SR 99: Alaskan Way Viaduct & Seawall Replacement Program

For Project: S. Holgate Street to S. King Street Viaduct Replacement Project, MP 29.89 to MP 30.78

Design Deviations No. 1 & 2:

Horizontal Stopping Sight Distance (HSSD) and Shoulder Width Reduction.

Submitted to:
Washington State Department of Transportation
Urban Corridors Office
401 Second Avenue S, Suite 560
Seattle, WA 98104-3850

Submitted by:
PB

Prepared by:
PB

May 2009

SR 99: Alaskan Way Viaduct & Seawall Replacement Program

For Project: S. Holgate St. to S. King St. Viaduct Replacement Project

Design Deviations No. 1 & 2; Horizontal Stopping Sight Distance (HSSD) and Shoulder Width Reduction

MP 29.89 to MP 30.78

Agreement No. Y-9715

Task SB.PC-34

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

PB
999 Third Avenue, Suite 2200
Seattle, WA 98104

In association with:
Arthur G. Bendelius
BERGER/ABAM Engineers Inc.
Black & Veatch Corporation
Bolima Drafting & Design
Cosmopolitan Engineering, Group, Inc.
David Evans and Associates, Inc.
Entech Northwest, Inc.
HDR Engineering, Inc.
Jacobs Engineering Group Inc.
Mimi Sheridan, AICP
Parametrix, Inc.
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RoseWater Engineering, Inc.
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Shannon & Wilson, Inc.
So-Deep, Inc.
Taylor Associates, Inc.
Televent Farradyne, Inc.
Tetra Tech, Inc.
William P. Ott

SR 99: Alaskan Way Viaduct & Seawall Replacement Program
For Project: S. Holgate Street to S. King Street Viaduct Replacement Project, MP 29.89 to MP 30.78

Design Deviations No. 1 & 2: Horizontal Stopping Sight Distance (HSSD) and Shoulder Width Reduction near S. Holgate Curve.

XL-3237 PIN-809936D

May 2009

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

Northwest Division
Urban Corridors Office
Seattle, Washington

Mark Anderson, P.E.
Project Engineer

Deviation Recommended for Approval:

Date_____

By_____, P.E.
Susan Everett, Deputy Director – Design Engineering

Deviation Approval:

Washington State Department of Transportation

Date _____

By _____ , P.E.
Ed Barry, Assistant State Design Engineer
for UCO

Deviation Approval:

U. S. Department of Transportation
Federal Highway Administration

Date _____

By _____ , P.E.
Randy Everett, Federal Highway

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1.0 Project Overview

The Alaskan Way Viaduct & Seawall Replacement Program (AWVSRP) is located in an urban area within the City of Seattle in King County. The program limits extend along SR 99 from north of the S. Spokane Street Bridge (Milepost [MP] 29.26) to Comstock Street (MP 33.26) and along the Seawall from S. Washington Street to Broad Street.

SR 99 is functionally classified as a Principal Arterial Highway by Washington State Department of Transportation (WSDOT); and is currently classified as an M1 Managed Access highway. It is expected that the ultimate classification of the SR 99 route for this project will be changed to a Principal Arterial (P1) designation with full Limited Access. This project will be designed to P-1 roadway design guidelines (WSDOT Design Manual fig. 440-6 May 2008). The project corridor has a WSDOT freight tonnage designation of T-1 (more than 10 million tons per year), and the City of Seattle classifies it as a Major Truck Street. Within the proposed project limits, SR 99 is a designated National Highway System (NHS) route and a Highway of Statewide Significance, per WSDOT classification.

On March 14, 2007, the project team was directed by WSDOT to advance portions of the project that would contribute to improving safety and mobility, and have fundamental consensus among the project partners. One part of the project that was directed to advance was an Early Safety and Mobility Project (ESMP) called the South Holgate Street to South King Street Viaduct Replacement Project (South Project).

The removal and replacement limits for bridge structures within the South Project extend from approximately S. Holgate Street (MP 29.89) to S. Dearborn Street (MP 30.66). Other required improvements for SR 99 and city surface streets extend the project construction limits as far north as S. King Street and as far south as S. Stacy Street. The project includes demolition of the existing viaduct and reconstruction of infrastructure elements, including portions of many local streets and portions of SR 99. Near S. Holgate Street, SR 99 will transition from an at-grade roadway to a bridge structure over railroad tracks and S. Atlantic Street, returning to grade near S. Royal Brougham Way. An interim bridge structure, in place for 4 to 5 years, will be built to connect the bridge structure spanning S Atlantic Street to the Existing Viaduct near the Railroad Way Ramps (MP 30.78) while construction for the tunnel takes place.

