



CHAPTER 7 - CUMULATIVE EFFECTS

What is in Chapter 7?

This chapter identifies possible cumulative effects of the build alternatives when combined with past trends and other ongoing or expected plans and projects.

CUMULATIVE EFFECTS OVERVIEW

1 What are cumulative effects, and why do we study them?

Cumulative effects result from the proposed action when added to other past, present, and reasonably foreseeable projects or actions. Cumulative effects are not caused by a single project, but include the effects of a particular project in conjunction with other projects (past, present, and future) on the particular resource. Cumulative effects are studied to enable the public, decision-makers, and project proponents to consider the “big picture” effects of a project on the community and the environment.

2 How does WSDOT evaluate cumulative effects?

Several sources of guidance are available to Washington State Department of Transportation (WSDOT) to conduct the cumulative effects analysis. These include general guidance in Section 412 of the *Environmental Procedures Manual*¹ and in Federal Highway Administration (FHWA) Technical Advisory T 6640.8A.² Specific guidance is provided in *Guidance on Preparing Cumulative Impact Analyses*,³ including the eight-step procedure shown in Exhibit 7-1.

**Exhibit 7-1
WSDOT's Approach for Assessing Cumulative Effects**

Step	Approach
1	Identify resources to consider
2	Define the study area for each resource
3	Describe current status/viability and historical context for each resource
4	Identify direct and indirect project effects that might contribute to a cumulative effect
5	Identify other current and reasonable foreseeable actions
6	Identify and assess cumulative effects
7	Document the results
8	Assess the need for mitigation

All resources evaluated for permanent and short-term construction-related effects were considered in the cumulative effects analysis for this Final Environmental Impact Statement (EIS). Please note that hazardous materials are not a resource and that the effects of encountering hazardous materials are included in the discussion of water quality and earth and groundwater resources.

3 How did WSDOT evaluate the cumulative effects for this project?

Following the eight-step procedure shown in Exhibit 7-1, WSDOT completed Steps 1 through 4 during the development of the resource-specific discipline reports. Chapters 5 and 6 describe the direct and indirect effects on the resources and further detailed information can be found in the discipline reports for each resource. Chapter 4 of this Final EIS specifically addresses Step 3 above in providing the current status and historic context of the resources within the study area.

The study area for each resource is listed in Exhibit 7-2. WSDOT determined the cumulative effects study area for each resource by determining:

- 1 The distribution of the resource itself.
- 2 The area within that distribution where the resource could be affected by the project in combination with other past, present, and reasonably foreseeable actions.

**Exhibit 7-2
Study Areas for Cumulative Effects**

Resource	Study Area
Transportation	Regional Effects – four-county area (King, Snohomish, Pierce, Kitsap) Local Effects – Seattle Center City
Visual Quality	Viewshed of the proposed project
Noise	Seattle Center City with focus on the waterfront area
Land Use	Interstate 5 (I-5) to the east and Elliott Bay to the west; S. Atlantic Street to the south and Valley Street to the north
Social	Seattle Center City with focus on the waterfront area
Historic and Archaeological	The project Area of Potential Affect (APE) as shown in Chapter 5
Public Services and Utilities	Seattle Center City with focus on the waterfront area
Economics	Regional effects – Puget Sound region and state Local effects – Seattle Center City with focus on the waterfront area
Air Quality	Regional effects – four-county area (King, Snohomish, Pierce, Kitsap) Local effects – Seattle Center City
Wildlife, Fish, and Vegetation	Upland habitat in the vicinity of the proposed improvements, nearby shorelines and open water habitats of Elliott Bay and Lake Union
Water Quality	Elliott Bay, Lake Union, central Puget Sound, and associated surface water draining to these water bodies
Earth and Groundwater	Seattle Center City with focus on the waterfront area
Energy	Washington State

The timeframe for the cumulative effects assessment for each resource begins when past actions began to change the status of the resource from its original condition, setting the long-term trend currently evident and likely to continue into the reasonably foreseeable future. For all resources, the timeframe begins in the mid-19th century,

What are cumulative effects?

Cumulative effects are defined as: “The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.” (40 CFR 1508.7)

1 WSDOT 2010.

2 FHWA 1987.

3 WSDOT et al. 2008.

when the central Puget Sound region began to be altered by non-indigenous settlers, and ends in 2030, the project design year.

WSDOT characterized the baseline (present) condition of each resource by describing its current status and providing historical context for understanding how the resource got to its current state⁴ (see Exhibit 7-1, Step 3). WSDOT used information from field surveys, interviews, and literature searches to assess the current condition of the resource.

