



The Alaskan Way Viaduct
& Seawall Replacement Project

Cost Estimate Tunnel and Elevated Structure Operating and Maintenance Cost Study

Submitted to:

Washington State Department of Transportation
Urban Corridors Office
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SR 99: Alaskan Way Viaduct & Seawall Replacement Project

Cost Estimate Tunnel and Elevated Structure Operating and Maintenance Cost Study

Agreement No. Y-9715

Task AC.B.PO.M.01

The SR 99: Alaskan Way Viaduct & Seawall Replacement Project 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:

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In association with:

BERGER/ABAM Engineers Inc.

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Cosmopolitan Engineering Group, Inc.

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Parametrix, Inc.

Power Engineers, Inc.

Preston Gates & Ellis LLP

ROMA Design Group

RoseWater Engineering, Inc.

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So-Deep, Inc.

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Cost Estimate Tunnel and Elevated Structure Operating and Maintenance Cost Study

1.0 Cost Estimate

1.1 Executive Summary

This study is a collaborative effort to capture costs for Operating & Maintaining the proposed Tunnel and Elevated Structure Alternatives for the Alaskan Way Viaduct and Seawall Replacement Project.

For the Tunnel Alternative, the scope of this work includes approximately 20.13 Lane Miles (LAMI) of roadway which includes about 5.25 LAMI of Waterfront Tunnel, about 2.01 LAMI of the Battery Street Tunnel (BST), about 2.90 LAMI of bridge/aerial structure, about 3.38 LAMI of retained cut, about 3.68 LAMI of retained fill, and about 2.90 LAMI of at-grade roadway.

For the Elevated Structure Alternative, the scope of work includes approximately 21.54 Lane Miles of roadway, which includes about 5.26 LAMI of waterfront bridge/elevated structure, about 7.61 LAMI of bridge/ aerial structure, about 1.80 LAMI of the BST tunnel, about 1.40 LAMI of retained cut, about 3.95 LAMI of retained fill, and about 1.67 LAMI of at-grade roadway.

The above quantities are based on the June 30, 2005 Conceptual Design Documents for the Elevated Structure and the June 2, 2006 Conceptual Design Documents for the Tunnel Alternative.

The O&M cost data is based on WSDOT tunnel costs experienced on the I-90 project and WSDOT/SDOT expenses on the existing viaduct. Seawall cost data is based on historical information as outlined in the 'Without Project Conditions Study' by the Corps of Engineers dated March 2006. At grade roadways and bridges are also included as part of a complete O&M program.

As this is a preliminary effort to determine an order of magnitude cost, going forward, it needs to be determined who will maintain this project (City of Seattle or WSDOT). Secondly an O&M plan will have to be developed before a final estimate can be completed.

1.1 Estimate Description

1.1.1 Unit Price Estimate

These estimates are built up from unit prices based on local data. The unit prices are derived from study of WSDOT data on I-90 tunnels. The historical cost data was refined to reflect current conditions and then adapted to the Alaskan Way Viaduct and Seawall Replacement Project scope and quantities. These estimates were developed using first quarter 2006 dollars.

1.1.2 Methodology

The workforce determination is based on current staffing levels that WSDOT has for the I-90 Mt. Baker and Mercer Island Tunnels and then adapted to the AWVSRP. We have talked to WSDOT staff and managers for these tunnels and obtained their staffing levels and discussed with them projected needs for the AWV tunnels based on their experience. An integral approach was used to develop the staffing requirements in which all facilities (tunnel, roadways, and bridges) would be monitored by the same personnel. This approach streamlines the procedures and minimizes staffing redundancy. It is also assumed that the existing Battery Street Tunnel will be upgraded and brought up to current codes in both the waterfront tunnel and elevated structure scenarios. The FTE (Full Time Equivalent) employees' breakdown is as follows:

