# US Route 395 – North Spokane Corridor

**MP 157.5 to MP 168.9**

# Greenhouse Gas Emissions Discipline Report – Final

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# ACRONYMS AND GLOSSARY

**Adaptation** – Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects.

**Carbon Dioxide Equivalents ($CO_2e$)** – Greenhouse gases, other than carbon dioxide have greater abilities to warm the atmosphere. Using their global warming potential, quantities of non-carbon dioxide gases are converted to $CO_2e$ for easy comparison.

**Carbon Sequestration** – Carbon can be sequestered, that is removed from the atmosphere and stored in other forms. Biosequestration occurs when plants take up $CO_2$ and grow faster than they decay. Carbon can also be sequestered mechanically by scrubbing it from stationary combustion sources (such as coal-fired power plants) and pumped deep underground.

**Corporate Average Fuel Economy (CAFE) Standards** – Vehicle fuel efficiency standards set by the National Highway Traffic Safety Administration for new light-duty vehicles.

**Embodied emissions** – The emissions generated in producing the materials that are used in the construction process and include emissions from sourcing the raw materials from the earth and their conversion into a usable form, including the energy used in processing. [1] Embodied emissions can be thought of as "cradle to site" emissions. For example, the emissions released while mining the coal used to manufacture the steel girders for a bridge would be considered embodied emissions.

**Environmental Protection Agency (EPA)**

**Inspection/Maintenance Program (I/M Program)** – Programs established to ensure personal automobiles meet emission standards. Typically vehicles must be tested every two years.

**Lifecycle emissions** – The emissions released during material production (embodied) and emissions released throughout a facility's lifetime, including demolition and disposal. Unlike embodied emissions, lifecycle emissions account for the durability of a product. Lifecycle emissions are often referred to as "cradle to grave" emissions.

**Mitigation** – Human interventions to reduce the quantity of greenhouse gases emitted or enhance the sinks that remove them from the atmosphere.

**Metric Ton (MT)** – 1000 kilograms or 2200 pounds

**Motor Vehicle Emissions Simulator (MOVES)** – EPA's mobile source emissions model

[1] Definition partially taken from the Simon's Group *Briefing Note – What is Embodied Carbon* viewed online February 4, 2009, at http://www.simonsgroup.com/simonsweb/csr/carbon-footprint.html

**National Highway Traffic Safety Administration (NHTSA)**

**Vehicle Miles Traveled (VMT)**

# EXECUTIVE SUMMARY

## Project Description

When completed, the North Spokane Corridor (NSC) will be a 10.5-mile north/south limited access facility connecting I-90 on the south end and existing US 395 on the north end. The corridor will alleviate increasing congestion and address other operational and safety issues on the existing street network. The project will provide a facility for balanced transportation options by including park and ride lots to support transit and vanpooling operations, as well as an expanded and enhanced pedestrian/bicycle facility. Right of way will also be reserved for future high-capacity transportation.

## WSDOT Efforts to Reduce Greenhouse Gas Emissions

In Washington, because of our abundant hydropower, the transportation sector (including air, rail, and marine sources) accounts for almost 50% of the states greenhouse gas emissions. WSDOT is working to reduce transportation emissions through a number of programs and activities, such as the Commute Trip Reduction program, the use of incident response teams to clear incidents on congested highways, and using biodiesel in state agency vehicles and ferry vessels.

Because of the interconnected nature of the transportation system, generally the choices about how to reduce the greenhouse gas emissions from on-road transportation are best made at a level where multiple options can be analyzed in aggregate. Therefore, the agency is also working with other state agencies, local governments, businesses, and non-profit organizations to develop additional greenhouse gas reduction strategies.

## Greenhouse Gas Emissions

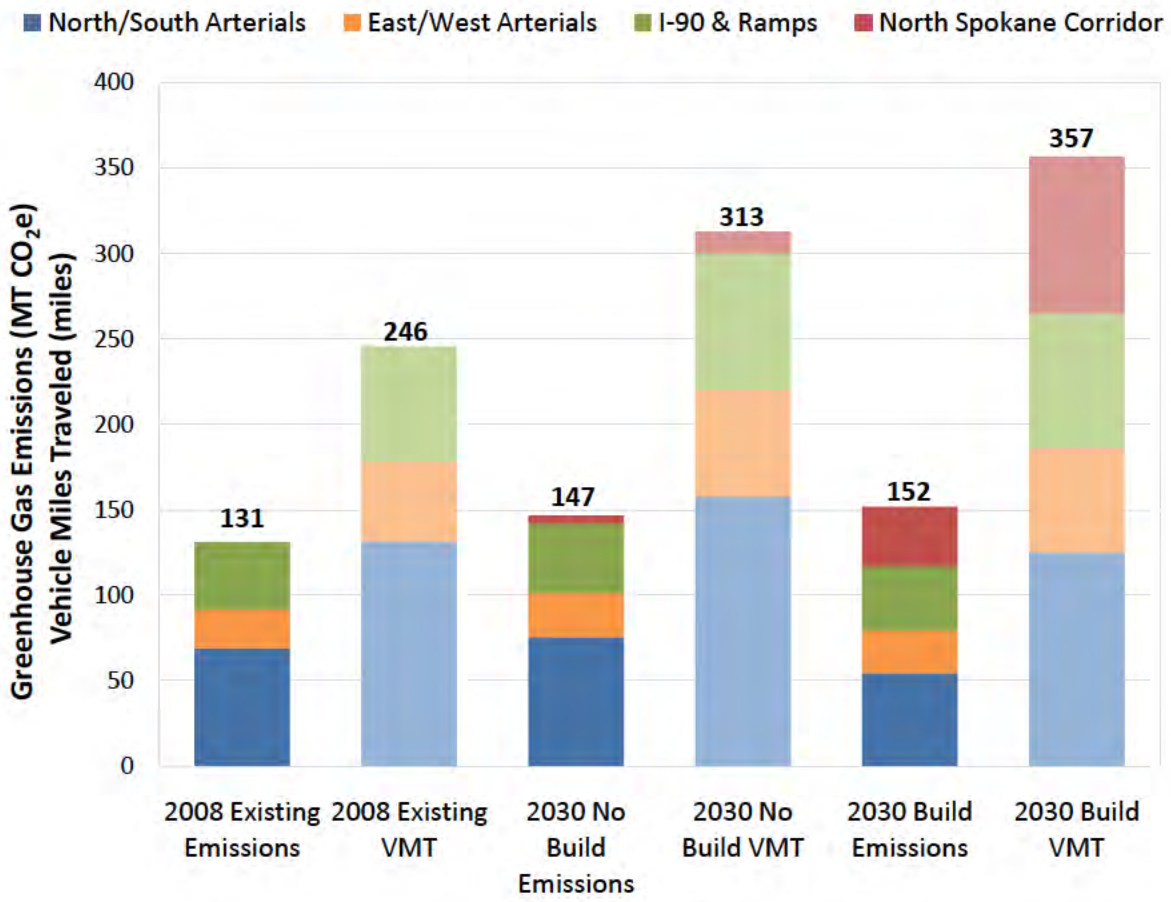
Afternoon peak period greenhouse gas emissions on the NSC and surrounding roadways were estimated using the US Environmental Protection Agency's (EPA) on-road mobile emissions Motor Vehicle Simulation Model (MOVES). The analysis includes fuel efficiency standards currently in law, but not additional improvements anticipated beyond 2016. Consequently, future emissions are expected to be lower than those reported here. Construction emissions were estimated based on the CalTrans transportation energy method.