Chapter 4 of this Final EIS, the chapter describing the current conditions, presents information on the baseline condition of each resource addressed in the cumulative effects assessments. The transportation section in Chapter 5 of this Final EIS describes how traffic would grow in the region with and without the project. Through the use of a travel demand model, traffic volumes were predicted for the year 2030 with and without the project. Future traffic was forecast for morning and evening commutes (peak hour travel), which enabled an assessment of how travel times would be affected and where congestion would occur. This section also examined how the project would affect transit facilities and service, non-motorized facilities, and parking.

To identify other present and reasonably foreseeable actions (see Exhibit 7-1, Step 5), WSDOT compiled information from local and state agencies, past environmental analyses, and comments received during the scoping process for this Final EIS.

“Reasonably foreseeable actions” were defined as actions or projects with a reasonable expectation of actually happening, as opposed to potential developments expected only on the basis of speculation. Accordingly, WSDOT applied the following criteria:⁴

- Is the proposed project included in a financially constrained plan (e.g., a capital improvement program)?

- Is it permitted or in the permit process?
- How reasonable is it to assume that the proposed project will be constructed?
- Is the action identified as high priority?

Based on these criteria, the following projects were identified as being reasonably foreseeable and were included in this cumulative effects analysis:

- Independent projects included as part of the Alaskan Way Viaduct and Seawall Replacement Program (Program) if the Bored Tunnel Alternative is built.
- Twenty-eight projects that may be built within a similar timeframe or in a nearby location, are currently under construction, or have recently been completed. These projects are listed in Exhibit 7-3.

Exhibit 7-3 summarizes the actions considered for the cumulative effects analysis. The Program is described in Chapter 2.

The Alaskan Way Viaduct Replacement Project (project) complements a number of other projects with independent utility. All of these projects are intended to improve safety and mobility along SR 99 and the Seattle central waterfront from the area south of downtown to Seattle Center. These improvements include the Moving Forward projects identified in 2007 and the improvements recommended as part of the Partnership Process. Collectively, these individual projects are referred to as the Alaskan Way Viaduct and Seawall Replacement Program (Program).

The 2004 Draft EIS and 2006 Supplemental Draft EIS did not refer to the Alaskan Way Viaduct and Seawall Replacement Program. The distinction between the project and the Program came after the Moving Forward projects were announced in 2007.

Exhibit 7-3
Current and Reasonably Foreseeable Actions Considered for Cumulative Effects

	A L T E R N A T I V E		
	Bored Tunnel	Cut-&Cover Tunnel	Elevated Structure
Independent Projects that Complement the Bored Tunnel Alternative			
Elliott Bay Seawall Project	X ²	Included in alternative	Included in alternative
Alaskan Way Surface Street Improvements	X ²	Included in alternative	Included in alternative
Alaskan Way Promenade/Public Space	X ²	Included in alternative	Included in alternative
Elliott/Western Connector	X ²	Function provided ¹	Function provided ¹
First Avenue Streetcar Evaluation	X ²	Included in alternative	Included in alternative
Transit Enhancements	X ²	Not proposed	Not proposed
Independent Projects that Complement All Build Alternatives			
S. Holgate Street to S. King Street Viaduct Replacement Project	X	X	X
Transportation Improvements to Minimize Traffic Effects During Construction	X	X	X
Seattle Planned Urban Development			
Gull Industries on First Avenue S.	X	X	X
North Parking Lot Development at Qwest Field	X	X	X
Seattle Center Master Plan (EIS) – Century 21 Master Plan	X	X	X
Bill and Melinda Gates Foundation Campus Master Plan	X	X	X
South Lake Union Redevelopment	X	X	X
U.S. Coast Guard Integrated Support Command	X	X	X
Seattle Aquarium and Waterfront Park	X	X	X
Seattle Combined Sewer System Upgrades	X	X	X
Local Roadway Improvements			
Bridging the Gap Projects	X	X	X
S. Spokane Street Viaduct Widening	X	X	X
SR 99/East Marginal Way Grade Separation	X	X	X
Mercer East Project from Dexter Avenue N. to I-5	X	X	X
Mercer Street West	X	X	X
Regional Roadway Improvements			
I-5 Reconstruction	X	X	X
SR 520 Bridge Replacement and HOV Program	X	X	X
I-405 Corridor Program	X	X	X
I-90 Two-Way Transit and HOV Operations Stages 1 and 2	X	X	X
Transit Improvements			
First Hill Streetcar	X	X	X
Sound Transit University Link Light Rail Project	X	X	X
RapidRide	X	X	X
Sound Transit North Link Light Rail	X	X	X
Sound Transit East Link Light Rail	X	X	X
Washington State Ferries Seattle Terminal Improvements	X	X	X
Transportation Network Assumptions			
HOV Definition to 3+ Throughout the Puget Sound Region	X	X	X
Sound Transit Phases 1 and 2	X	X	X

X – Evaluated as a reasonably foreseeable action.
¹ While the listed project is not part of the Program, the project alternative would provide a similar function for traffic purposes.
² These projects are included in the Alaskan Way Viaduct and Seawall Replacement Program (Program).

