
Guidance for Project-Level Greenhouse Gas and Climate Change Evaluations



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Summary

WSDOT's Environmental Services Office offers this practical guidance to all WSDOT project teams so that they can answer the question: *How should we address greenhouse gas emissions and climate change in our environmental documents?* WSDOT is analyzing project level greenhouse gas emissions in response to commitments by our leaders (Governor Gregoire and Secretary Paula Hammond) and public interest. Most often these questions come through the public involvement steps in the National and State Environmental Policy Acts (NEPA and SEPA).

We issued the first version of this guidance in 2009. The most current version is posted on our website: <http://www.wsdot.wa.gov/Environment/Air/Energy.htm>

This guidance has been developed over several years, and will continue to evolve. To date, WSDOT has published multiple EAs and EISs that relate statewide and project-specific information on greenhouse gas (GHG) emissions. As an example, the Columbia River Crossing draft and final EIS included a full description of greenhouse gas estimates, energy use, and climate change effects. An independent panel validated the Columbia River Crossing Project's approach and it won a national award from the National Association of Environmental Professionals. Similarly, our recent EAs and EISs include general information about the projected climate change for our region. In 2011, USDOT agencies were given clear policy direction to consider climate change impacts.¹

WSDOT serves as the SEPA lead agency for our proposed actions, and as the project proponent and/or joint NEPA lead with federal transportation agencies. Our primary funding partners, the Federal Highway Administration and Federal Transit Administration have not issued formal direction or compiled best practices for addressing project-level GHG emissions. We acknowledge is no federal or state "threshold" for GHG emissions from a particular project.

Secretary Hammond has stated our position as follows: "While greenhouse gas emissions generated from highway users are best addressed at the region, state, or national transportation systems level, the public is seeking information about project-specific emissions. In our environmental documents (NEPA and SEPA), we seek to provide information that is useful for the public and decision makers."

The basic tenants of WSDOT's approach are:

- WSDOT guidance is consistent with recent draft guidance from the White House Council on Environmental Quality (CEQ) for analyzing project level GHG emissions and considering future climate change impacts.
- The Washington Climate Change Impacts Assessment (June 2009) provides sufficient information to enable planning-level consideration of our state's forecasted climate impacts. WSDOT advises project teams to use this information, in combination with the internal statewide vulnerability assessment (completed November 2011).

¹ Secretary Ray LaHood issued an executive order June 2011 (www.dot.gov/docs/climatepolicystatement.pdf)

- All WSDOT projects subject to NEPA and SEPA are required to follow this guidance. The use of this guidance is recommended, but not mandatory, for federally funded local agency projects processed by the Highways and Local Programs Division of WSDOT.
- While the guidance satisfies WSDOT’s responsibilities for disclosure related to the NEPA and SEPA processes, it does not apply to documents prepared to satisfy the federal Endangered Species Act.

This guidance outlines a standard analytical process and provides template language with the agency’s key messages. The guidance is consistent with the technical and policy guidance contained in WSDOT’s *Environmental Procedures Manual* chapters 412 (cumulative effects), 425 (air), and 440 (energy).

The Environmental Services Office is available to help project teams use this guidance and to answer questions about greenhouse gas emissions and climate impacts as they relate to our analysis of proposed actions under NEPA and SEPA.

At the project-level, our work focuses on two main topics:

- Evaluating emissions related to our proposed projects and
- Assessing the projects’ vulnerability to changes in climate forecasted for the Pacific Northwest.

What level of analysis is recommended?

All WSDOT projects should consider the available traffic data, climate data and the internal vulnerability assessment data for their project area.

WSDOT’s guidance for GHG emissions is tailored to the level of environmental review required under NEPA and SEPA (see table 1). WSDOT evaluates three types of GHG emissions:

- Operational – “tailpipe” emissions from vehicles using project roadways
- Construction – primarily from fuel used to build project
- Embodied/Lifecycle – “Embodied” includes material extraction and transfer to project site; “Lifecycle” includes embodied and end of service demolition/disposal, (a.k.a. “cradle to grave”)

Table 1: GHG emission level of analysis based on NEPA or SEPA classification

| Type of Emission | Exempt | DCE/Checklist/EA | EIS |
|--------------------|---------------|------------------|--------------|
| Operational | No evaluation | Qualitative* | Quantitative |
| Construction | No evaluation | Qualitative | Quantitative |
| Embodied/Lifecycle | No evaluation | No evaluation | Qualitative |

*Highly visible and/ or controversial projects should consider a basic quantitative GHG analysis of operational GHG emissions for NEPA EA documents when traffic and/or energy use information is available and when a comparison to the No Action alternative is possible and useful.

For a NEPA CE: We don't recommend analysis of Operational and Construction Emissions for most NEPA CEs. A qualitative discussion is optional for projects that receive GHG questions/comments from public or agencies.

Why Not? Most CE-level projects have little or no effect on GHG emissions. Many are maintenance operations that are captured in WSDOT's annual greenhouse gas emissions inventory.

NEPA DCE or SEPA Checklist: We recommend a brief (one or two sentence) qualitative analysis of Operational and Construction Emissions. Template language is included in Appendix A.

Why? Most of these projects have a small potential for increased GHG emissions.

NEPA EA: We require WSDOT EA's to include the standard language from this guidance in the Cumulative Effects section of EA documents. In addition, some highly visible or controversial projects may benefit from a basic quantitative analysis of operational emissions.

Why? EA-level projects normally do not have sufficient traffic data available for a more advanced Operational Emissions analysis. Also, EAs typically do not include an energy analysis, which provide the basis for analysis of Construction Emissions.