The results of the operational analysis are shown in Exhibit 1. When comparing the 2030 No Build to the 2030 Build, comparable north/south and east/west arterial VMT and emissions are reduced. This analysis indicates that the NSC relieves the north/south arterials to such an extent that the VMT and emissions are lower in the 2030 Build alternative than in the 2008 base model. By attracting trips from less efficient local arterials and streets to the NSC's faster speed and impedance-free flow, the NSC reduces emission by allowing vehicles to travel more

efficiently. In addition to the local arterials, I-90 and the NSC's VMT and emissions are included in the analysis as well.

Construction of the remaining sections of the North Spokane Corridor is estimated to produce about 575,000 metric tons of carbon dioxide equivalents.

**Exhibit 1 Weekday PM Peak Greenhouse Gas Emissions and Vehicle Miles Traveled[2]**




[2] The No Build alternative includes portions of the NSC that are currently in construction. The Build alternative includes portions of the NSC that are currently in construction and the additional sections extending the corridor to I-90.

# INTRODUCTION

## Project Description

The North Spokane Corridor (NSC) is located in the northeast quadrant of Spokane County and the City of Spokane. When completed, the NSC will be a 10.5-mile north/south limited access facility connecting I-90 on the south end and existing US 395 on the north end. The corridor will alleviate increasing congestion and address other operational and safety issues on the existing street network. The project will provide a facility for balanced transportation options, including park and ride lots to support transit and vanpooling operations, as well as an expanded and enhanced pedestrian/bicycle facility. Right of way will also be reserved for future high-capacity transportation. Exhibit 2 shows the project location.

The completed NSC will be a 60-mile per hour, limited access highway with a direct connection to I-90 just west of the existing Thor/Freya Interchange. Other interchanges will be placed at locations such as Trent Avenue (SR 290), Wellesley Avenue, Francis / Freya Street, Parksmith Drive, US 2, and US 395 at Wandermere.

The following sections of the project have already been built or are currently under construction:

***Completed***

- NSC – Hawthorne Road to SR 2 Grading
- NSC – Farwell Rd Lowering
- NSC – Gerlach to Wandermere
- NSC – Francis Ave to Us 2 Structures – Rebid
- US 395/NSC – Freya to Fairview – Grading And Structures
- US 395/NSC – Freya St to Farwell Rd – PCCP Paving
- US 395/NSC – BNSF Railroad Tunnel

***Under Construction***

- US 395/NSC – Freya St to Farwell Rd – SB Additional Lanes
- US 395/NSC – Parksmith Interchange
- US 395/NSC – US 2 Lowering
- NSC – US 2 To Wandermere

**Exhibit 2 Project Vicinity**

When finished, these projects will complete 5.5 miles of the NSC. This segment will be open to traffic in 2011, and will allow travel from the northern end at US 395 near Wandermere south to the Francis/Freya roundabout. This greenhouse gas report analyzes the remaining segments of the NSC, from Francis/Freya to the southern terminus at I-90.

## Climate Change and Greenhouse Gas Emissions

Vehicles emit a variety of gases during their operation; some of these are greenhouse gases (GHGs). The GHGs associated with transportation are water vapor, carbon dioxide ($CO_2$), methane (also known as "marsh gas"), and nitrous oxide (used in dentists' offices as "laughing gas"). Any process that burns fossil fuel releases $CO_2$ into the air. Carbon dioxide makes up the bulk of the emissions from transportation.

Vehicles are a significant source of greenhouse gas emissions and contribute to climate change primarily through the burning of gasoline and diesel fuels. National estimates show that the transportation sector (including on-road vehicles, construction activities, airplanes, and boats) accounts for almost 30 percent of total domestic $CO_2$ emissions. However, in Washington State, transportation accounts for nearly half of GHG emissions because the state relies heavily on hydropower for electricity generation, unlike other states that rely on fossil fuels such as coal, petroleum, and natural gas to generate electricity. The next largest contributors to total GHG emissions in Washington are fossil fuel combustion in the residential, commercial, and industrial sectors at 20%; and electricity consumption, also 20%. Exhibit 3 shows the gross GHG emissions by sector, nationally and Washington State. Exhibit 4 compares Washington's per capita transportation emission to the national average and high and low jurisdictions. By this metric, Washington's emissions are just above average.