Appendix C, Transportation Discipline Report

Transportation information is contained in *Appendix C*.

Appendix B, Alternatives Description and Construction Methods

The projects considered in this cumulative effects analysis are described in *Appendix B*.

The 2010 Supplemental Draft EIS evaluated the short- and long-term environmental effects of the project and the cumulative effects of complementary projects included in the Program. Studying the combined effects of the project and the Program helps the public and decision-makers understand how our transportation system would function in the future when the planned improvements are completed.

This Final EIS evaluates the project build alternatives: Bored Tunnel (preferred alternative), Cut-and-Cover Tunnel, and Elevated Structure with and without tolls. The environmental effects of the independent projects that comprise the Program are examined in detail through separate environmental processes for those projects. After considering the combined effects of this project and the Program, this Final EIS then considers their effects combined with other ongoing or expected plans or projects.

4 What are the results of the cumulative effects analysis?

The rest of this chapter describes the results of WSDOT's analysis of cumulative effects. Exhibit 7-4 summarizes the cumulative effect on the resource with and without the project (the build alternatives are discussed as a whole unless otherwise noted), and the remainder of the section discusses each resource. The cumulative effects analysis discusses future conditions as follows:

- Without the project – Viaduct Closed (No Build Alternative)
- With the project – Bored Tunnel Alternative with Program, Cut-and-Cover Tunnel Alternative, and Elevated Structure Alternative, with and without tolls for all build alternatives

**Exhibit 7-4
Cumulative Effects by Resource**

Resource	Without the Project	With the Project
Land Use	No change	Does not contribute
Visual Quality	No change	Does not contribute
Transportation	Adverse	Beneficial contribution
Noise	No change	Slight beneficial contribution for tunnel alternatives Does not contribute for elevated structure
Economics	Slight adverse	Slight beneficial contribution
Social and Neighborhood Resources	Slight benefit	Slight beneficial contribution
Historic, Cultural, and Archaeological Resources	Slight adverse	Slight adverse contribution
Public Services and Utilities	Slight adverse	Does not contribute
Energy and Greenhouse Gas Emissions	No change	Does not contribute
Water Quality	Slight adverse	Beneficial contribution
Air Quality	No change	Does not contribute
Wildlife, Fish, and Vegetation	No change	Does not contribute
Earth and Groundwater	No change	May have beneficial contribution if contaminated soil or groundwater removed

Note: These cumulative effects are relative to a baseline that reflects existing conditions and trends.

The project, Program, and other plans and projects would not contribute to a cumulative effect for public services, utilities, energy, greenhouse gas emissions air quality, wildlife, and fish and vegetation. For these resources, there are direct effects as indicated in Chapter 5. However, the project will not contribute to a cumulative effect as explained below.

Public Services and Utilities

All of the build alternatives would modify the transportation network in and around downtown including having direct effects on public services and utilities. However, the project would not contribute to cumulative effects on public services beyond the numerous minor traffic revisions that public service providers normally have to accommodate. Existing utilities may be impacted during construction; however, these would be rerouted and upgraded, resulting in a neutral cumulative effect. Operation of the build alternatives would not impact future utility projects.

Energy and Greenhouse Gas Emissions

Modeling shows that greenhouse gas emissions, through the consumption of fuel by vehicles on the roadway, would be less with the project than without it. The energy used for operating the tunnel and energy demands of other projects would not be significant in the regional context, and overall there would be no contribution to a cumulative effect on energy use or greenhouse gas emissions.

Air Quality

The project is not expected to result in or exacerbate a violation of air quality standards. The project, Program, and all transportation improvements considered in the cumulative effects analysis are part of the conforming Metropolitan Transportation Plan maintained by PSRC and are not expected to contribute to an adverse cumulative effect on air quality.

Wildlife, Fish, and Vegetation

The project is not expected to have adverse effects on wildlife, fish, and vegetation, and it will improve water quality. Therefore, it would not contribute to cumulative effects. Other elements of the Program,⁵ such as the Elliott Bay Seawall Project, would likely have long-term beneficial effects on habitat, although some short-term adverse effects are likely during construction. The Washington State Ferries Seattle Terminal Improvements have not been defined but are not expected to result in new long term adverse effects.

5 What is the cumulative effect on the built environment?

The existing built environment was established early in Seattle's history. The central waterfront played a key role in the development of Seattle as the historic gateway from the water to the city. The Mosquito Fleet was the primary transport around Puget Sound from the 1850s to the 1930s and was replaced by the modern ferry system; cargo vessels have been an important part of the city's long-time function as a major West Coast port. Seattle also became part of a north-south route for railroads and later vehicle traffic.