Design Matrix 3, line 3-7 (*WSDOT Design Manual* Figure 325-5, November 2009) applies to this project. This requires that improvements be designed to full standards, except as defined under the approved corridor analysis and its addenda. The AWVSRP is partially funded through a combination of state funds from the 2003 Nickel Funding Package and the 2005 Transportation Partnership Account (TPA) Package. It has also received funding from the U.S. Federal Highway Administration (FHWA) and the City of Seattle.

Deleted: however, due to its urban setting and managed access, its current design classification is that of an Urban Managed Access Highway (see approved *SR 99 Corridor Analysis Addendum B*

Comment [W1]: I am having problems dealing with this issue. Technically this is designated as urban managed access until the new corridor report is completed and signed off.

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Deleted: The SR 99 roadway will be designed under design class IP-1 per WSDOT Design Manual Figure 440-6 (dated May 2008).

This document requests a deviation for horizontal stopping sight distance near S Holgate Street (MP 29.89) and a deviation for shoulder width from beginning of permanent work at the southern project limits (MP 29.60) to Royal Brougham Way S (MP 30.39).

2.0 Existing Conditions in Vicinity of S. Holgate Street

The average daily traffic (ADT) along the existing mainline in the vicinity of S Holgate Street is 42,500 for the northbound direction and 39,500 for the southbound direction. In this area, northbound mainline traffic operates at a Level of Service (LOS) C and southbound mainline traffic operates at a LOS D. Existing ADT truck traffic volumes are approximately 5% of the total traffic. The existing viaduct near S Holgate Street experiences low collision rates. See the *SR 99 Corridor Analysis* (October 2004) for accident information.

Topography in the vicinity of S. Holgate Street to S. King Street is mostly level terrain. The posted speed limit is 50 mph in this segment for both the northbound and southbound roadways.

Within the project limits, SR 99 existing lane widths range from 9.5 to 12 feet and shoulder widths range from 0 to 3 feet. Near S Holgate Street, the existing lane widths are 12 feet and the shoulder widths are approximately 1 foot. The existing transition between the six-lane surface highway and the viaduct occurs near S. Holgate Street. The existing curve near S. Holgate Street is built on separate elevated structures for both northbound and southbound. The northbound roadway has a radius of 920 feet, and the southbound roadway has a radius of 1040 feet, with a superelevation rate of 6% for both roadways. Using the 10% maximum superelevation rates (*WSDOT Design Manual* Figure 642-4a, November 2007) to determine a design speed based on current standards for the existing horizontal geometric elements indicates the design speed is less than 40 mph. The vertical curves in this area for both northbound and southbound roadways are 350 feet. The grade for both roadways in this area is 5 percent. Figure 650-1 from the WSDOT Design Manual (May 2008) indicates these sag curves meet 40 mph design criteria.

The Seattle International Gateway (SIG) Rail Yard lies immediately east of SR 99 and the Whatcom Rail Yard is immediately west of SR 99 in the vicinity of S. Holgate Street. In some areas the closest rail tracks are within 12 feet of the roadway.

The AWVSRP is coordinating with the SR 519 Intermodal Access Project Phase 2: Atlantic Corridor.

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Comment [W2]: Why were they comparing the old standard to something higher than what were designing to. 10% charts use more stringent standards compared to the 6% charts that we are designing to. This is misleading.

Comment [W3]: Why didn't they use figure 650-13 to account for existing conditions

Comment [LKM4]: I agree with your comments. The posted speed is 50mph, so the design speed should match that. But the roadway is being rebuilt so they aren't justifying keeping existing conditions.

3.0 Proposed Roadway Configuration in Vicinity of S. Holgate Street

The South Project will reconstruct the existing SR 99 facility along the south portion of the alignment with at-grade, retained fill, and aerial roadways. The proposed SR 99 alignment begins major roadwork to the south near S. Walker Street (MP 29.89) with a six-lane, at-grade roadway that transitions to an elevated structure near S. Holgate Street. SR 99 is carried over the railroad tracks and South Atlantic Street before returning to grade in the vicinity of S. Royal Brougham Way.