- Administration – made up of a Tunnel Supervisor, one IT person and one person for clerical staff. Their primary function is to insure continuous, safe operation of the tunnel and maintenance of the various tunnel systems for Battery Street and waterfront tunnels.
- Incident Response Workers – are field personnel who respond to roadway emergencies and are critical to the incident response emergency management plan and fire life safety plan for tunnel and project wide safety. The estimates include incident response vehicles for both scenarios at either end of the tunnels. The Tunnel Alternative estimate includes 4 FTE's (1 Lead Worker and 3 Techs). This translates to 2 people on duty during peak periods (assuming a split shift 6-10 am and 3-7 pm). The Lead Worker would be on duty mid-day weekdays. Additionally, one person would be on duty 12 hours a day on weekends only and special events during weekday evenings. The Elevated Structure Alternative estimate includes 2.5 FTE's (1 Lead Worker and 1.5 Techs). This would translate into 2 FTE's for weekdays (1 person starting early and 1 person from midday through the PM peak). One person on weekends for 10 hours a day (1/2 FTE). Primary function is to monitor the condition of the AWV corridor and implement responses to incidents in accordance with a defined procedure.

- Maintenance – The maintenance crew is divided by job function and deployed project wide. Maintenance trades include plumbers, millwrights, electricians, and roadway workers. Primary responsibility is for maintaining the various systems associated with the operation of the tunnel and the roadway prism. Additionally, assist in the setup and removal of temporary traffic control required in the case of incidents or planned tunnel maintenance.
- Operations – Staff includes one tunnel operator on duty 24/7 and a supervisor during one of the shifts. The assumption is one control center for the waterfront tunnels, BST tunnel, and roadway prism. Independent control centers will cause the estimate to change, unless the control centers are redundant, providing full control for all the systems for each tunnel. Operation’s primary responsibility is to monitor the various systems related to the operation of the tunnels and roadway prism, to acknowledge alarms or incidents detected or reported and to implement appropriate responses.

1.1.3 Labor

Labor rates used were City of Seattle 2006 Salary Schedule. If the position wasn’t an exact fit, a position closely related in function and skill set was used. Typical WSDOT wage rates were compared and were found to be in line with City of Seattle wage rates. In estimating the total number of personnel required to perform the necessary services it is assumed that certain workers will actually be on the job fewer hours than their shift therefore their duties must be covered during their off time. Examples of such activities are the tunnel operators and IRT workers. Since the duties of these personnel must be covered 24 hours per day, 7 days per week. A possible FTE breakdown is as follows: WSDOT typically uses 1800 hr/yr after factoring for time off, holidays, etc for FTE’s. Additionally we can deduct 80 hr/yr for meetings, training, etc and use 1720 hr/yr. Therefore, for a 24/7 FTE, we used 8760 hr/yr /1720 hr/yr for a FTE of 5.1.

1.1.4 Equipment and Materials

The equipment and material costs used were based on actual WSDOT equipment and materials that were repaired/ replaced or are being repaired/ replaced for the I-90 tunnels over an approximately 20 year period. These costs were then factored to current 2006 dollars and annualized. As an Operations & Maintenance Plan is developed and the design is better defined material and equipment costs will be estimated in detail reflecting actual requirements. Vehicle costs were based on discussions with WSDOT staff. Both estimates have an average of 5 pieces of equipment with life spans ranging from 7 to 14 years, which were annualized for a yearly unit cost.

1.1.5 Seawall

The Seawall estimate is based on major maintenance history of the City as outlined in the “Without Project Conditions Study” by the Corps of Engineers dated March 2006. Historically the City of Seattle’s approach to O&M has been to monitor and maintain the seawall as necessary to assure life safety and preserve a viable corridor. This approach has been referred to as “patch as fail”. In order to develop conceptual O&M costs for this study the historical information was factored to consider that a new structure would not require maintenance for a number of years. However since the design and scope of the wall is currently very preliminary costs contained herein must be interpreted as allowances based on historical information rather than project specific costs.

1.1.6 Utilities

Utilities costs are based on actual WSDOT cost for the I-90 tunnels. Rates will be similar for these tunnels since we are dealing with the same utilities. For Telephone/Communication and for Water/Other, we used the actual yearly costs for the I-90 tunnels for these estimates. The systems and requirements should be similar. However, electrical costs have been prorated based on a linear foot of tunnel. This was done because most of the electrical power is used for roadway lighting and ventilation systems within the tunnel. This figure was then increased some for roadway lighting and sign lighting within the project but outside the tunnel.