⁵ Note that replacement of the seawall is an element of the Cut-and-Cover Tunnel and Elevated Structure Alternatives and a Program element under the Bored Tunnel Alternative, as it has separate utility.

With development came significant topographic changes, including earth-moving projects like the Denny Regrade and the filling of Elliott Bay tidelands. Drawing on the historic trends briefly described above, as well as in Chapter 4 of this Final EIS, this section describes the cumulative effect on the built environment without and with the project.

There are differences in direct effects whether the project is tolled or not as indicated in Chapter 5. However, these differences are not significant enough to change the project contribution to cumulative effects for the following resources: Visual Quality, Economics, Social and Neighborhood Resources, and Historic, Cultural, and Archaeological Resources.

LAND USE

Historic Trend

Large earth-moving projects over the past 100 years and development of multiple modes of transportation infrastructure have shaped the land use patterns in the Seattle area. Many of the land use patterns that were established by 1900 are still in effect today, with commercial, industrial, and port development in the south project area; retail businesses, hotels, and office space in the downtown core; and retail businesses, hotels, and residential uses in the Belltown and north project area.

6 What cumulative effects are anticipated?

There is a new emphasis on increasing livability in Seattle by bringing people closer to jobs and amenities. The City has also been studying development plans for the area South of Downtown (SODO) that are intended to stimulate housing and development in the area. In the north, recent zoning changes encourage housing and job opportunities in the South Lake Union neighborhood, with residential, commercial, and manufacturing uses. The provision for commercial uses was intended in part to support biotechnology uses and biotechnology research and development laboratories.

Without the project, there would be limited opportunity to redevelop the central waterfront area. The City is currently engaged in efforts to develop a new central waterfront plan, which will be the primary guide for determining the types and areas of future land uses along the waterfront. The City can continue with redevelopment plans, although somewhat revised from current vision, under the Viaduct Closed (No Build) Alternative, which would alter land use in the area by encouraging housing and commercial development. The change in land use would be consistent with locally approved plans.

The Bored Tunnel or Cut-and-Cover Tunnel Alternative would contribute to a beneficial cumulative effect by complementing the numerous ongoing improvements in Seattle, particularly the central waterfront Alaskan Way Promenade/Public Space project.

The Elevated Structure would result in a condition similar to what exists today. While the construction of the Elevated Structure Alternative does not fit in with specific future development plans along the central waterfront (e.g., Alaskan Way Promenade), the Elevated Structure Alternative would not change existing land uses into the future. All build alternatives would connect the street grid north of Denny Way. This would support planned urban development in the South Lake Union area.

Because the Bored Tunnel, Cut-and-Cover Tunnel, or Elevated Structure Alternatives would replace an existing facility that is included in local and regional plans rather than expand or build new routes, they are expected to support other currently planned land uses and densities including projects planned along the central waterfront.

VISUAL QUALITY

Historic Trend

The visual character of the landscape has been dramatically transforming ever since the first Europeans settled in the area. The area was logged and cleared for farming and development; hills were moved; shoreline areas were filled; rivers were channelized; and other

activities such as mining, shoreline development, and road building all contributed to changes in the landscape. The urban character of the project area has also changed over time as the architecture of the city evolved and building materials have improved. Historic structures within the project area contribute to the visual landscape. Even though development has blocked some views of the landscape, Seattle benefits from many natural features such as Mount Rainier, Puget Sound, and the Olympic and Cascade Mountains, which are so dominant that they can still be seen from many viewpoints.

7 What cumulative effects are anticipated?

There would be no immediate major changes in the visual character along the waterfront if the project is not built. Once the viaduct is closed the urban landscape will continue to be the dominant feature. In addition, once the viaduct is closed, dramatic views from the viaduct would be lost. Other development would continue to occur and continue the trend of slowly altering the visual landscape of the urban environment over time. While individual visual features may change, the general visual setting would remain urban.

The Bored Tunnel and Cut-and-Cover Tunnel Alternatives would change the visual features in the waterfront area, which would largely be due to removing the existing viaduct (a dominant visual feature in the urban landscape). Viaduct removal would open up views and allow projects such as the Alaskan Way Surface Street Improvements and Alaskan Way Promenade/Public Space to occur, resulting in more green space and improvements to pedestrian facilities that would improve the aesthetics of the urban environment. There still will be some visual obstruction by the elevated portion of the Cut-and-Cover Tunnel Alternative between the north portal and Aloha Street. The visual effects of these projects in combination with the Washington State Ferries Seattle Terminal Improvements and other future projects will be the continuation of the urban visual character in this area. Visual conditions in the north project area from near Aurora Avenue to about Harrison Street will also be slightly modified by planned development and changes to Aurora Avenue as it is

Appendix G, Land Use Discipline Report

Land uses and densities are described in *Appendix G*.