NEPA / SEPA EIS: A quantitative analysis of Operational and Construction Emissions. Advanced analysis is recommended, using the EPA MOVES 2010a model, for EISs. The WSDOT ANE group can provide technical support. A basic analysis may be more appropriate if detailed traffic data is not available for an advanced analysis. Standard language must be included in the Cumulative Effects section.

Why? EIS-level projects typically have a high level of public interest and multiple alternatives with both detailed traffic data and an energy analysis available.

How was WSDOT's guidance developed?

WSDOT's guidance for project-level GHG analysis was developed through collaboration with internal and external experts, evaluation of other agencies' approaches, and the assessment of a number of tools designed to calculate project-level GHG emissions. Tools were evaluated based on their ease of use, the complexity and availability of inputs, the effort needed to model, cost, and the usefulness of results. WSDOT's program and policy leads continue to coordinate closely with USDOT lead agencies, EPA, state departments of Ecology and Commerce, Puget Sound Regional Council, and the clean air agencies.

The WSDOT state environmental managers receive regular briefings and opportunities to review each version of this guidance.

Contacts

Technical support is available to help determine the appropriate level of analysis and to prepare documentation at the project-level.

For help applying this guidance, contact these WSDOT Environmental Services staff:

Tim Sexton, AICP

Air Quality, Noise, Energy Policy Manager
(206) 440-4549 SextonT@wsdot.wa.gov

Carol Lee Roalkvam

Policy Branch Manager
(360) 705-7126
Roalkvc@wsdot.wa.gov

Definitions and Terminology

GHG Emissions Terms

There are four types of GHG emissions that may be considered at the project-level: operational, construction, embodied, and lifecycle emissions. WSDOT's guidance focuses on operational and construction emissions, while acknowledging embodied and lifecycle emissions.

Operational GHG emissions are released by vehicles using project roadways. The quantity of emissions released depends on the fuel type, vehicle fuel efficiency, speed of the vehicle, distance traveled, and the number of vehicles on a roadway. In general, operational emissions are the largest category of GHG emissions released by the transportation sector. Approximately 72 percent of the transportation sector's emissions are generated from on-road transport, including both passenger and freight travel.²

Constructions emissions are released during project construction and primarily come from fuel burned in the equipment used to build a project, such as bulldozers, pavers, and rollers. Construction emissions can also result from increased traffic congestion caused by construction activities.

Embodied emissions are 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.³ 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.

Lifecycle emissions include 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.

² AASHTO, Primer on Transportation and Climate Change, 2008.

<http://downloads.transportation.org/ClimateChange.pdf>

³ 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>

Climate Change Impacts Terms

Except where otherwise noted, these definitions are based on Intergovernmental Panel on Climate Change's (IPCC) *Climate Change 2007: Impacts, Adaptation and Vulnerability Report*⁴ and their *Climate Change 2007: Mitigation*.⁵

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

Adaptive Capacity – The ability of a system to adjust to climate change to moderate potential damages, to take advantage of opportunities or cope with the consequences.⁶

Climate – The long-term average of conditions in the atmosphere, ocean, and ice sheets and sea ice described by statistics, such as means and extremes.

Climate Change – A significant and persistent change in the mean state of the climate or its variability. Climate change occurs in response to changes in some aspect of Earth's environment: these include regular changes in Earth's orbit about the sun, re-arrangement of continents through plate tectonic motions, or anthropogenic modification of the atmosphere.

Climate Forecasts and/or Projections – A prediction about average or extreme climate conditions for a region in the long-term future (seasons to decades). Pacific NW climate projections are available from the Climate Impacts Group at the University of Washington <http://cses.washington.edu/cig/fpt/ccscenarios.shtml>.

Climate Variability – Natural changes in climate that fall within the normal range of extremes for a particular region, as measured by temperature, precipitation, and frequency of events. Drivers of climate variability include the El Niño.

Weather Forecast – A prediction about the specific atmospheric conditions expected for a location in the short-term future (hours to days). Differs from **Climate Forecast**.

Global Warming – The observed increase in average temperature near the Earth's surface and in the lowest layer of the atmosphere.

Resilience – is the capacity of a system to absorb disturbance and still retain its basic function and structure.

Vulnerability – The degree to which physical, biological, and socio-economic systems are susceptible to and unable to cope with adverse impacts of climate change.⁷

⁴ Accessed at <http://www.ipcc.ch/ipccreports/ar4-wg2.htm>, 9/20/2010.

⁵ Accessed at <http://www.ipcc.ch/ipccreports/ar4-wg3.htm>, 9/20/2010.

⁶ IPCC 2001, also referenced in 2009 California Climate Adaptation Strategy.

⁷ AASHTO, Primer on Transportation and Climate Change, 2008.

Overview of Guidance

The first section of this guidance presents the approach to assessing greenhouse gas (GHG) emissions at the project-level. The WSDOT Air, Noise, and Energy (ANE) Program can provide technical support for all levels of analysis below.

The second section outlines the steps project teams should follow to consider anticipated changes in the Pacific Northwest’s climate while planning and designing transportation projects. The WSDOT Policy Branch provides support and up-to-date climate data.

Greenhouse Gas Emissions

What level of GHG emissions analysis is recommended for transportation projects?

WSDOT has grouped transportation projects into three categories and recommends a different level of analysis for each category.