The mainline roadway lane and shoulder layout will consist of a 4-foot left shoulder, three 12-foot lanes, and a 10-foot-wide right shoulder for both the northbound and southbound roadways. The proposed southbound left shoulder will vary along the S. Holgate Curve in order to maximize the stopping sight distance (SSD) and accommodate existing site constraints.

The approved Corridor Analysis established the design speed for SR 99 as 55 mph from the southern project limit to the vicinity of the south portal, with an anticipated posted speed of 50 mph along this roadway segment (*SR 99 Corridor Analysis*, December 2004).

The design speed for this project is 55 mph from the southern project limits to the vicinity of S. Royal Brougham Way. From S. Royal Brougham Way to the northern project limits the design speed is reduced to 50 mph. The design speed associated with this document is 55 mph.

Table 1 summarizes the geometric design elements that are proposed for deviations on SR 99 in the vicinity of S. Holgate Street.

Table 1: Proposed Deviated Geometric Elements in Vicinity of S. Holgate St. Curve

Geometric Element	Standard Design	Proposed SR 99 Design
Shoulder Width (Figure 440-6) See Table 3 for station limits	10 foot (inside) 10 foot (outside)	NB: varies 1 to 22 feet (inside) varies 6 to 10 feet (outside) SB: varies 1 to 5.5 feet (inside) varies 6 to 10 feet (outside)
Stopping Sight Distance (Figure 650-2 & 3) Sta. 149+50 to 159+50	Northbound 495' Southbound 542'	Northbound 443' Southbound 465'

Comment [W5]: The channelization currently shows a 5.5 ft inside shoulder on the SB-1 bridge structure. I will look through the design manual to see why this is so but I thought it said that 4 to 8 foot shoulders created unwanted characteristics. Will talk to John F when I get the chance. Are bridges a different situation?

Comment [LKM6]: This mostly likely includes shy distance of 2'. Need to verify if the shoulder narrows to less than 4 feet anywhere.

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Comment [LKM7]: This may change.

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4.0 Deviation Description

This document requests deviations for horizontal stopping sight distance and right and left shoulder widths for both the northbound and southbound SR 99. Section 4.1 and 4.2 define the proposed roadway deviations between MP 29.60 and MP 30.39. The requested shoulder deviations are required at the southern limits of the project to match existing conditions.

4.1 Stopping Sight Distance

WSDOT Design Manual defines the required minimum stopping sight distance based on design speed and vertical grade as presented in Table 2. The project team is requesting a deviation for the horizontal stopping sight distance (HSSD) for the northbound outside (right side direction of travel) lane and southbound inside (left side in direction of travel) lane roadways between approximate stations 149+50 and 159+50, as shown on Figures 1Bn and 1C.

The project team proposes designing the northbound outside lane at this location for a HSSD of 443 ft. The line of sight will be inside the right side barrier face. The roadway cross-section through the curve from left to right, ahead on stationing, will consist of a barrier, 4-foot left shoulder, two 12-foot lanes, one 13-foot right lane, a 10-foot right shoulder and a right side barrier. The 13-foot right lane is provided in order to accommodate the turning roadway width criteria per the WSDOT Design Manual.

The project team proposes designing the southbound inside lane at this location for a HSSD of 465 ft. The line of sight will be inside the left side barrier face. The roadway cross-section through the curve consists of an inside left shoulder that varies between 4 and 21 feet, a 13-foot left lane, two 12-foot lanes, and a 10-foot right shoulder. The inside shoulder was widened from 4 feet to 22 feet to provide adequate clearance for the construction sequencing and maintenance of traffic while the project is under construction. The widened part of the shoulder also increases the HSSD through the curve to provide standard sight distance for a vehicle traveling at 50 miles per hour, which is the posted speed through the curve (the design speed of the curve is 55 mph). WSDOT's Northwest Region Traffic has created a plan to clearly delineate the widened shoulder to prevent drivers from using it as a pull-out parking location.

Table 2 summarizes the minimum stopping sight distance required and the proposed stopping sight distance near S. Holgate Street, which meets a 50 mph stopping sight distance design standard. Note that the HSSD distances being provided in the project meet a 55 mph stopping sight distance design per AASHTO standards.

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Comment [W8]: Is this already done now that the we have hatched yellow lines delineated in this area.