Appendix D, Visual Quality Discipline Report and Appendix E, Visual Simulations

A description of visual quality and visual simulations are provided in *Appendices D* and *E*.

converted to a roadway with fewer lanes, less traffic, and at-grade signalized intersections, which would result in reduced SR 99 traffic.

The Elevated Structure Alternative would be wider than the existing viaduct and would, therefore, be a more dominant visual element of the central waterfront urban landscape. It would reduce opportunities for opening views and providing green spaces, and thus would reduce the opportunity to improve the aesthetics in the waterfront area. However, this alternative would not result in a change to the urban character of the study area.

None of the build alternatives would contribute to an adverse cumulative effect on overall visual quality. The view with the elevated structure would be similar to the current view but different from the view with the two tunnel alternatives. Similar to the discussion of visual quality without the project, none of the alternatives would contribute to a change in the visual conditions of an urban setting.

TRANSPORTATION

Historic Trend

Transportation has had a significant role in the development of the downtown area, including marine vessels, surface streets, railroads, and highways. Neighborhoods and districts have changed little since the early 1900s when the street grid was established and pattern of development set in place.⁶ Growth and development in Seattle and the Puget Sound region have resulted in increased traffic volumes and congestion for many decades. SR 99, which includes the Alaskan Way Viaduct, is a significant north-south route through the Seattle downtown and was built to provide a bypass through downtown.

8 What cumulative effects are anticipated?

Viaduct closure would cause a large number of trips to redistribute. This would accelerate the trend of increased roadway and intersection congestion at a faster rate than if the viaduct functions were replaced. Even with other

planned transportation improvements, the increased congestion would discourage vehicle travel through downtown, causing longer travel trips to avoid the downtown area. Key north south routes, including I-5 and possibly I-405, would experience higher traffic volumes due to the loss of SR 99, and travel times would increase while travel speeds would decrease. This would adversely affect public transit travel times and the reliability of bus operations, as well as cause delay for heavy trucks involved in freight movement.

Certain intersections would experience heavy queuing and long backups:

- **South end** – along First Avenue S. at S. Atlantic Street and S. Royal Brougham Way
- **Downtown area** – most intersections on First Avenue between S. King Street and Madison Street, and at intersections along Second and Fourth Avenues
- **North end** – Battery, Broad, and Wall Streets in Belltown

Other planned transportation improvements, including rail projects, would help to decrease congestion to some extent, but the large contribution of traffic to the downtown street network from loss of the viaduct would contribute to an adverse effect.

Replacing the Alaskan Way Viaduct is part of the Puget Sound Regional Council's (PSRC) adopted Regional Transportation Plan and a key link in maintaining regional mobility and transportation infrastructure. The Bored Tunnel, Cut-and-Cover Tunnel, or Elevated Structure Alternatives with or without tolls, combined with other planned transportation improvements, will continue to facilitate the safe and efficient movement of passenger vehicles, transit, and freight to and through downtown Seattle. However, the tolled build alternatives would result in diversion onto city streets and I-5 that would affect passenger vehicles, transit, and freight going to and through downtown Seattle.

The number of parking spaces would be reduced under all of the build alternatives relative to the Viaduct Closed (No Build Alternative). Generally, the Cut-and-Cover Tunnel Alternative and Elevated Structure Alternative would result in loss of greater numbers of parking spaces than the Bored Tunnel Alternative. This continues a trend of limiting parking opportunities in the downtown area to encourage use of public transportation and thereby reducing vehicle traffic.

The build alternatives would contribute to a beneficial cumulative effect for neighborhoods located north and south of downtown (such as Ballard, Fremont, Greenwood, West Seattle, White Center, and Georgetown) that use SR 99 as an alternative route to access downtown and other parts of Seattle from the various transportation and transit improvements that are expected, such as the new public transit RapidRide projects. These improvements would make access easier and more desirable for individuals from surrounding neighborhoods.

NOISE

Historic Trend

Cities tend to be noisy places. Seattle has steadily developed as an urban center, with commercial, industrial, and port development in the south project area; retail businesses, hotels, and office space in the downtown core; and retail businesses, hotels, and residential buildings in Belltown and the north project area. Historically, noise would have come from construction activity, and transportation noises would have been associated with whistles on trains and ships and wheels on cobblestone streets. Today, traffic, especially along the central waterfront, is the main noise source; in many areas, the noise levels are high enough to interfere with outdoor activities.

9 What cumulative effects are anticipated?

Under the Viaduct Closed (No Build Alternative), traffic noise from the viaduct would decrease when the facility is closed. Along Alaskan Way, traffic would increase once the

Appendix C, Transportation Discipline Report

Transportation effects are discussed in *Appendix C*.

Appendix F, Noise Discipline Report

Noise effects are discussed in *Appendix F*.