Table 1: GHG emission level of analysis based on NEPA or SEPA classification

| Type of Emission | Exempt | DCE/Checklist/EA | EIS |
|--------------------|---------------|------------------|--------------|
| Operational | No evaluation | Qualitative* | Quantitative |
| Construction | No evaluation | Qualitative | Quantitative |
| Embodied/Lifecycle | No evaluation | No evaluation | Qualitative |

*Highly visible and/ or controversial projects should consider a basic quantitative GHG analysis of operational GHG emissions for NEPA EA documents when traffic and/or energy use information is available and when a comparison to the No Action alternative is possible and useful.

WSDOT’s guidance considers the potential for substantial GHG emissions, the data typically available at different levels of documentation, and the likelihood of generating meaningful information that will be useful in decision making. This tiered organization helps us scope the level of effort needed for each project and to focus our evaluations on the projects with the greatest potential GHG emissions.

Our guidance is further guided by our position that contributions of project-level emissions should be treated as cumulative effects and as an issue of global concern. Our approach is to disclose information as a contribution to cumulative effects. See **Appendix B** for template language for use in EAs and EISs. This approach is consistent with WSDOT’s cumulative effects guidance, on-line at <http://www.wsdot.wa.gov/Environment/Compliance/CumulativeEffects.htm>.

SEPA or NEPA Categorical Exemption/Exclusion (CE) – No Analysis

WSDOT recommends no GHG emissions analysis for SEPA or NEPA CE projects for all type of GHG emissions. WSDOT believes evaluation of GHG is not warranted for minor transportation actions (such as operation and maintenance activities, minor repairs, pavement rehabilitation, installation of signs, bus pullouts). No discussion of Embodied or Lifecycle Emissions is recommended. GHG emissions from WSDOT operations are captured in the annual agency-wide GHG inventory that is completed in accordance with recently passed reporting requirements for Washington state agencies.

Project teams can include the qualitative discussion in public materials. A qualitative project-level analysis of Operational or Construction GHG Emissions is optional for projects that receive GHG questions/comments from public or agencies.

Recommended standard language for ERS/ECS forms can be found in **Appendix A**.

SEPA Checklist or NEPA Documented Categorical Exclusion (DCE) – Qualitative Analysis

WSDOT recommends a qualitative analysis for Operational and Construction GHG Emissions for SEPA Checklist and NEPA DCE projects because of the small potential for substantial GHG emissions. No discussion of embodied or lifecycle emissions is recommended.

A qualitative project-level GHG analysis is currently recommended for most EAs because of the following:

- Usually, do not have alternatives to compare
- Most lack the detailed traffic data needed to model emissions (e.g., EPA MOVES)
- Do not typically include an energy analysis that will provide the data required to analyze construction emissions.

Suggested text to use in SEPA Checklists and NEPA DCEs is provided in **Appendix A**.

NEPA Environmental Assessments (EA) – Qualitative Analysis

WSDOT recommends a qualitative analysis for Operational and Construction GHG Emissions on most NEPA EA projects because of the small potential for substantial GHG emissions. No discussion of Embodied or Lifecycle Emissions is recommended.

WSDOT Standard language is provided in **Appendix B** and should be included in the Cumulative Effects section of the EA document.

Some highly visible and/or controversial projects should consider a basic quantitative GHG analysis of operational GHG emissions for NEPA EA documents. This basic quantitative approach is recommended when vehicle miles traveled (VMT) or energy use information is available and when a comparison with the No Action alternative is possible and useful. WSDOT recommends construction emissions be addressed qualitatively. No discussion of Embodied or

Lifecycle Emissions is recommended.

The recommended standard “basic” quantitative approach for project-level GHG analysis for highly visible and/or controversial projects for EAs is outlined in Appendix C. This approach should also use the standard language in **Appendix B**.

SEPA or NEPA Environmental Impact Statements (EIS) - Quantitative Analysis

WSDOT recommends a quantitative analysis of Operational and Construction GHG Emissions for SEPA or NEPA environmental impact statements (EIS) because the intensity and magnitude of projects triggering this level of documentation have the potential for substantial GHG emissions. A qualitative discussion of embodied and lifecycle emissions is suggested.

The recommended methodology for developing quantitative information is outlined in **Appendix C**; however, project teams should discuss with the WSDOT Air, Noise, and Energy (ANE) Program prior to initiating work. The analysis should use the most current version of the federal Environmental Protection Agency MOtor Vehicle Emission Simulator (MOVES)⁸ model for operational emissions. The results of the Energy Discipline Report should be used for construction emissions.

In reaching this recommended approach, WSDOT examined a number of methodologies and tools for “advanced” operational GHG calculations and recommends using the EPA MOVES model. This decision was based on a balance of effort and potential benefit. WSDOT’s approach seeks to generate useful data to assist project teams in their work to educate the public about the proposal, distinguish project alternatives, and inform decisions about the project.

The quantitative analysis should be included in the Energy Discipline Report. Within the EIS, we recommend that the results of the analysis be included in the Cumulative Effects section. The EIS should include the standard language in **Appendix B**.

⁸ <http://www.epa.gov/otaq/models/moves/index.htm>

How should projects consider future conditions related to climate change?

Understanding future conditions is essential for WSDOT's mission: to keep people and business moving. WSDOT is committed to sustainability goals designed to meet society's needs today without compromising the ability of future generations to meet their needs.

WSDOT is fully committed to long-term asset management. WSDOT's 2011-2017 Strategic Plan directs us to evaluate future climate-related risks and identify strategies to reduce risk. Secretary Hammond and WSDOT Senior Managers have been briefed on the changes expected in the Pacific Northwest and have authorized the study of our existing asset vulnerabilities (completed in November 2011) as well as the analysis of climate risks during planning and design of improvement projects.