Table 2: Stopping Sight Distance in S. Holgate St. Curve Vicinity

Direction	Grade	Required Minimum Stopping Sight Distance for 55 mph (Design Manual Figure 650-2&3, May 2008)	Proposed Minimum Stopping Sight Distance	
Northbound	0%	495 feet	443 feet	
Southbound	-5%	542 feet	465 feet	

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4.2 Shoulder Width

A deviation for left shoulder width is proposed along this alignment between NB Sta. 141+93 and Sta. 177+64, and SB Sta. 141+95 and Sta. 177+70, as shown on Figures 1A, 1B, 1C, and 1D. A deviation for right shoulder width is proposed along this alignment between NB Sta. 143+93 to Sta. 146+92, and SB Sta. 141+94 to Sta. 149+80, as shown on Figure 1A. Table 3 lists the design standard and proposed left and right shoulder widths for the mainline curves near the beginning and ending of the project, as well as the minimum shoulder width.

Table 3: Shoulder Widths

Direction	Left Shoulder Width (feet)		Right Shoulder Width (feet)	
	Standard (Design Manual Figure 440-6, May 2008)	Proposed	Standard (Design Manual Figure 440-96, May 2008	Proposed
Northbound	10	141+93to 177+64 Varies 1 to 22	10	141+93 to 146+92 Varies 6 to 10
Southbound	10	141+95 to 177+70 Varies 1 to 5.5	10	141+94 to 149+80 Varies 6 to 10

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A deviation is necessary for both right and left shoulders at the southern project limits in order to match the existing shoulder widths at the point where this project meets the existing SR 99 route at MP 29.60. The transition from existing shoulder widths to proposed shoulder widths along both the northbound and southbound roadways generally occurs south of the Holgate curve. A left shoulder deviation is necessary throughout the project length. Lack of right of way, property rights, and economic impacts limit the amount of shoulder that can be provided on SR 99 through this area. Providing standard shoulders in this area will require full closure of

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the Whatcom Yard or significant modifications to the SIG Yard which will heavily effect BNSF and UP operations. The southbound left shoulder width varies through the Holgate curve which increases horizontal sight distance without increasing the radius of the preferred curve or traveled way width.

Alternatives Considered

The project team developed and assessed alternate alignments to best meet WSDOT design standards, minimize impacts to adjacent rail facilities, and allow for efficient staging of the construction of the project's south end. The alignment alternatives for the mainline roadway are summarized in the following sections.

4.3 Alternative 1: Preferred alternative – Nonstandard Stopping Sight Distance and Shoulder Width

Alternative 1 provides an alignment that maximizes horizontal stopping sight distance while minimizing rail and right-of-way impacts. The preferred roadway configuration is illustrated in Figures 1A, 1B, 1C, and 1D. The preferred alternative includes deviations for the stopping sight distance and shoulder width as described in the previous sections. The following justifications are provided for these deviations.

A significant negative impact on the region, particularly the industrial port area, would be sustained if the railroads were unable to continue operating at a capacity that insures their viability. Additionally, significant growth in both port and rail usage is anticipated and requires that these facilities function at an increased level of activity. The proposed design of the SR 99 roadway avoids adversely impacting rail operations. The proposed design does not require major reconfiguration of the SIG Rail Yard, and minor permanent impacts to the Whatcom Yard. The following constraints have been determined through preliminary design and discussion with the SR 99 South End Subcommittee, the Port of Seattle, the BNSF railroad and the Union Pacific Railroad:

- There is insufficient right-of-way between the Whatcom Rail Yard and SIG Rail Yard for full SR 99 mainline geometric and design guidelines to be met without impacting rail yard configuration and capacity;
- Track relocation/reconfiguration cannot be accommodated within the existing SIG Yard due to space constraints;
- Throughput of the rail yard is anticipated to increase significantly, requiring that current and future rail operations work efficiently within the constrained rail yard;
- Track length is a key consideration in the assembly and staging of trains and is essential to maintaining the efficiency and capacity of rail yard operations.

Deviating the stopping sight distance and shoulder widths avoids major reconfiguration of the SIG Rail Yard and doesn't preclude any further redevelopment of the Whatcom Yard after construction activities have taken place. The space between the Whatcom Yard and the SIG Yard has already been used to full capacity and standard left shoulder widths cannot be designed without a westward movement

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of the Whatcom Rail Yard or removing it permanently. Moving the Whatcom Rail Yard farther west would impact the existing East Marginal Way surface street at the south end of the Holgate curve and create further impacts to the United States Coast Guard property. The October 2005 CEVP 90% level cost estimate for reconfiguring the Whatcom Rail Yard was approximately $15 million. Deviating the shoulder widths at the southern project limits also allows for the transition between the overall narrower existing SR 99 roadway to the south, and the overall wider proposed roadway to the north.