⁶ See Question 5 of this chapter; *Appendix G, Land Use Discipline Report*; and *Appendix I, Historic, Cultural, and Archaeological Resource Discipline Report*.

viaduct is closed and hence noise levels near the surface street would increase.

The Elevated Structure Alternative would maintain the current noise levels produced from the viaduct and continue to be the dominant source of traffic noise in the waterfront area. Noise reducing design features of the Elevated Structure Alternative would improve noise levels as might the introduction of quieter vehicles like all electric cars.

With the Bored Tunnel or Cut-and-Cover Tunnel Alternatives, the levels of traffic noise near the south area, including the area near the south portal, would be similar to conditions without the project. However, along the central waterfront and north of Denny Way to Harrison Street (including the area around the north portal), traffic noise levels would be greatly reduced compared to the Viaduct Closed (No Build Alternative). These build alternatives would contribute to a slight beneficial cumulative effect on noise levels; however, general sound levels would remain high and would continue to increase over time as additional development occurs. With or without tolls, traffic noise will continue to approach or exceed FHWA's noise abatement criteria in the study area due to increased traffic.

ECONOMICS

Historic Trend

The economy of the Puget Sound region has fluctuated greatly because of the strong dependence on natural resource-based industries such as logging, fishing, and agriculture and, more recently (in the second half of the 20th century), aerospace. With the growth of high-technology industries, tourism, clean technology, medical care, and other trade and service-sector businesses, the economy has become more diversified and the fluctuations are less severe. However, the region's continued prosperity is challenged by the increasingly competitive global economy. Washington depends on foreign trade more than any other state, and the Puget Sound region is vital to this trade, with companies such as

Boeing, Costco, Microsoft, Amazon.com, Paccar, Starbucks, and Weyerhaeuser based in the region.

10 What cumulative effects are anticipated?

In the short term, there would be no changes to the existing conditions for the Viaduct Closed (No Build Alternative) because the viaduct would remain open; however, once the viaduct was closed, the movement of vehicles and goods would be adversely affected by the increased congestion and delays on the downtown street network. The ability of the street network to support existing and future development is one factor in keeping existing businesses and attracting new businesses to the area. This may have a slight negative effect on the economy. By maintaining local and regional mobility along the SR 99 corridor, the Bored Tunnel, Cut-and-Cover Tunnel, or Elevated Structure Alternatives would help businesses that depend on the efficient movements of goods and freight and would support a core part of the local economy.

It is very difficult to predict economic impacts due to the many external factors, such as worldwide economic conditions and local economy fluctuations. However, on Seattle's central waterfront, the Bored Tunnel or Cut-and-Cover Tunnel Alternatives could help facilitate more pedestrian and tourist activity for the waterfront businesses that rely on this traffic. Viaduct removal, implementation of the central waterfront plan, and improvements to the Seattle Ferry Terminal and Alaskan Way Promenade would cumulatively provide economic benefits in the form of increased investment, revitalization, and development opportunities. This could stimulate more economic activity, allow opportunities for new or expanded business and employment, and generate more tax revenues.

SOCIAL AND NEIGHBORHOOD RESOURCES

Historic Trend

Social conditions in the project area have changed over time due to the development and redevelopment of the downtown core and surrounding neighborhoods and due

to major events such as the Great Seattle Fire of 1889, which destroyed the downtown area.

As the population grew, social services and community facilities, including parks and recreational spaces, also increased to serve the growing population. Seattle's population includes minorities and low-income persons. Historically, many of these populations have been in the Pioneer Square area. A variety of community facilities and social services are now provided by the City, as well as numerous private and nonprofit organizations.

11 What cumulative effects are anticipated?

In the short term, there would be no contribution to cumulative effects on social or neighborhood resources for the Viaduct Closed (No Build Alternative).

The Elevated Structure Alternative would not contribute to any cumulative effects on social or neighborhood resources; although the alternative would provide a minimal beneficial contribution to improvements in recreational, park and open spaces.

The Bored Tunnel and Cut-and-Cover Tunnel Alternatives, combined with other transportation and urban development projects, are expected to contribute to a beneficial cumulative effect on social resources in downtown Seattle neighborhoods. Viaduct removal and redevelopment of the central waterfront area would invigorate community life and strengthen neighborhood identity by accommodating plans for businesses and residential development, including low- and moderate-income housing. This would enhance and diversify community life, provide improved opportunities for people to live closer to their work, and sustain economic growth. These alternatives contribute to the beneficial cumulative effect of the planned projects in the study area on recreational, park, and open spaces enabling other projects to move forward as planned.

Enhanced transit and extension of the City's streetcar network along First Avenue and S. Jackson Street would substantially improve downtown access to affordable,

Appendix L, Economics Discipline Report

A discussion of economic effects is provided in *Appendix L*.