WSDOT has a responsibility to look ahead and ensure we protect our infrastructure and prepare for potential risks. Our transportation structures are critical to keep people and goods moving and the economy growing.

Paula Hammond
Washington State Secretary of
Transportation

WSDOT acknowledges that effects of climate change may alter the function, sizing, and operations of our facilities. To ensure that our facilities can function as intended for their planned 50, 70, or 100 year lifespan, they should be designed to perform under the variable conditions expected as a result of climate change. For example, drainage culverts may need to be resized to accommodate more intense rainfall events or increased flows due to more rapid glacial thawing.

Project teams are expected to examine available information about climate trends (summarized in **Appendix D**) and the assessment of vulnerable infrastructure (as outlined in this guidance). Project teams are encouraged to consider ways to make their proposed projects more resilient to future climate impacts and severe storm events.

NEPA specialists and our technical experts must also understand that climate science also changes how we describe the "affected environment" in NEPA. In the draft national guidance (CEQ 2010), federal agencies and project proponents are encouraged to consider the effects of climate change when evaluating projects "designed for long-term utility" in areas that are "vulnerable to specific effects of climate change". That means that project teams need to examine the future affected environment differently from the past. Past trends for a specific resource (water, habitat, air) may not be accurate predictions for the future; instead, we need

to look at scientifically-based projections of the changing climate as part of our analysis. Our approach to wetland mitigation provides a clear example: WSDOT teams are looking at future issues that may impact the success of environmental mitigation (like salt water inundation or drought as concerns for long-term wetland viability).

Since 2008, WSDOT has lead the nation in the analysis of climate change in its NEPA and SEPA EISs and EA's. Our guidance has been evolving, and we have examples in several published documents.

Project teams are expected to ask and answer the question, "how will my project be affected by climate change? Follow these steps:

1. Examine the results of WSDOT's Climate Impacts Vulnerability Assessment for your project area (2011, available on-line at: <http://www.wsdot.wa.gov/SustainableTransportation/adapting.htm>) This information will alert you to vulnerabilities and/or strengths in the existing WSDOT facilities.
2. Contact WSDOT Environmental Services Policy Branch for assistance in creating an up-to-date summary of climate threats in your project area;
3. Direct project technical specialists to consider the available information (steps 1 and 2) in their NEPA and SEPA analysis, as well as their proposals for mitigating impacts;
4. Document your findings regarding anticipated climate threats in the cumulative effects section (if separate) or in specific discipline sections (Fish and Wildlife, Wetlands, Land Use, etc.);
5. Document how the project will be designed to be resilient or resistant to climate threats (such as the use of drilled shafts or site selection to avoid a potential threat).

Below is a summary of the key elements of WSDOT's Climate Impacts Vulnerability Assessment:

- WSDOT collected an inventory of department-owned assets and climate change data using GIS. University of Washington climate scientists provided us with climate data.
- WSDOT leveraged its ten years of project risk management experience through its signature Cost Estimate Validation Process and Cost Risk Assessment Workshops to develop an appropriate risk assessment method for the climate change analysis.
- Fourteen workshops engaged experts across all regions, state ferries, rail, and aviation.
- The outcome of each workshop is a qualitative assessment of the vulnerability agreed upon by participants.

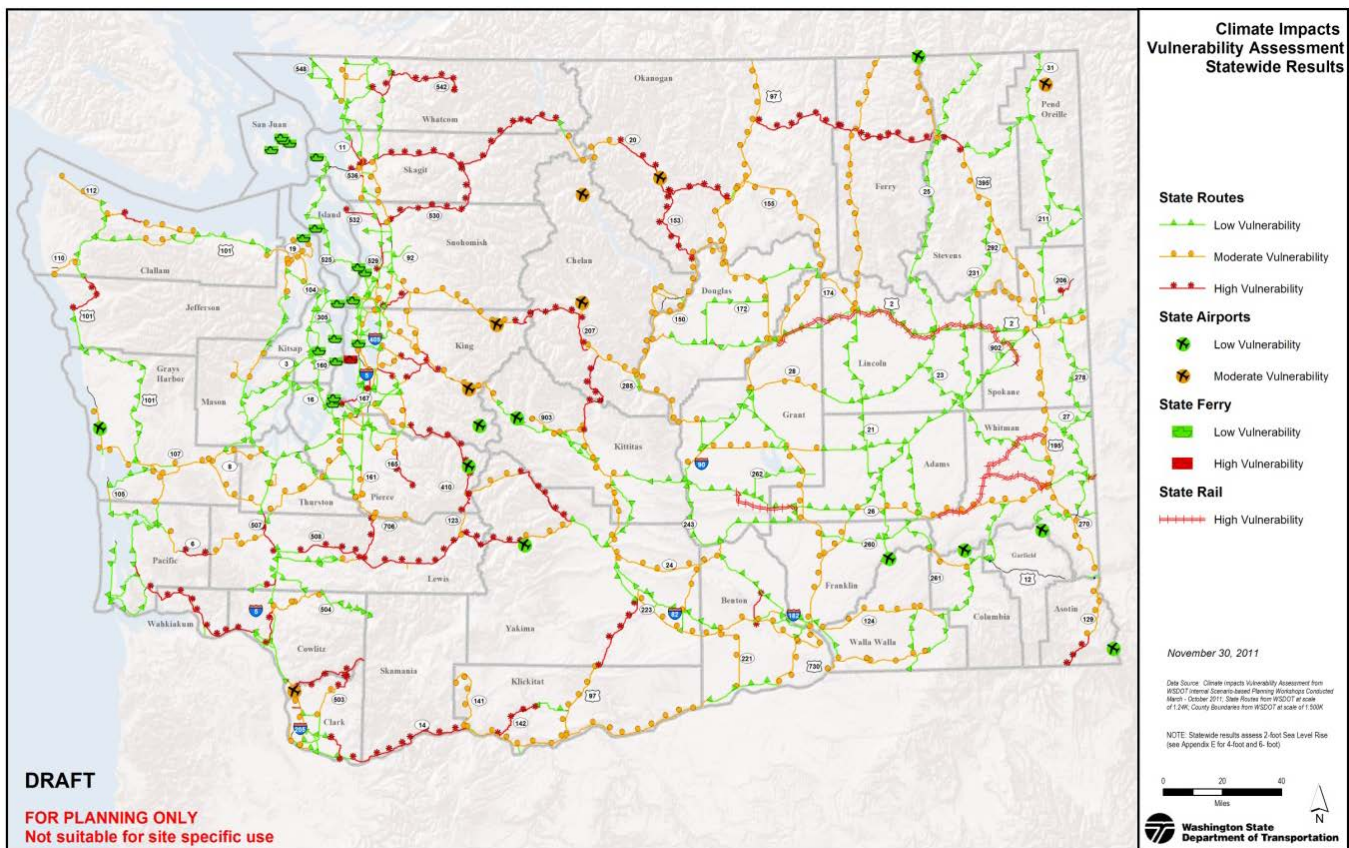
Project teams should look at the GIS layer (which will be posted on the Environmental Workbench). The metadata contains the comments from the workshops about the climate