**Exhibit 3 GHG Emissions by Sector, 2005, US and Washington State**

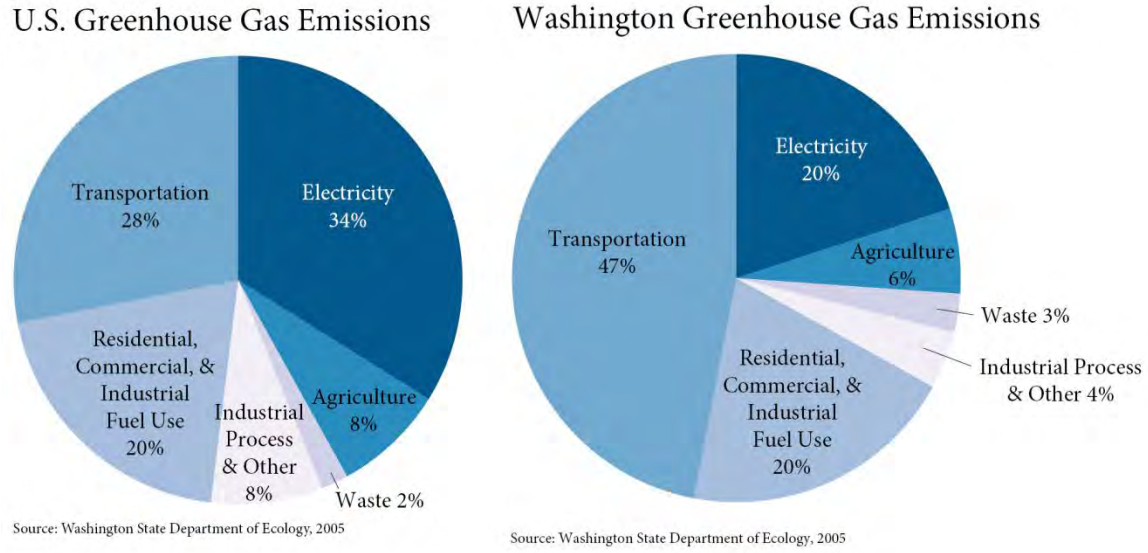
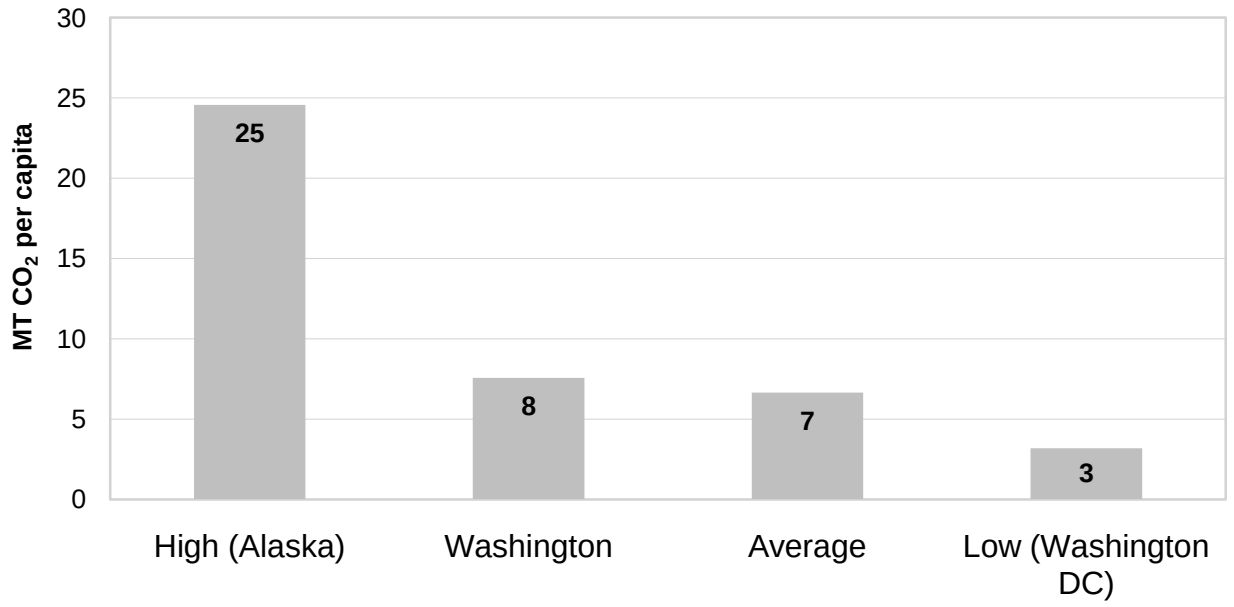


**Exhibit 4 Per Capita Transportation Greenhouse Gas Emissions by State**




## What efforts are underway to reduce greenhouse gas emissions in Washington State?

In 2007, Governor Gregoire and the legislature set greenhouse gas reduction goals for Washington State:

- 1990 greenhouse gas levels by 2020
- 25% reduction below 1990 levels by 2035
- 50% reduction below 1990 levels by 2050

Also in 2007, the Climate Advisory Team was formed by Governor's executive order 07-02 to find ways to reduce greenhouse gas emissions. The final report included 13 broad recommendations, many of which are now being implemented.

In March 2008, the Governor signed Washington's Climate Change Framework/Green-Collar Jobs Act (HB 2815), which was developed with the help of a broad coalition of business, environment, education, labor and energy leaders. This law includes, among other elements, statewide per capita VMT reduction goals as part of the state's GHG emission reduction strategy. The final report and other information on the process are available at: http://www.ecy.wa.gov/climatechange/2008CAT_overview.htm.

In 2009, the Governor issued Executive Order 09-05. Under the order WSDOT is currently leading an effort to evaluate the changes needed in transportation, including reductions in VMT, to meet the state's greenhouse gas reduction goals. The agency is collaborating with businesses, environmental groups, transportation advocates, and local and regional

jurisdictions to complete this work. In addition, WSDOT is among the six agencies leading the development of the initial climate change response strategy – due December 2011.

WSDOT is leading the development of effective, measurable, and balanced emission reduction strategies. Current WSDOT activities that reduce GHG emissions include:

> **Transportation Options –** For 30 years, WSDOT has supported carpooling, vanpooling, and public transportation through the funding, building, and maintenance of the freeway HOV system, ferries, rail, and other programs. The Commute Trip Reduction program has been partnering with employers to offer alternatives to drive alone commuting for 17 years and we have the nation's largest public vanpool program. All of these programs continue to expand. These investments help to reduce the number of vehicles on the roadway during peak congestion and help reduce total vehicle miles traveled
>
> **Incident Response Team (IRT)** – WSDOT has 55 vehicles that patrol 500 miles of highway to clear blocking incidents quickly and safely. IRT clears 98.6 percent of all incidents in less than 90 minutes, reducing the amount of time motorists spend sitting and idling in traffic.
>
> **Using Biodiesel in Ferries** – Each year, the state ferry system burns approximately 17 million gallons of diesel fuel in its ferries, making the agency a significant fuel consumer in Puget Sound. In March 2008, WSF began testing the use of biodiesel in the marine environment. Using biodiesel instead of traditional petroleum-based fuels reduces emissions of particulate matter and greenhouse gases, improving both local air quality and the Earth's climate.

**WSDOT is also taking action to reduce our agency's emissions. Two key elements of our internal effort are the agency's no idle policy and our expanded use of biodiesel.** In 2006, WSDOT adopted a no-idle policy to reduce fuel use and vehicle emissions. WSDOT estimates by reducing vehicle idling by 50 percent, the agency can save as much as $500,000 annually in fuel costs. In 2005, WSDOT started using five percent biodiesel (B5) mixed with regular diesel in maintenance vehicles operating in the Central Puget Sound area. Currently, 25 WSDOT fueling stations have 10 percent biodiesel (B10) available and we are working towards using 20 percent biodiesel (B20), depending on availability.

In addition, the agency has now prepared emission inventories for four years. With this understanding of emissions WSDOT is now developing strategies to reduce agency emissions over the coming years.