Appendix H, Social Discipline Report

Neighborhoods, community, social services, and environmental justice are discussed in *Appendix H*.

convenient, and reliable transportation, which would be especially beneficial to low-income and transit-dependent populations in the downtown area.

HISTORIC, CULTURAL, AND ARCHAEOLOGICAL RESOURCES

Historic Trend

The central Puget Sound area has a long history of occupation by indigenous peoples and was settled by European-Americans in 1851. Development of a city began shortly after settlement, including exporting natural resources such as coal and timber. Originally, marine vessels were the primary mode of transportation of goods and people through the region, but these were supplanted almost entirely by roads, railroads, airplanes, and eventually freeways.

The Great Fire of 1889 destroyed a large portion of the city and led to significant redevelopment and expansion of the commercial district; most of this area is now the Pioneer Square Historic District. Aurora Avenue (SR 99) opened to traffic in 1933, and the Battery Street Tunnel opened in the 1950s to connect with the new Alaskan Way Viaduct.

Land development efforts in Seattle involved extensive modification to the landscape, including filling wetlands and nearshore areas (e.g., seawall development in the central waterfront area and creation of the industrial area at the mouth of the Duwamish River) as well as removing hilltops (e.g., Denny Hill Regrade) and digging canals (e.g., Lake Washington Ship Canal).

12 What cumulative effects are anticipated?

The occasional loss of historic sites is likely to continue with or without the project. However, since the 1960s and even more so today, there are increased regulatory protections and awareness of the value of historic structures, which have slowed the pace of loss and spurred the development of reasonable alternative and mitigation options. We note that the Alaskan Way Viaduct and Battery Street Tunnel are eligible for listing on the National

Register for Historic Places, and that under the Viaduct Closed (No Build Alternative) the Alaskan Way Viaduct would no longer be in use and its future uncertain while the Battery Street Tunnel would likely be retrofitted and remain in use.

With all of the build alternatives, the incremental loss of historic and culturally important resources would continue, as it would under the Viaduct Closed (No Build Alternative). As cited in Chapter 4, the existing Alaskan Way Viaduct would be removed for any of the build alternatives. Construction of the build alternatives as well as other reasonably foreseeable actions such as other transportation and land development projects would potentially adversely affect several other buildings and have the potential to disturb archaeological resources, which occurs only with the project. Overall, the build alternatives would contribute to the trend of the gradual loss or disturbance to historic or archaeology resources over time and thus contribute to the negative cumulative effect.

13 What is the cumulative effect on the natural environment?

In general, the natural environment within the study area has been dramatically altered by the past 100 years of urbanization. As discussed in Question 5, this includes significant topographic changes with projects like the Denny Regrade and the filling of Elliott Bay tidelands. Also of significance is the channelization of the Duwamish and other rivers in the area, as well as the use of waterways for municipal discharges and stormwater runoff. This section describes the cumulative effect on the natural environment without and with the project.

WATER QUALITY

Historic Trend

From 1850 through the 1950s, water bodies such as Elliott Bay, Puget Sound, and the Duwamish River provided convenient locations for discharging municipal sewage, stormwater runoff, and other industrial wastes. Logging and land clearing resulted in sedimentation in streams,

lakes, and marine water bodies. Pesticides and fertilizers used on landscaped areas and contaminated runoff from impervious surfaces made their way into surface water via stormwater runoff.

These past and ongoing actions have resulted in poor water quality in the project area. Elliott Bay, the Duwamish River, and Lake Union all have water quality problems. Current regulations target point discharge sources, and new development or redevelopment is required to control and treat stormwater runoff. However, water quality problems persist, particularly temperature and bacterial contamination.

14 What cumulative effects are anticipated?

The long-term trend is the slow improvement in water quality resulting from regulatory requirements for treating discharges to water. As redevelopment occurs, requirements are triggered and updated methods of treating and managing discharges are implemented. The reasonably foreseeable future without the project includes several road improvements and other projects that will help improve water quality, reduce pollution, and retrofit older stormwater systems. In addition, the region has invested in public education and pollution prevention programs that will help to keep contaminants from reaching the waters.

The project will provide a slight benefit through the measures designed to treat stormwater and control surface water flow. The project and other reasonably foreseeable actions would improve water quality in Elliott Bay and Lake Union by providing currently untreated stormwater discharges with basic water quality treatment. These measures would include detention facilities and reduced pollutant-generating impervious surfaces, with the potential benefits of reduced peak flows, lower frequency of combined sewer overflows, and removal of contaminated sediments that may be leaching pollutants into Elliott Bay. The project will have a minor beneficial contribution to the cumulative effects on water quality.

Appendix I, Historic, Cultural, and Archaeological Resources Discipline Report

A discussion of affected historic resources is provided in *Appendix I*.

