pounds per summer day)

Alternative	CO	NO_X	VOC	PM_{10}	$PM_{2.5}$	Ben-zene	1,3-Buta-diene	Formal-dehyde	Acetal-dehyde	Acro-lein	Diesel PM
Existing	11,504	1,727	1,055	23	22	38	4	10	5	0	22
No-Build	7,789	459	497	2	2	17	2	6	4	0	2
Replacement Crossing with LRT and I-5 Standard Toll	6,336	375	360	2	2	13	2	4	3	0	2
Replacement Crossing with LRT and No Toll	8,513	507	507	2	2	18	2	6	4	0	2
Replacement Crossing with LRT and High Toll	6,064	359	342	2	2	12	1	4	3	0	2
Replacement Crossing with BRT and I-5 Standard Toll	6,298	373	358	2	2	13	2	4	3	0	2
Supplemental Crossing with LRT and I-5 High Toll	5,781	342	325	2	2	11	1	4	3	0	2

Change - Existing to No Build	32%	73%	53%	91%	91%	55%	50%	40%	20%	0%	91%
Change - Replacement w LRT and Std Toll to NB	19%	18%	28%	0%	0%	24%	0%	33%	25%	0%	0%
Change - Replacement W LRT and No Toll to NB	-9%	-10%	-2%	0%	0%	-6%	0%	0%	0%	0%	0%
Change - Replacement W LRT and High Toll to NB	22%	22%	31%	0%	0%	29%	50%	33%	25%	0%	0%
Change - Replacement w BRT and Std Toll to NB	19%	19%	28%	0%	0%	24%	0%	33%	25%	0%	0%
Change - Supplemental w LRT and High Toll to NB	26%	25%	35%	0%	0%	35%	50%	33%	25%	0%	0%

Columbia River Crossing
Air Quality Technical Report
Subarea 4 Emissions (pounds per summer day)

Alternative	CO	NO_X	VOC	PM_{10}	$PM_{2.5}$	Ben-zene	1,3-Buta-diene	Formal-dehyde	Acetal-dehyde	Acro-lein	Diesel PM
Existing	12,270	1,933	1,083	25	24	39	4	11	5	1	24
No-Build	7,052	414	404	2	1	14	2	5	3	0	1
Replacement Crossing with LRT and I-5 Standard Toll	6,378	373	360	2	1	13	2	4	3	0	1
Replacement Crossing with LRT and No Toll	7,321	432	429	2	1	15	2	5	3	0	1
Replacement Crossing with LRT and High Toll	6,285	367	352	2	1	13	2	4	3	0	1
Replacement Crossing with BRT and I-5 Standard Toll	6,366	372	359	2	1	13	2	4	3	0	1
Supplemental Crossing with LRT and I-5 High Toll	6,258	365	349	2	1	12	2	4	3	0	1

Change - Existing to No Build	43%	79%	63%	92%	96%	64%	50%	55%	40%	100%	96%
Change - Replacement w LRT and Std Toll to NB	10%	10%	11%	0%	0%	7%	0%	20%	0%	0%	0%
Change - Replacement W LRT and No Toll to NB	-4%	-4%	-6%	0%	0%	-7%	0%	0%	0%	0%	0%
Change - Replacement W LRT and High Toll to NB	11%	11%	13%	0%	0%	7%	0%	20%	0%	0%	0%
Change - Replacement w BRT and Std Toll to NB	10%	10%	11%	0%	0%	7%	0%	20%	0%	0%	0%
Change - Supplemental w LRT and High Toll to NB	11%	12%	14%	0%	0%	14%	0%	20%	0%	0%	0%

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APPENDIX C

Intersection Ranking Tables

AIR QUALITY ANALYSIS DATA

EXISTING CONDITIONS

(2005)