The most valuable contributions are found in the delivery of well-planned transportation improvements. WSDOT and our partners are actively implementing the 2005 Transportation Partnership Act, a 16-year plan to meet Washington State's most critical transportation needs. Many of these local, regional, and statewide transportation system improvements work in

conjunction with ongoing programs to help reduce the number of miles that vehicles need to travel each year. Together these efforts combine to create more efficient driving conditions, offer mode choices, and help move us toward state GHG reduction goals.

## What is WSDOT's Approach to Climate Change at the Project-Level?

In our work to date, we have found that the GHG emissions from a single project are usually small relative to regional or statewide emissions, and often less than without the project. However, overall, users of the transportation system contribute close to half of the state's GHG emissions (see Exhibit 3). WSDOT believes that transportation GHG emissions are better addressed at the transportation system, region, or state level where multiple projects can be analyzed in aggregate. However, WSDOT recognizes that most current transportation plans do not yet provide the emissions analysis that would put individual proposed transportation projects in a larger context. WSDOT also recognizes the public's interest in these issues and the direction from the Governor and WSDOT's leaders to disclose GHG emissions at the project level for major public projects. WSDOT will reference planning level information when it becomes available.

# METHODOLOGY

The analysis of both operational and construction greenhouse gas emissions described here follows the WSDOT Guidance for Project-Level Greenhouse Gas and Climate Change Evaluations.

## Operational Emissions

As recommended by WSDOT's Guidance for projects being evaluated at the Environmental Impact Statement-level, this analysis used the US Environmental Protection Agency's (EPA) MOVES2010a model. MOVES generated emission rates specific to Spokane County by speed at 5 mile per hour increments as recommended by the FHWA Technical Resource Center's Air Quality Team.[3] The run specifications and inputs are described below.

### *Description of Study Area*

In order to fully understand the effects the proposed project has on greenhouse gas emissions, the study area includes not only the North Spokane Corridor, but also major roadways in the surrounding area as shown in Exhibit 5.

The study area is bounded by the Maple/Ash/Country Homes/US 395 arterial corridor to the west, the Argonne/Bruce corridor to the east, I-90 to the south, and Day/Mt. Spokane to the north. Within this area, the most significant north/south and east/west arterial corridors (plus the NSC, when applicable) were included in the analysis. It should be noted that not all streets that are active in the regional model are included in the analysis; it was limited to the most significant arterials.

### *Traffic Data*

The project office supplied traffic data representing the weekday PM peak period for existing conditions (2008) and future (2030) Build and No Build conditions. Vehicle miles traveled (VMT), link length, link speed, and link volume were predicted using the Spokane Regional Transportation Council's (SRTC) regional travel demand model using VISUM 10.03-33 software.

### *MOVES Run Specifications*

The MOVES run specifications were chosen to represent the Spokane area on an average day during the PM peak period.

- **Month** – Because temperature has a limited effect on greenhouse gas emissions, March was chosen as a representative month for the analysis.

[3] Personal communication with Mike Claggett, Air Quality Specialist, FHWA Technical Resource Center, 11/10/2010.

- **Hour** – The hour from 5:00 pm to 6:00 pm was modeled because the traffic data was for the pm peak period.
- **Processes** – The purpose of the analysis is to estimate the differences in greenhouse gas emissions from alternative roadway conditions, therefore, only running exhaust was modeled.

**Exhibit 5 Roadways Included in Greenhouse Gas Analysis**

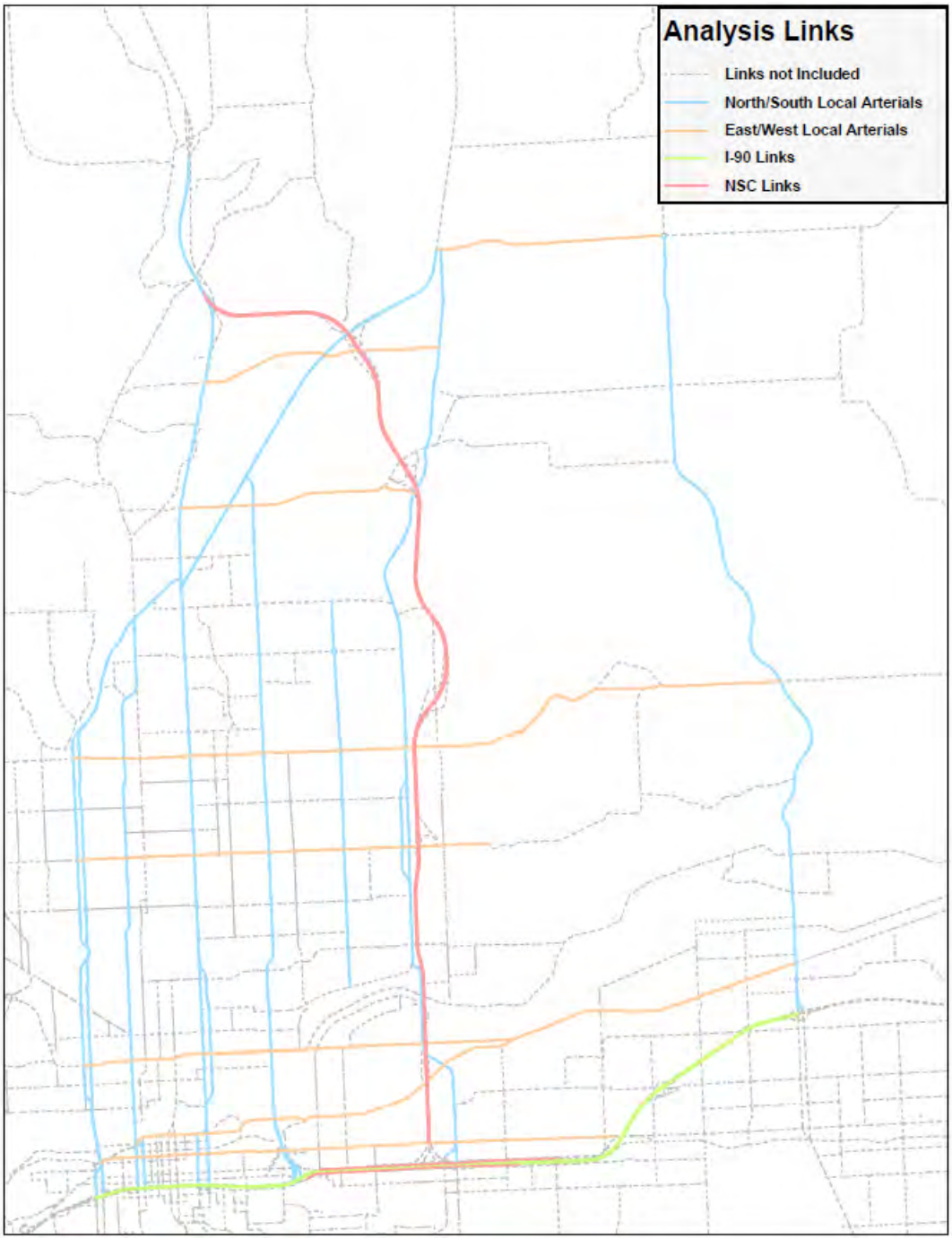


Exhibit 6 provides an overview of the run specifications. See Appendix A for the full run specification for each of the alternatives.