Appendix O, Surface Water Discipline Report

A discussion of effects to water quality is provided in *Appendix O*.

EARTH AND GROUNDWATER

Historic Trend

The significant land alterations and long term development, especially industrial uses, in the project area has affected the earth and groundwater in the study area through removal, filling, and contamination.

15 What cumulative effects are anticipated?

Under the Viaduct Closed (No Build Alternative), there would be no effects to soil or groundwater including the lost opportunity to remove contaminated soils and/or groundwater. Under all the build alternatives, soil improvements and other protective measures included in the project would prevent impacts on earth resources, which are primarily limited to construction (direct) effects. Operation of either tunnel alternative could alter groundwater flow including causing mounding, which could raise the water table. If this occurs, it is more likely to affect buildings and utilities in the southern portion of the tunnel including in the Pioneer Square Historic District. Replacement of the seawall either as part of this project⁷ or as a separate project also has the potential to affect groundwater flow including raising the water table. Current modeling capabilities cannot predict where the water table will rise so this will be closely monitored. The Elevated Structure Alternative could require removal of contaminated soil and/or groundwater although to a lesser extent than either tunnel alternative.

Construction of the reasonably foreseeable projects in the study area will likely lead to reduced soil and groundwater contamination because these are removed and treated off site when encountered, leading to a beneficial cumulative effect. There is sufficient capacity in regional landfills and there are improved treatment options for contaminated soil and groundwater to meet development needs.

CLIMATE CHANGE

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

WSDOT acknowledges that effects of climate change may alter the function, sizing, and operations of our facilities. Therefore, in addition to mitigating greenhouse gas emissions, WSDOT must also ensure that its transportation facilities can adapt to the changing climate. To ensure that WSDOT 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.

Climate projections for the Pacific Northwest are available from the Climate Impacts Group at the University of Washington.⁸ The climate projections indicate that Washington State is likely to experience some or all of the following effects over the next 50 to 100 years:

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

WSDOT is working with other state agencies to develop the state's integrated climate response strategy. The strategy is under development at the time of this writing, it will be delivered to the state legislature in December 2011. As part of this work, Washington state agencies are looking at the complex interplay between these climate variables and our communities. For example, rising sea levels can inundate the transportation infrastructure; ports and their associated facilities; drinking water, wastewater, and stormwater facilities; housing; and businesses. Inundation from rising sea levels and heavy surface flows from storms

will challenge the capacity of storm drains, natural conveyances (creeks and rivers), and wastewater treatment facilities.⁹ Recommendations contained in this strategy will include consideration of future climate conditions in state-funded capital projects to improve resilience.

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 current projected median change in Puget Sound sea level is 13 inches by 2100 (with a range of 6 to 50 inches).¹⁰ Overall, recent studies appear to be converging on projected increases in the range of 2 to 4 feet.^{11, 12, 13}

With help from the Puget Sound Regional Council, WSDOT provided the project team with maps showing 2- and 4-foot rise in the project area.

The design team confirmed that the project would not be at risk from projected sea-level rise. The proposed project will be designed to withstand sea-level rise and increased storm intensities. Other forecasted climate variables such as temperature and precipitation are within the wide range of climate conditions experienced in the Seattle area. The design/build process will continue to examine project features to provide greater resilience and function with the potential effects brought on by climate change.¹⁴

MITIGATION

17 How could the cumulative effect on the resources be mitigated?

In addition to efforts to minimize effects on resources, WSDOT has proposed mitigation measures for project effects as discussed in Chapter 8. While these project-specific mitigation measures are intended to mitigate for direct and indirect effects, they also help to mitigate cumulative effects.

By using the steps in the WSDOT guidance, the analysts considered how the effects of the proposed project may combine with other effects to create a cumulative effect on

Appendix P, Earth Discipline Report

A discussion of effects to soil is provided in *Appendix P*.

7 The Cut-and-Cover Tunnel and Elevated Structure Alternatives include replacement of the seawall as part of the alternative.

8 Mote et al. 2008a.

9 Washington State Climate Change Response Strategy 2011.

10 Mote et al. 2008b.

11 Binder, personal communication March 2011.

12 Jevrejeva et al. 2010.

13 Pfeffer et al. 2008.

14 Roalkvam and Williamson, personal communication April 2011.

the resource. For the majority of the resources, they concluded that there is no contribution to an adverse cumulative impact. Per the guidance, WSDOT considers potential mitigation options where there is an adverse cumulative effect (see Exhibit 7-1, Step 8). The project has a minor contribution to the adverse cumulative effects to historic and archaeological resources that is mitigated through the Memorandum of Agreement with the State Historic Preservation Office. In addition, WSDOT notes that the City has a strong commitment to protecting its cultural heritage as do a number of groups in the region including Historic Seattle and Washington Trust for Historic Preservation, among others.