Intersection Name	Intersection Number	Time Period	**Entering Volume**	LOS	V / C	Delay (s/veh)	Synchro PDF File Name
Vancouver							
Mill Plain Blvd. @ I5 NB Ramp Terminal	510	PM	**3310**	C	0.92	25	
39th St. @ Main St.	880	PM	**2220**	D	0.84	45	
4th Plain Blvd. @ Main St.	690	PM	**1805**	C	0.78	30	
Mill Plain Blvd. @ Main St.	470	PM	**1660**	B	0.58	13	
Portland							
Lombard St. @ Interstate Ave.	420	PM	**2650**	D	0.69	37	
Going St. @ Interstate Ave.	190	PM	**2605**	D	0.72	45	
Marine Dr. @ I5 Ramp Terminals	660	PM	**2125**	C	0.90	35	
Rosa Parks Blvd. @ Interstate Ave.	350	PM	**1900**	D	0.71	39	
Marine Dr. WB Slip Ramp to I5 NB	661	PM	**1205**				
Hayden Island Dr. @ I5 NB Ramp Termina	710	PM	**1095**	B	0.44	16	
Victory Blvd. @ I5 NB Ramp Terminal	590	PM	**800**	A	0.41	10	

ALTERNATIVE 1

(2030 NO-BUILD)

Intersection Name	Intersection Number	Time Period	**Entering Volume**	LOS	V / C	Delay (s/veh)	Synchro PDF File Name
Vancouver							
Mill Plain Blvd. @ I5 NB Ramp Terminal	510	PM	**4495**	C	0.99	33	
39th St. @ Main St.	880	PM	**3705**	F	1.27	106	
4th Plain Blvd. @ Main St.	690	PM	**3335**	D	1.07	44	
Mill Plain Blvd. @ Main St.	470	PM	**2490**	C	0.88	24	
Portland							
Lombard St. @ Interstate Ave.	420	PM	**4020**	F	0.95	93	
Going St. @ Interstate Ave.	190	PM	**3345**	E	0.84	58	
Marine Dr. @ I5 Ramp Terminals	660	PM	**2775**	E	0.90	56	
Rosa Parks Blvd. @ Interstate Ave.	350	PM	**2435**	D	0.75	39	
Marine Dr. WB Slip Ramp to I5 NB	661	PM	**1445**				
Hayden Island Dr. @ I5 NB Ramp Termina	710	PM			0.67		
Victory Blvd. @ I5 NB Ramp Terminal	590	PM	**920**	A	0.53	9	

ALTERNATIVE 2 & 3

(2030 Build Replacement Bridge)

Intersection Name	Intersection Number	Time Period	**Entering Volume**	LOS	V / C	Delay (s/veh)	Synchro PDF File Name
Vancouver							
Mill Plain Blvd. @ I5 NB Ramp Terminal	505	PM	**3875**	C	0.99	28	
39th St. @ Main St.	880	PM	**3750**	F	1.22	86	
4th Plain Blvd. @ Main St.	690	PM	**3580**	F	0.94	80	
Mill Plain Blvd. @ Main St.	470	PM	**2680**	F	1.24	168	
Portland							
Lombard St. @ Interstate Ave.	420	PM	**3940**	F	0.92	101	
Going St. @ Interstate Ave.	190	PM	**3205**	F	0.83	103	
Marine Dr. EB On-Ramp to I5 NB/SB	830	PM	**2525**				
Rosa Parks Blvd. @ Interstate Ave.	350	PM	**2425**	E	0.77	62	
Marine Dr. SPUI Ramp Terninal	660	PM	**1615**	C	0.51	21	
Hayden Split SPUI (NB On/SB Off) RT	1000	PM	**1040**	B		19	
Victory Blvd. @ I5 NB Ramp Terminal	590	PM	**1020**	B	0.50	12	

NOTE:

Total Entering Volume, Level of Service, V/C, & Average Delay are all for the overall intersection

AIR QUALITY ANALYSIS DATA

EXISTING CONDITIONS

(2005)