**Exhibit 6 MOVES Run Specification**

| Input | Selection |
|---|---|
| Scale | Project/Inventory |
| Year | 2008/2030 |
| Month | March |
| Days | Weekday |
| Hour | 5:00 to 6:00 PM |
| County | Spokane |
| Road Types | Rural Unrestricted, Urban Restricted, and Urban Unrestricted |
| Pollutants | Total Gaseous Hydrocarbons (required for methane)<br>Total Energy Consumption<br>Methane<br>Nitrous Oxide<br>Atmospheric $CO_2$<br>$CO_2$ Equivalent |
| Processes | Running Exhaust |

***Project Data Manager Inputs***

Because the purpose of this analysis is to compare alternative traffic schemes' effects on greenhouse gas emissions, where available, MOVES defaults were used and held constant for all three runs. An overview of inputs is shown in Exhibit 7.

- **Age Distribution** – Because Washington has an older fleet than the national average, Washington State 2008 registration information prepared for use with MOBILE6 was entered into EPA's Registration Distribution Conversion template. The converted data was used for both existing and future years. This means that for all three alternatives the same age distribution of vehicles was used. For example, the same portion of vehicles was assumed to be five years old for each alternative.
- **Links** – The MOVES run was used to develop emission rates, rather than total emissions, so sample links of 1 mile long with 1000 vehicles per hour were used. Speeds were modeled in 5-mile increments (0, 5, 10, etc.).
- **LinkSource Types** – Thirteen SourceTypes are associated with each link. The LinkIDs and associated RoadTypeIDs were taken from the Links file and correlated with the fractions provided by the Washington State Department of Ecology in WA_LinkSourceTypeHour.

**Exhibit 7 MOVES County Data Manager File Sources**

| Tab | Input Source |
|---|---|
| Meteorological Data | Default values |
| Age Distribution | Converted 2008 Reg File from Ecology using EPA converter |
| Inspection/Maintenance Program | Default values |
| Fuel Supply | Default values |
| Fuel Formulations | Default values |
| Links | 1 mile long, 1000 vehicles per hour, speeds in increments of 5 miles per hour |
| Link Source Types | WA_LinkSourceTypeHour data by county provided by Ecology |

### *MOVES Output and Post-Processing*

The MOVESoutput table provided emission quantities by link and the MOVESactivityoutput table provided distance. Dividing the link emissions quantity by the distance provided emission rates for each link type by speed.

These emission rates were applied to the traffic data based on each link's speed and road type. Multiplying the link's VMT by the emission rate produced the link's emissions. Emissions were then summed by roadway segment, roadway group, and alternative.

## Construction Emissions

Construction emissions come primarily from the combustion of fuel used to construct the facility. Because construction emissions are most directly related to the energy use, the construction emissions estimate is based on an estimate of construction energy use.

Construction energy use was calculated using the CalTrans methodology from project cost information and energy factors relating project cost and energy use. These factors take into account the energy used to obtain the raw materials, manufacture and transport the supplies, and construct the facility. While embodied emissions are not directly calculable in this method, these emissions are included in the factors.

The energy factors based on 1977 dollars were updated to 2010 dollars using the CalTrans Index for Selected Construction Items for the quarter ending September 30, 2010 (see Appendix B).

The project office supplied project cost detail as shown in Exhibit 8. Costs are in 2010 dollars.

**Exhibit 8 Project Cost by Section and Facility Type (million dollars)**

| Section | Spokane River to Francis/Freya | Trent to Spokane River | Trent to I-90 | I-90 and CD system | Total |
|---|---|---|---|---|---|
| Urban Freeway | $104 | $38 | $62 | $91 | $295 |
| Interchange | $15 | $3 | | $30 | $48 |
| Bridge Steel Girder | $12 | $20 | | | $32 |
| Bridge Concrete Girder | $98 | $160 | $246 | $102 | $606 |
| Total | $229 | $221 | $308 | $223 | $981 |

Emissions from construction equipment result primarily from fuel combustion producing carbon dioxide, but small amounts of nitrous oxide and methane are also produced. Nitrous oxide and methane are more effective at warming the atmosphere than carbon dioxide. A commonly used assumption that transportation and related equipment's total greenhouse gas emissions are about five percent higher than the carbon dioxide emissions was used to account for the nitrous oxide and methane.

Since most construction equipment runs on diesel fuel, all construction energy needs were assumed to be met with diesel fuel. The emission factors for diesel fuel were applied to the fuel needs to calculate greenhouse gas emissions.

## EFFECTS

Exhibits 9 and 10 show the greenhouse gas emissions and VMT results for the weekday PM peak period.

To better understand the project's effects, the emissions were summed using four roadway groups:

- north/south local arterials (blue)
- east/west local arterials (orange)
- I-90 (green)
- NSC (red)

The specific roadways in each group are listed in Appendix C and the colors correspond to those used in Exhibit 5.

The north/south, east/west, and I-90 links are similar for all three alternatives. Since the NSC is not the same between the three scenarios, the NSC results are shown for information only.

Not surprisingly, the north/south arterials see the most benefit from the NSC Build alternative – about a 20 percent drop in emissions over current conditions and an estimated 28 percent decrease from the No Build alternative.

Over all the roadways analyzed, both of the future scenarios increase emissions by roughly 12 to 16 percent over the existing conditions. The difference between the No Build and Build alternatives is negligible given the uncertainty associated with this type of analysis. Increased emissions are a result of large increases in VMT on the evaluated roadways: 27 percent in the No Build and 45 percent in the Build. The Build alternative will have about a 14 percent increase in VMT over the No Build alternative but only minimal increase in greenhouse gas emission due to improved travel efficiency.

This analysis indicates that the NSC draws trips off many of the local arterials not included in the analysis, moving traffic from stop and go to impedance-free driving conditions, thereby increasing the overall efficiency of the roadway network. The analysis points to the benefits of a fully constructed NSC – congestion relief and reduced stop and go travel on local arterials.