threats that lead to the ratings. WSDOT Environmental Services staff is available to help. The information is very easy to access and provides a very useful starting place for project teams.

In the statewide map (below), red shows high likelihood of vulnerability, yellow denotes roads that could experience temporary operational failures at one or more locations, and green indicates roads that could experience reduced capacity somewhere along that roadway segment. Users must note that roadway segments may be shown as having a high impact (red), however, this does not mean the whole segment is vulnerable—rather that one or two areas along that segment are vulnerable to catastrophic failure. Data accuracy is *generally* suitable for statewide planning purposes. Any scenario-based dataset will have significant errors when applied to *specific* locations.

In general, areas shown with locations having a high impact are:

- In the mountains
- Either above or below steep slopes
- In low-lying areas subject to flooding
- Along rivers that are aggrading due to glaciers melting
- In low-lying coastal areas subject to inundation from sea level rise



Appendix A

Example Language for use in WSDOT documents

This appendix contains example text. It is organized from the earliest type of environmental documentation – our internal project summary database (ERS) to the larger and more complex publications prepared to satisfy NEPA and SEPA.

WSDOT Environmental Review Summary or “ERS”

There is no tab for climate impacts. Staff filling in the ERS should check the Climate Impacts Vulnerability Assessment (CIVA) GIS layer. Climate data should be factored into the design of the proposed project.

Under the Air Tab

- **SEPA CE and NEPA CE** – *“No GHG emissions analysis is recommended because the project is not expected add traffic or increase emissions beyond current levels”*
- **SEPA Checklist** – *“A brief statement addressing greenhouse gas emissions may be needed. Use the appropriate text from Appendix A of WSDOT’s Guidance to Project-Level Greenhouse Gas and Climate Change Evaluations.”*
- **NEPA EA** – *“The cumulative effects section will need to include a climate change discussion. Refer to the standard language provided in Appendix B of WSDOT’s Guidance to Project-Level Greenhouse Gas and Climate Change Evaluations. Please work with staff from the WSDOT Air, Noise, and Energy Program.”*
- **SEPA/ NEPA EIS** – *“A quantitative GHG emissions analysis is needed and should be included in the Energy Discipline Report. Standard language provided in Appendix B of WSDOT’s Guidance to Project-Level Greenhouse Gas and Climate Change Evaluations needs to be included in the EIS document along with results of the quantitative analysis. Contact WSDOT Air, Noise, and Energy Program.”*

NEPA CE (ECS form), SEPA Checklist

Climate data should be factored into the design of the proposed project.

- **SEPA CE/NEPA CE** – *“No GHG emissions analysis is recommended because the project is not expected add traffic or increase emissions beyond current levels.”*
- **SEPA Checklist/NEPA DCE** – *Include in the Air Section of SEPA Checklist*
 - No change in traffic –
“Because the project will not change traffic, operational greenhouse gas emissions are not expected to change. Construction greenhouse gas emissions will result primarily from fuel used in construction equipment.”
 - Expected to improve traffic flow/reduce congestion –

“The project is expected to improve traffic flow, which should reduce operational greenhouse gas emissions. Construction greenhouse gas emissions will result primarily from fuel used in construction equipment.”

- Expected to add traffic to roadway –

“The project is expected increase traffic flow [describe in one sentence how; for example, adding lane]. This may result in a small increase in operational greenhouse gas emissions. However, the data needed to quantitatively evaluate greenhouse gas emissions for this project are not available. Construction greenhouse gas emissions will result primarily from fuel used in construction equipment.”

Please consult staff from the WSDOT, Air, Noise, and Energy Program for more information when a project is increasing traffic.

NEPA Environmental Assessment (EA)

Climate data should be factored into the design of the proposed project. Although emissions will not be quantified, a consistent approach should be followed to ensure that the relevant aspects of every project are adequately addressed. We recommend using the standard language developed for this purpose, see Appendix B.