Intersection Name	Intersection Number	Time Period	Total Entering Volume	LOS	V / C	**Delay (s/veh)**	Synchro PDF File Name
Vancouver							
39th St. @ Main St.	880	PM	2220	D	0.84	**45**	
4th Plain Blvd. @ Main St.	690	PM	1805	C	0.78	**30**	
Mill Plain Blvd. @ I5 NB Ramp Terminal	510	PM	3310	C	0.92	**25**	
Mill Plain Blvd. @ Main St.	470	PM	1660	B	0.58	**13**	
Portland							
Going St. @ Interstate Ave.	190	PM	2605	D	0.72	**45**	
Rosa Parks Blvd. @ Interstate Ave.	350	PM	1900	D	0.71	**39**	
Lombard St. @ Interstate Ave.	420	PM	2650	D	0.91	**37**	
Marine Dr. @ I5 Ramp Terminals	660	PM	2125	C	0.88	**35**	
Hayden Island Dr. @ I5 NB Ramp Termina	710	PM	1095	B	0.60	**16**	
Victory Blvd. @ I5 NB Ramp Terminal	590	PM	800	A	0.52	**10**	
Marine Dr. WB Slip Ramp to I5 NB	661	PM	1205				

ALTERNATIVE 1

(2030 NO-BUILD)

Intersection Name	Intersection Number	Time Period	Total Entering Volume	LOS	V / C	**Delay (s/veh)**	Synchro PDF File Name
Vancouver							
39th St. @ Main St.	880	PM	3705	F	1.27	**106**	
4th Plain Blvd. @ Main St.	690	PM	3335	D	1.07	**44**	
Mill Plain Blvd. @ I5 NB Ramp Terminal	510	PM	4495	C	0.99	**33**	
Mill Plain Blvd. @ Main St.	470	PM	2490	C	0.88	**24**	
Portland							
Lombard St. @ Interstate Ave.	420	PM	4020	F	0.95	**93**	
Going St. @ Interstate Ave.	190	PM	3345	E	0.84	**58**	
Marine Dr. @ I5 Ramp Terminals	660	PM	2775	E	0.90	**56**	
Rosa Parks Blvd. @ Interstate Ave.	350	PM	2435	D	0.75	**39**	
Victory Blvd. @ I5 NB Ramp Terminal	590	PM	920	A	0.44	**9**	
Marine Dr. WB Slip Ramp to I5 NB	661	PM	1445				
Hayden Island Dr. @ I5 NB Ramp Termina	710	PM					

ALTERNATIVE 2 & 3

(2030 Build Replacement Bridge)

Intersection Name	Intersection Number	Time Period	Total Entering Volume	LOS	V / C	**Delay (s/veh)**	Synchro PDF File Name
Vancouver							
Mill Plain Blvd. @ Main St.	470	PM	2680	F	1.24	**168**	
39th St. @ Main St.	880	PM	3750	F	1.22	**86**	
4th Plain Blvd. @ Main St.	690	PM	3580	F	0.94	**80**	
Mill Plain Blvd. @ I5 NB Ramp Terminal	505	PM	3875	C	0.99	**28**	
Portland							
Going St. @ Interstate Ave.	190	PM	3205	F	0.83	**103**	
Lombard St. @ Interstate Ave.	420	PM	3940	F	0.92	**101**	
Rosa Parks Blvd. @ Interstate Ave.	350	PM	2425	E	0.77	**62**	
Marine Dr. SPUI Ramp Terninal	660	PM	1615	C	0.51	**21**	
Hayden Split SPUI (NB On/SB Off) RT	1000	PM	1040	B		**19**	
Victory Blvd. @ I5 NB Ramp Terminal	590	PM	1020	B	0.50	**12**	
Marine Dr. EB On-Ramp to I5 NB/SB	830	PM	2525				

NOTE:

Total Entering Volume, Level of Service, V/C, & Average Delay are all for the overall intersection