Additional greenhouse gas reductions will result from future vehicle efficiency requirements. These reductions will be in addition to those reported here because this analysis includes the Corporate Average Fuel Economy (CAFE) standard improvements currently in law, but not any additional increases in vehicle fuel efficiency standards beyond 2016. The EPA and National Highway Traffic Safety Administration (NHTSA) are currently working to set additional vehicle efficiency standards:

- New light-duty fuel efficiency standards will cover the years 2017 to 2025. EPA and NHTSA are considering annually increases in fuel efficiency between 3 and 6 percent over this eight year time period.[4] The final rule is expected by July 31, 2012.
- First ever fuel efficiency standards will apply to mid- and heavy-duty vehicles for model years 2014 to 2018. EPA and NHTSA are considering about a 20% cut in fuel use for heavy-duty trucks.[5] Some industry experts believe improvements up to 35% can be achieved with existing technologies.[6]

**Exhibit 9 Greenhouse Gas Emissions and VMT**

| | Emissions (MT $CO_2e$) VMT (miles) | | | Compare to Existing | | Compare to No Build |
|---|---|---|---|---|---|---|
| **Roadways** | **Existing** | **No Build** | **Build** | **No Build** | **Build** | **Build** |
| North South Arterials (blue) | 69 | 75 | 54 | 10% | -21% | -28% |
| | 131,000 | 158,000 | 125,000 | 21% | -5% | -21% |
| East West Arterials (orange) | 23 | 26 | 25 | 13% | 9% | -3% |
| | 47,000 | 63,000 | 61,000 | 34% | 30% | -3% |
| I-90 (green) | 40 | 41 | 38 | 3% | -5% | -7% |
| | 67,000 | 80,000 | 79,000 | 19% | 18% | -1% |
| **Subtotal** | **131** | **142** | **117** | **8%** | **-11%** | **-18%** |
| | **245,000** | **301,000** | **265,000** | **23%** | **8%** | **-12%** |
| North Spokane Corridor (Red) | | 5 | 35 | | | |
| | | 13,000 | 92,000 | | | |
| **Grand Total** | 131 | 147 | 152 | 12% | 16% | 3% |
| | 245,000 | 314,000 | 357,000 | 28% | 46% | 14% |

Notes:

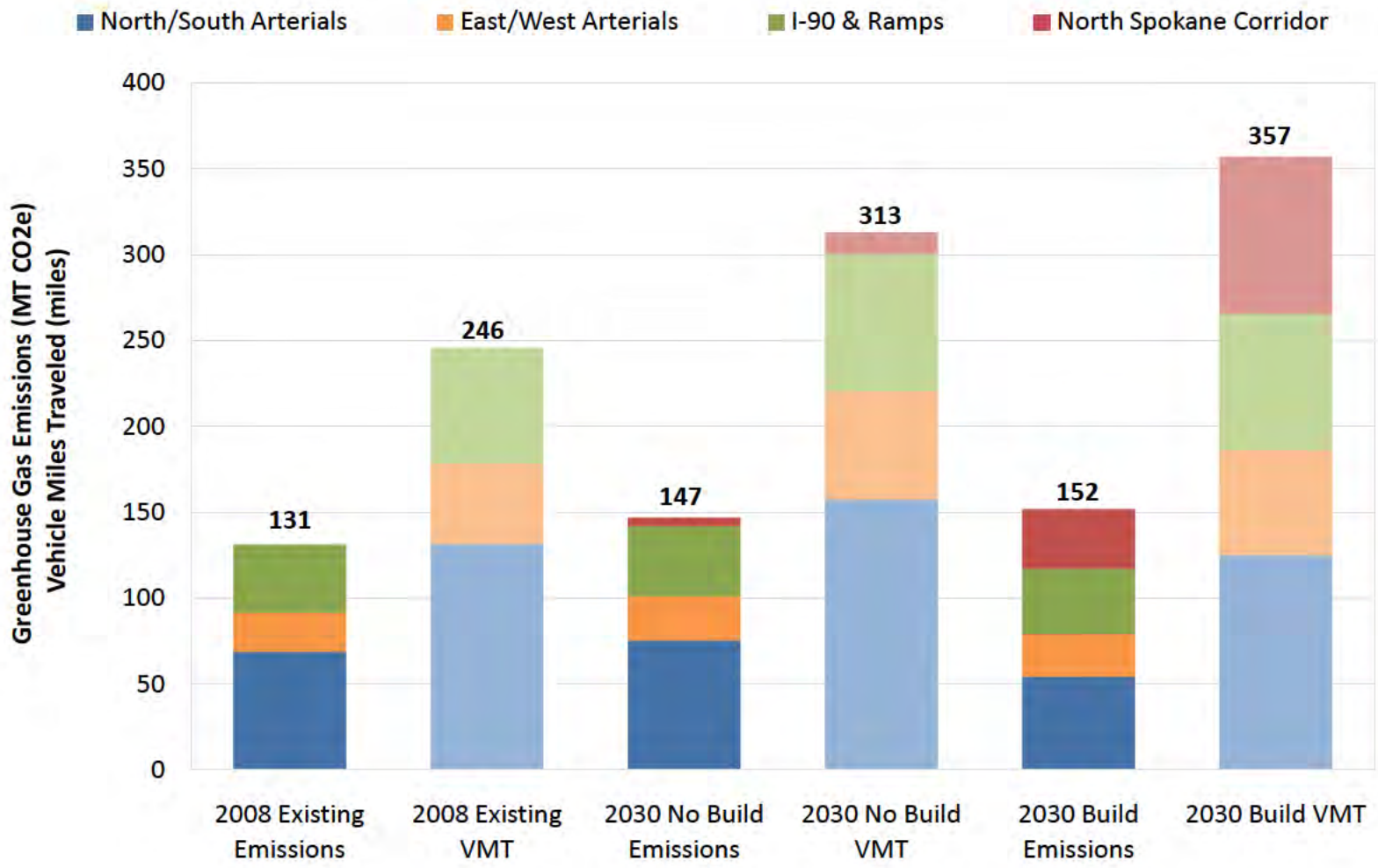
- Numbers may not add due to rounding.
- Roadway color groups correspond to Exhibit 5.
- Due to uncertainty associated with this type of analysis, scenarios with differences less than 10 percent should be considered negligible.

[4] "EPA and NHTSA Announce a First Step in the Process for Setting Future Greenhouse Gas and Fuel Economy Standards for Passenger Cars and Light Trucks." EPA. http://www.epa.gov/oms/climate/regulations/420f10051.htm#1, accessed on 12/09/2010.

[5] "Administration Proposes 20 Percent Cut in Fuel Use, Emissions for Heavy-Duty Trucks." AASHTO Climate Change Weekly Briefing, Volume 1, Issue No 35, October 28, 2010.