Justifications

Alternative 1 (Preferred Alternative) proposes nonstandard design elements for the curve near S. Holgate Street which are:

- Minimum horizontal stopping sight distance: 443 feet in the northbound direction and 465 feet in the southbound direction, which meets the requirements for a 50 mph design speed
- Northbound shoulder width: Varies 1 foot to 22 feet (left) from NB Sta. 141+93to 177+64 , and varies 6 feet to 10 feet (right) from NB Sta. 141+93 to 146+92.
- Southbound shoulder width: Varies 1 foot to 5.5 feet (left) from SB Sta. 141+95 to 177+70, and varies 6 feet to 10 feet (right) from SB Sta. 141+94 to 149+80.

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The justifications for this recommendation are:

1. There exists insufficient right-of-way to accommodate a roadway with full standard roadway design elements, with very low probability of being able to acquire additional right-of-way due to uses of regional importance on adjoining properties;

2. Application of full standard roadway design would result in significant adverse impacts to existing rail operations, which are considered highest and best use of the property on which these operations occur, and are not easily moved to, nor are viable on, other properties in the area;

3. The proposed shoulder widths must match existing shoulder widths at the end of the project limits, which requires that a portion of the shoulder widths within the project limits be tapered down to match the non-standard shoulder widths of the existing roadway;

4. The horizontal stopping sight distances that are provided meet standards for a 50-mph design speed, which matches the posted speed limit for the facility;

Alternative 1 provides an alignment that prevents major reconfiguration of the SIG Rail Yard, and reduces amount of footprint that is reduced in the Whatcom Rail Yard.

This alignment requires that the stopping sight distance and shoulder width be deviated from design standards and designed with appropriate mitigation measures.

4.4 Alternative 2: Full Design Standards Alternative 1

Comment [W9]: I can create a third alternative depicting an alignment that impacts the SIG yard if needed.

Alternative 2 provides an alignment that meets horizontal stopping sight distance requirements for a 55 MPH design speed. As mentioned above, the shoulder widths must be deviated to match into the existing SR 99 facility at the beginning of the project. This alternative requires the removal of the Whatcom RR Yard and all associated constraints. Removal of these RR constraints would facilitate a westerly shift of SR 99 and larger radii for the northbound and southbound roadways. This alternative would also allow simpler solutions to construction staging and maintenance of traffic for the project.

This alternative does not rely on the acquisition of additional right-of-way, however, the project would have to acquire the rights to property that is currently occupied by the Union Pacific and Burlington Northern Santa Fe railroads. The cost and schedule impacts associated with acquisition of these rights are prohibitive. A formal Project Decision process to reject this alternative was conducted and documented in April, 2008 (decision documented in *AWVSR Program Trend Number SS005 for Issues Relating to Lead Railroad Track for BNSF and UPRR and the Whatcom Yard*).

5.0 Mitigation

Mitigation measures for the preferred alternative proposed alignment near S. Holgate Street could include:

- A future project may choose to install permanent Variable Message Signing (VMS) or Active Traffic Management Signing (ATMS) to provide advance warning of potential traffic backups that may extend into areas with deviated stopping sight distances.
- Raised pavement markings or other traffic control measures to keep motorists from using the shoulder. This project also includes illumination enhancements, which will provide improved visibility during night hours.

Comment [LKM10]: This is being designed right now, isn't it?

Comment [W11]: The ITS projects are constructing a sign bridge south of the project but I am not sure if it satisfies this statement for the SB direction.

6.0 Recommendation

The project team recommends that stopping sight distance near the Holgate curve (MP 29.89) and shoulder widths from MP 29.60 to 30.37 be deviated from design standards.

The project team recommends approval of these deviations based on the above justifications.

Figures 1A, 1B, & 1C: Proposed SR 99 Near S. Holgate Street

(Following Pages)

Figure 2: Full Design Standards

(Following Page)

Comment [W12]: I didn't create a drawing showing all of the full standard design elements. This could take some time but headquarters might request it.