For NEPA EA documents, a qualitative discussion should be included in the “Cumulative Effects” section.

SEPA and NEPA Environmental Impact Statement (EIS)

Climate data should be factored into the design of the proposed project.

We recommend using the standard template language in Appendix B to ensure a consistent approach to the qualitative discussion on GHG emissions and climate change.

The Energy Discipline Report should include the quantitative GHG emissions analysis and the discussion of climate change should be in the Cumulative Effects section of the EIS. The EIS document should also include a summary of the quantitative analysis.

WSDOT Recommended Standard Language for EA/EIS Discussion

The standard qualitative language template below is recommended for the Cumulative Effects section of environmental documentation. This text can be pared down and should be tailored to your specific project. However, it is very important that project teams work with the Air/Noise/Energy Program to tailor language prior to finalizing.

Appendix B

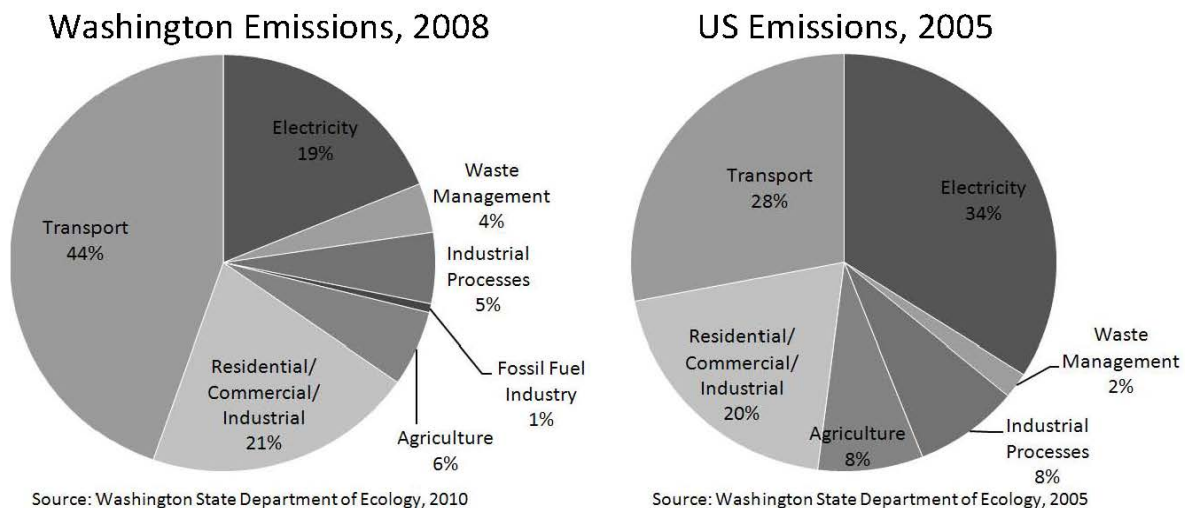
EA and EIS Template Language

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 (CO₂), methane (also known as “marsh gas”), and nitrous oxide (used in dentists’ offices as “laughing gas”). Any process that burns fossil fuel releases CO₂ 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 global warming 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 CO₂ 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%. Figure 1 shows the gross GHG emissions by sector, nationally and Washington State.

Figure 1. GHG Emissions by Sector, Washington State (2008) and National (2005)



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

Project teams should refer to the WSDOT Sustainable Transportation website for up-to-date information about state efforts and WSDOT-specific initiatives.

<http://www.wsdot.wa.gov/SustainableTransportation>

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 action are usually very small, (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 Figure 1 (pie chart)). WSDOT believes that transportation GHG emissions are better addressed at the region, state, or transportation systems level where multiple projects can be analyzed in aggregate. We recognize that most current plans at these broader levels do not yet provide the emissions analysis that would put our proposed transportation improvements in a larger context. We also recognize 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. Essentially, project-specific analysis can be done now, and WSDOT will reference planning level information when it becomes available.

All WSDOT projects subject to NEPA and SEPA are required to follow WSDOT's guidance when evaluating GHG and climate change. When this is done, the following language should be used: *Project Name* followed the *WSDOT Guidance for Project-Level Greenhouse Gas and Climate Change Evaluations* and received technical support from the WSDOT Environmental Services Office.

What effect will the transportation improvements from this project have on greenhouse gas emissions?

The state and federal investments in transportation projects are made to improve current conditions of the multi-modal transportation network. The proposed type: *Ferry, Highway, Rail, Transit, Multi-Modal* project contains several features that will *improve – or not increase --* GHG. In general, project-level actions that can help reduce greenhouse gas emissions include:

- Reducing stop and go conditions
- Improving roadway speeds to a moderate level
- 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 sequester carbon

Note: a quantitative analysis is recommended at the EIS-level of documentation where more detailed traffic data is typically available and where an Energy Analysis is prepared. Please contact Air, Noise, and Energy Program staff for more details about the methodology and appropriate language for preceding paragraph in EIS-level documents.

Example Project Description paragraph:

Traffic improvements proposed by this project will create smoother driving conditions. More specifically, widening and intersection improvements proposed on the project will minimize stop and go conditions thereby conserving fuel. It will also promote more efficient energy consumption by moderating speeds. This proposed project will enable better movement of vehicles in (insert air quality horizon year) for project area intersections and on the mainline, thereby reducing traffic congestion and collisions. Decreased vehicle delay at off and on ramps further reduces collisions and promotes more efficient driving.

How will this project minimize emissions while under construction?