[6] "Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles." Committee to Assess Fuel Economy Technologies for Medium- and Heavy-Duty Vehicles. National Research Council. Transportation Research Board. http://www.nap.edu/catalog/12845.html, accessed on 10/14/2010.

**Exhibit 10 PM Peak Operational Emissions and Vehicle Miles Traveled**



## Construction Emissions

Exhibit 11 shows the project's total estimated energy needs and corresponding greenhouse gas emissions. These emissions will be spread throughout the duration of the project's construction.

**Exhibit 11 Project Construction Energy Requirements and Emissions**

| Section | Cost (Million $) | Energy (MBTU) | GHG Emissions (MT $CO_2e$) |
|---|---|---|---|
| Urban Freeway | $295 | 2,061,000 | 158,000 |
| Interchange | $48 | 855,000 | 66,000 |
| Bridge Steel Girder | $32 | 247,000 | 19,000 |
| Bridge Concrete Girder | $606 | 4,326,000 | 332,000 |
| Total | $981 | 7,489,000 | 575,000 |

Note: numbers may not add due to rounding
MBTU = million British thermal units
MT $CO_2e$ = metric tons carbon dioxide equivalents

The production and disposal of materials used in the project will release greenhouse gases. However, at this time, there is no accurate and standardized methodology for calculating the embodied and lifecycle emissions for transportation projects separate from the total construction emissions.

# REDUCING EMISSIONS

## Operational Emissions

The state and federal investments in transportation projects are made to improve current conditions of the multi-modal transportation network. The proposed project contains several features that will provide improved mobility with a modest increase in greenhouse gas emissions. In general, project-level actions that can help reduce greenhouse gas emissions include:

- Reducing stop and go conditions
- Improving roadway speeds to a more efficient speeds
- Improving intersection traffic flow to reduce idling
- Creating more safe and efficient freight movement
- Expanding transit and non-motorized options for travelers
- Increasing the reliability of transit and HOV travel times
- Increasing vegetation density over pre-project conditions to absorb carbon dioxide

Future emissions are expected to be less than those reported here due to future, more stringent, vehicle fuel efficiency standards.

## Construction Emissions

Construction of the project is currently planned to last 18 years from 2012 to 2030. The project traffic plan includes detours and strategic construction timing (like night work) to continue moving traffic through the area and reduce backups to the traveling public to the extent possible. WSDOT will seek to set up active construction areas, staging areas, and material transfer sites in a way that reduces idling times for equipment. WSDOT will work with our partners to promote ridesharing and other commute trip reduction efforts for employees working on the project.

WSDOT has designed the project using materials with the longest available life. This includes using Portland cement pavement rather than asphalt. These choices mean that the new highway will have a longer life before needing to be replaced, which reduces overall emissions for highway reconstruction and replacing materials.

## PROJECT ADAPTATION TO THE CHANGING CLIMATE

WSDOT acknowledges that the effects of climate change may alter the function, sizing, and operations of our facilities. Therefore, in addition to mitigating GHG emissions, WSDOT must also ensure that its transportation facilities can adapt to the changing climate. To ensure that our facilities can function as intended for their planned 70 year lifespan, they should be designed to perform under the variable conditions expected as a result of climate change.

The Pacific NW climate projections are available from the Climate Impacts Group at the University of Washington http://cses.washington.edu/cig/fpt/ccscenarios.shtml.

For the region, the anticipated changes are more frequent or longer lasting heat waves; seasonal water scarcity; and changes in intensity, timing and location of extreme weather events. The information available at this time shows modest seasonal changes in precipitation that fall within the range of current observed precipitation. The project area may experience an increased incidence of drought or an increase in the number of high heat events (days over 100 degrees). The project team consulted with WSDOT headquarters environmental staff to assess whether the forecasted climate changes may affect the project area – or necessitate changes in project design.

The only surface water body present within this segment of the NSC is the Spokane River. The NSC profile at the Spokane River crossing is elevated high enough that future 100-year flood flow clearance should be easily accommodated. The abutments will be set back from the river far enough to not restrict flow during larger flood events and will be stable in such flows.

The features of the North Spokane Corridor project (in particular the north/south route and the multi-modal features) will improve the transportation system's ability to withstand temporary disruptions due to weather-related events.

# REFERENCES

AASHTO Climate Change Weekly Briefing. "Administration Proposes 20 Percent Cut in Fuel Use, Emissions for Heavy-Duty Trucks." Volume 1, Issue No 35. October 28, 2010.

Claggett, Mike, Air Quality Specialist. FHWA Technical Resource Center. Personal communication. 11/10/2010.

WSDOT. Guidance for Project-Level Greenhouse Gas and Climate Change Evaluations. October, 2010.

EPA. "EPA and NHTSA Announce a First Step in the Process for Setting Future Greenhouse Gas and Fuel Economy Standards for Passenger Cars and Light Trucks." http://www.epa.gov/oms/climate/regulations/420f10051.htm#1, accessed on 12/09/2010.

Committee to Assess Fuel Economy Technologies for Medium- and Heavy-Duty Vehicles. "Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles." National Research Council. Transportation Research Board. http://www.nap.edu/catalog/12845.html, accessed on 10/14/2010.

# APPENDIX A – MOVES RUN SPECIFICATIONS

## Existing Run

**EPA MOVES RunSpec File Name:**

C:\Documents and Settings\landsbk\My Documents\Climate Change\Projects\SR 395 NSC GHG\Inputs_RunSpecs\NSC_Ex_101110.mrs

**Description:**

NSC GHG Existing - 2008
October 28, 2010
Karin Landsberg

**Domain/Scale: Project**

Calculation Type: Inventory

**Time Spans:**

Aggregate By: Hour
Years:
2008
Months:
March
Days:
Weekdays
Hours:
Begin Hour: 17:00 - 17:59
End Hour: 17:00 - 17:59

**Geographic Bounds:**

LINK geography
Selection: WASHINGTON - Spokane County

**On Road Vehicle Equipment:**

Diesel Fuel - Combination Long-haul Truck
Diesel Fuel - Combination Short-haul Truck
Diesel Fuel - Intercity Bus
Diesel Fuel - Light Commercial Truck
Diesel Fuel - Motor Home
Diesel Fuel - Passenger Car
Diesel Fuel - Passenger Truck
Diesel Fuel - Refuse Truck
Diesel Fuel - School Bus
Diesel Fuel - Single Unit Long-haul Truck
Diesel Fuel - Single Unit Short-haul Truck