Construction of the project is currently planned to last number of year years from 20xx to 20xx. 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 standing wait times for equipment. WSDOT will work with our partners to promote ridesharing and other commute trip reduction efforts for employees working on the project.

Will the products used to construct the facility contribute to GHG emissions?

The production and disposal of materials used in the Project Name 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.

Example Design Efficiency paragraph:

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

How did the project consider future conditions related to climate change?

WSDOT acknowledges that effects of climate change may alter the function, sizing, and operation 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 50, 70, or 100 year lifespan, they should be designed to perform under the variable conditions expected as a result of climate change. For example, drainage culverts may need to be resized to accommodate more intense rainfall events or increased flows due to more rapid glacial thawing.

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>

Washington State is likely to experience over the next 50 years:

- increased temperature (extreme heat events, changes in air quality, glacial melting)
- changes in volume and timing of precipitation (reduced snow pack, increased erosion, flooding)
- ecological effects of a changing climate (spread of disease, altered plant and animal habitats, negative impacts on human health and well-being)
- sea-level rise, coastal erosion, salt water intrusion

The project team considered the information on climate change with regard to preliminary design as well as the potential for changes in the surrounding natural environment.

The project is designed to last (30, 50, 70 Years) years. As part of its standard design, this project has incorporated features that will provide greater resilience and function with the potential effects brought on by climate change.

Appendix C

GHG Quantitative Methodologies

Basic Quantitative Approach to SEPA Checklist and NEPA EA Documents

WSDOT recommends that highly visible and/or controversial projects use the following procedure to perform a basic quantitative Operational GHG Emission's analysis. The determination of a need for this type of analysis should be made in coordination with the WSDOT Air Quality, Noise, and Energy Program.

WSDOT currently describes the following as a basic quantitative GHG analysis:

1. Qualitative statements in Appendix A for SEPA Checklists, and relevant discussions from Appendix B for EA documents
2. Comparison of vehicle miles traveled (VMT) values and discussion of the differences Using an emissions factor based on average fuel economy to VMT

Methodology: Average fuel economy multiplied by VMT provides an estimate of Operational GHG Emissions. Percent changes in emissions/VMT between alternatives are then compared.

Advanced Quantitative Analysis for SEPA and NEPA EIS Documents

WSDOT recommends an advanced quantitative analysis of Operational and Construction GHG Emissions for EIS-level documents. The traffic data required for a quantitative an advance quantitative Operational GHG Emissions' analysis is normally only generated for our largest projects. Energy Discipline Reports contain the information needed to analysis Construction GHG Emissions and these reports are only required on EIS-level documents. The determination of this need and the appropriate data to use should be determined in coordination with the WSDOT Air Quality, Noise, and Energy Program.

Example project: SR 520, I-5 to Medina Bridge Replacement and HOV Supplemental Draft Environmental Impact Statement (SDEIS) June 2010.

Operational GHG Emissions

WSDOT currently describes the following as an advanced quantitative Operational GHG Emissions' analysis:

1. Relevant discussions from Appendix B for EA documents
2. Quantify GHG emissions from vehicle operations on the facility and, depending on the project, on nearby facilities that are directly affected by the project using the most current version of the EPA MOVES model.

Methodology: Operational GHG emissions from highway projects depend on several factors: primarily, distance traveled (VMT) and fuel economy. Total VMT in a project area is determined by the project itself and the project's relationship to the surrounding transportation network. Fuel economy varies with speed and vehicle type.

Periods of peak traffic volumes are evaluated and modeled to reflect the most congested periods when fuel-efficiency is lowest (e.g. "worst-case" scenario). Modeling is done with the Environmental Protection Agency's (EPA) Motor Vehicle Emissions Simulator (MOVES) model to develop emission rates based on the vehicle type and modeled speed. Emission rates are then applied **to the traffic volumes to calculate the total GHG emissions produced during average weekday peak periods.**

Please contact Tim Sexton (sextont@wsdot.wa.gov) with the Air, Noise, and Energy Group for the most recent modeling inputs.

Construction GHG Emissions

WSDOT currently describes the following as an advanced quantitative Construction GHG Emissions' analysis:

1. Convert construction energy results to GHG emissions based on project assumptions regarding fuel quantities and types

Methodology: CALTRANS has developed a standard methodology⁹ for converting project costs to fuel use. These values can be converted to GHG emission based on the fuel type(s).

⁹ Caltrans, *Energy Requirements for Transportation Systems*, June 1980

Appendix D

Pacific Northwest Climate Change Impacts

While impacts will vary by location, the [Washington Climate Change Impacts Assessment](#) and other published works provide useful information about our region's climate trends.

Washington State is likely to experience:

Higher Temperatures

Increases in average annual temperature of 2.0°F (range: 1.1°F to 3.4°F) by the 2020s, 3.2°F (range: 1.6°F to 5.2°F) by the 2040s, and 5.3°F (range: +2.8°F to +9.7°F) by the 2080s (compared to 1970–1999) are projected. There is an increasing likelihood of extreme heat events (heat waves) that can stress energy, water, and transportation infrastructure.

Enhanced Seasonal Precipitation Patterns

Wetter autumns and winters, drier summers, and small overall increases in annual precipitation in Washington (+1 to +2% by the 2040s) are projected. Increases in extreme high precipitation in western Washington are also possible.

Declining Snowpack

Spring snowpack is projected to decline, on average, by approximately 28% by the 2020s, 40% by the 2040s, and 59% by the 2080s (relative to 1916–2006).

Seasonal Changes in Streamflow

Increases in winter streamflow, shifts in the timing of peak streamflow in snow-dominant and rain/snow mix basins, and decreases in summer streamflow are expected. Also, the risk of extreme high and low flows is expected to increase.

Sea Level Rise

Medium projections of sea level rise for the 2100s are 2 to 13 inches (depending on location) in Washington State. Higher increases (up to 50 inches depending on location) are possible depending on trends in ice loss from the Greenland ice sheet, among other factors.

See the following pages for a summary of the PNW forecast.

Project PNW Climate Forecast Summary¹⁰

| Climate Variable | General change expected | Specific change expected |
|------------------------------|---|---|
| Precipitation | Small annual increase projected, although still within the range of historical variability; potentially large seasonal changes | <ul style="list-style-type: none"> • Projected change in average annual precipitation: • +1-2% through midcentury Mean change (with range) in annual precipitation for benchmark periods, relative to 1970-1999: <ul style="list-style-type: none"> - 2020s: +1% (-9 to 12%)* - 2040s: +2% (-11 to +12%) - 2080s: +4% (-10 to +20%) |
| Extreme precipitation | Increases in extreme rainfall magnitudes throughout the state, but the range of projections generally falls within the range for historic recorded rainfall events. | <ul style="list-style-type: none"> • Statewide (<i>Salathé et al. 2009</i>): More intense precipitation projected by regional climate model but distribution is variable; substantial changes only over the North Cascades and northeastern Washington. • For sub-regions (<i>Rosenberg et al. 2009</i>): the projected increases vary depending upon the data employed. |
| Temperature | Increasing temperatures expected through 21st century | <ul style="list-style-type: none"> • Projected change in average annual temp is 0.5°F per decade (range: 0.2- 1.0°F). • Mean change (with range) in average annual temperature for specific benchmark periods, relative to 1970-1999: <ul style="list-style-type: none"> - 2020s: +2°F (1.1-3.3°F)* - 2040s: +3.2°F (1.5-5.2°F) - 2080s: +5.3°F (2.8-9.7°F) |
| Extreme Heat | Generally projecting increases in extreme heat events for the 2040s, particularly in south central WA and the western WA lowlands (Salathé et al. | <ul style="list-style-type: none"> • Western Washington, the frequency of exceeding the 90th percentile daytime temperature (Tmax) increases from 30 days per year in the current climate (1970-1999) to 50 days per year in the 2040s (2030-2059). |

¹⁰ Source: http://www.ecy.wa.gov/climatechange/2010TAGdocs/20100521_projecteddrivers.pdf

| Climate Variable | General change expected | Specific change expected |
|-----------------------|--|--|
| | 2009). | |
| Snowpack | Decline in spring (April 1) snowpack expected | <ul style="list-style-type: none"> • Projected decrease in mean April 1 snowpack for the B1 and A1B scenarios, respectively (changes relative to 1916-2006): <ul style="list-style-type: none"> - 2020s: -27% (B1), -29% (A1B) - 2040s: -37% (B1), -44% (A1B) - 2080s: -53% (B1), -65% (A1B) |
| Streamflow | <p>Seasonally, expecting increases in winter streamflow, an earlier shift in the timing of peak streamflow in snow dominant and rain/snow mix (transient) basins, and decreases in summer streamflow.</p> <p>Increasing risk of extreme high and low flows expected. In all cases, results will vary by location and basin type.</p> | <ul style="list-style-type: none"> • Projected changes in mean annual runoff for WA state: <ul style="list-style-type: none"> • 2020s: +2% (B1), 0% (A1B) • 2040s: +2% (B1), +3% (A1B) • 2080s: +4% (B1), +6% (A1B) • All changes relative to 1916-2006; numbers rounded to nearest whole value (<i>Elsner et al. 2009</i>) • Increasing risk of lower low flows (e.g., 7Q10) most strongly in rain dominant and transient basins. Snow-dominant basins demonstrate relatively small decreases in 7Q10 statistics. (<i>Mantua et al. 2009; Tohver and Hamlet 2010, in draft</i>) • Changes in flood risk vary by basin type. Spatial patterns for the 20-year and 100-year flood ratio (future /historical) indicate slight or no increases in flood risk for snowmelt dominant basins due to declining spring snowpack. |
| Sea-level rise | Varying amounts of sea-level rise (or decline) projected in Washington due to regional variations in land movement and coastal winds. | <ul style="list-style-type: none"> • Projected global change (2090-2099): 7- 23", relative to 1980-99 average (<i>Solomon et al. 2007</i>) • 2050: Projected medium change in WA sea level (with range) (<i>Mote et al. 2008</i>): <ul style="list-style-type: none"> • NW Olympic Peninsula: 0" (-5-14") |

| Climate Variable | General change expected | Specific change expected |
|--------------------------------|---|---|
| Sea surface temperature | Warmer temps expected | <ul style="list-style-type: none"> • Central and South Coast: 5" (1-18") • Puget Sound: 6" (3-22") • 2100: Projected medium change in WA sea level (with range) (<i>Mote et al. 2008</i>): • NW Olympic Peninsula: 2" (-9-35") • Central and South Coast: 11" (2-43") • Puget Sound 13" (6-50") |
| Coastal upwelling | Little change in coastal upwelling expected | <ul style="list-style-type: none"> • Mean change in winds that drive coastal upwelling is minimal |
| Ocean acidification | Continuing acidification expected | <ul style="list-style-type: none"> • IPCC projects reductions in average global surface pH of 0.14-0.35 units over the 21st century. |