Diesel Fuel - Transit Bus
Gasoline - Combination Short-haul Truck
Gasoline - Light Commercial Truck
Gasoline - Motor Home
Gasoline - Motorcycle
Gasoline - Passenger Car
Gasoline - Passenger Truck
Gasoline - Refuse Truck
Gasoline - School Bus
Gasoline - Single Unit Long-haul Truck
Gasoline - Single Unit Short-haul Truck
Gasoline - Transit Bus

**Road Types:**
Rural Unrestricted Access
Urban Restricted Access
Urban Unrestricted Access

**Pollutants And Processes:**
Running Exhaust Atmospheric CO2
Running Exhaust CO2 Equivalent
Running Exhaust Methane (CH4)
Running Exhaust Nitrous Oxide (N2O)
Running Exhaust Total Energy Consumption
Running Exhaust Total Gaseous Hydrocarbons

**Strategies:**
Strategies:
Rate of Progress:
Rate of Progress calculations are disabled

**Manage Input Data Sets:**

**General Output:**
Output Database Server Name: [using default]
Output Database Name: NSC_Ex_101112_2_out

**Units:**
Mass Units: Grams
Energy Units: Joules
Distance Units: Miles
Activity Outputs:
Distance Traveled
Source Hours
Source Hours Idling

Source Hours Operating

**Output Emissions Breakdown:**

Emission Process
On Road/Off Road
Road Type
Output Time Step
Hour
Geographic Output Detail
LINK

**Advanced Performance Features:**

Do Not Execute:
Save Data From:
Do Not Save Generator Data
Saved Data Database Server Name: [using default]
Saved Data Database Name: [using default]
Custom Default Database Server Name: [using default]
Custom Default Database Name: [using default]
Perform Final Aggregation (if necessary

## 2030 Run

**EPA MOVES RunSpec File Name:**

C:\Documents and Settings\landsbk\My Documents\Climate Change\Projects\SR 395 NSC GHG\Inputs_RunSpecs\NSC_Future_101110.mrs

**Description:**

NSC Build GHG
October 28, 2010
Karin Landsberg

**Domain/Scale: Project**

Calculation Type: Inventory

**Time Spans:**

Aggregate By: Hour
Years:
2030
Months:
March
Days:
Weekdays
Hours:
Begin Hour: 17:00 - 17:59
End Hour: 17:00 - 17:59

**Geographic Bounds:**

LINK geography
Selection: WASHINGTON - Spokane County

**On Road Vehicle Equipment:**

Diesel Fuel - Combination Long-haul Truck
Diesel Fuel - Combination Short-haul Truck
Diesel Fuel - Intercity Bus
Diesel Fuel - Light Commercial Truck
Diesel Fuel - Motor Home
Diesel Fuel - Passenger Car
Diesel Fuel - Passenger Truck
Diesel Fuel - Refuse Truck
Diesel Fuel - School Bus
Diesel Fuel - Single Unit Long-haul Truck
Diesel Fuel - Single Unit Short-haul Truck
Diesel Fuel - Transit Bus

Gasoline - Combination Short-haul Truck
Gasoline - Light Commercial Truck
Gasoline - Motor Home
Gasoline - Motorcycle
Gasoline - Passenger Car
Gasoline - Passenger Truck
Gasoline - Refuse Truck
Gasoline - School Bus
Gasoline - Single Unit Long-haul Truck
Gasoline - Single Unit Short-haul Truck
Gasoline - Transit Bus

**Road Types:**

Rural Unrestricted Access
Urban Restricted Access
Urban Unrestricted Access
Pollutants And Processes:
Running Exhaust Atmospheric CO2
Running Exhaust CO2 Equivalent
Running Exhaust Methane (CH4)
Running Exhaust Nitrous Oxide (N2O)
Running Exhaust Total Energy Consumption
Running Exhaust Total Gaseous Hydrocarbons

**Strategies:**

Strategies:
Rate of Progress:
Rate of Progress calculations are disabled

**Manage Input Data Sets:**

**General Output:**

Output Database Server Name: [using default]
Output Database Name: NSC_Future_101112_2_out

**Units:**

Mass Units: Grams
Energy Units: Joules
Distance Units: Miles
Activity Outputs:
Distance Traveled
Source Hours
Source Hours Idling
Source Hours Operating

Population

**Output Emissions Breakdown:**

Emission Process
On Road/Off Road
Road Type
Output Time Step
Hour
Geographic Output Detail
LINK

**Advanced Performance Features:**

Do Not Execute:
Save Data From:
Do Not Save Generator Data
Saved Data Database Server Name: [using default]
Saved Data Database Name: [using default]
Custom Default Database Server Name: [using default]
Custom Default Database Name: [using default]
Perform Final Aggregation (if necessary)

# APPENDIX B – CONSTRUCTION EMISSION FACTORS

**Exhibit 12 Project Energy Factors**

| Facility Type | BTU per 1977 Dollar | BTU per 2010 Dollar |
|---|---|---|
| Urban Freeway | 27,500 | 6,987 |
| Interchange | 70,100 | 17,810 |
| Bridge Steel Girder | 30,400 | 7,724 |
| Bridge Concrete Girder | 28,100 | 7,139 |

**Exhibit 13 Conversion Factors**

| Description | Factor |
|---|---|
| BTUs per gallon diesel fuel | 139,000 |
| $CO_2$ per gallon diesel | 10.15 kg |
| $CO_2e$ per gallon diesel | 10.66 kg |

# APPENDIX C – ROADWAY GROUPS

Colors correspond to Exhibit 5.

## North/South Arterials (Blue)

- Country Homes, Ash, Maple
- Monroe, Lincoln, North Wall, Browne
- Division, Ruby US 395, US 2
- Hamilton, Nevada, Crestline
- Haven, Greene, Market, Freya
- Bruce, Argonne, Mullan

## East/West Arterials (Orange)

- Riverside, Sprague
- Spokane Falls Blvd, Trent
- Maxwell, Mission
- Wellesley
- Francis, Bigelow Gulch
- Hawthorne
- Hastings, Farwell, Mt Spokane Park

## I-90 (Green)

- Maple to Monroe
- Monroe to Browne
- Browne to Hamilton
- Hamilton to Thor
- Thor to Argonne
- I-90 Ramps
    - Thor EB Off
    - Thor WB On
    - Freya EB on
    - Freya WB Off

## North Spokane Corridor (Red)

- Constructed as part of No Build Alternative
  - Freya to Farwell
  - Farwell to US 395
- Constructed as part of Build Alternative
  - I-90 to Trent
  - Trent to Wellesley
  - Wellesley to Francis
  - Francis to Parksmith
  - Parksmith to US 2
  - US 2 to 395
  - Hamilton to Broadway CD