For the water quality maintenance requirement, it was assumed that each tunnel will have vaults for detaining fire flow water (2 for BST and 4 for the waterfront tunnels). These will not collect rain water inside the tunnel and will only need heavy maintenance in the event of a fire. Additionally, in the current design there are to be 5 outfalls into Elliott Bay. However, it is assumed that these outfalls will not be part of SR99 and are therefore not included in this estimate. Storm-water requirements for the elevated structure and at-grade work are included on a historical unit cost basis.

1.1.7 Mitigation

Mitigation costs were not included in this study.

1.1.8 Contract Add-Ons

There are no additional indirect costs included in this estimate. Costs are for a typical year in today’s dollars. Future costs will have to account for escalation.

1.1.9 Implementation

Implementation items are not included in this study.

1.1.10 Right-of-Way

Right-of-way acquisition costs do not apply to this study.

1.1.11 Design Allowance

A Design Allowance or contingency is included to allow for changes between the current conceptual design and final design of the AWVSPR Project particularly with regards to systems costs.

1.1.12 Statement of Probable Cost

The Alaskan Way Viaduct and Seawall Replacement Project Team have no control over the actual costs labor and materials used. This opinion of probable cost is made on the basis of experience, qualifications, and best judgment of cost consultants familiar with the construction industry.

A staff of professional cost consultants has prepared this estimate in accordance with generally accepted principals and practice. This staff is available to discuss its contents with any interested party

Appendix A

Key Cost Estimate Assumptions

Key Cost Estimate Assumptions

- Battery Street Tunnel costs reflect upgrading systems, structure, finishes, etc. to a similar level as I-90 complying with the latest codes for all alternatives.
- One operations control center.
- Non-tunnel segment costs are included (at-grade, bridge, retained cut or fill)
- FTE's are based on information provided by the AWVSRP Team and WSDOT staff.
- All costs are typically for 1 year.
- Labor rates used were based on information obtained from the 2006 City of Seattle Salary Schedule. WSDOT rates were also checked and found to be comparable to City of Seattle rates for most trades.
- Quantities used were based on the 6-30-05 concept drawings for the elevated structure and 06-05-06 for the tunnel.
- There is a design contingency included as design is still at the conceptual level.
- There are no escalation costs included.

Appendix B

Cost Estimate – Back-up

**TUNNELS
O&M CONCEPTUAL ESTIMATE**

Project name	Tunnel O&M AWVSRP
Job size	1 Year
Duration	1 Year
Notes	<p>This is a preliminary estimate for Operations and Maintenance Costs for the AWVSRP Project. Please note the following items:</p> <ol style="list-style-type: none">1. Seawall costs are based on SDOT information contained in the "Without Project Conditions Study" dated 3-06.2. Full Time Equivalent (FTE) costs for staffing include BST & Waterfront Tunnels as well as bridges, retained cut or fill, and at-grade sections.3. Non-tunnel segment costs for at-grade, bridge, retained cut or fill are included for complete project O&M costs.4. FTE's are based on information provided by the AWVSRP Team.5. All costs are typically for 1 Year.6. Labor rates used were based on information obtained from 2006 City of Seattle Salary Schedule.7. Costs are currently in \$2006.8. See narrative for additional information.
Report format	Sorted by 'Work Type' 'Detail' summary

Work Type	Phase	Description	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Total Cost/Unit	Total Amount	Notes
Administration										
	01300.001	Tunnel Supervisor (1 Full Time Equivalent)	12.00 MO	95,904	-	-	-	7,992.00 /MO	95,904	
	01300.001	IT/ Programmer (1FTE)	12.00 MO	62,616	-	-	-	5,218.00 /MO	62,616	
	01300.001	Clerk/ Document Control (1 FTE)	12.00 MO	36,348	-	-	-	3,029.00 /MO	36,348	
		Administration		194,868					194,868	
Incident Response										
	01300.001	Incident Response Team Lead (1 FTE)	12.00 MO	85,008	-	-	-	7,084.00 /MO	85,008	
	01300.001	Incident Response Team Tech (3 FTE)	36.00 MO	185,868	-	-	-	5,163.00 /MO	185,868	This is for 1 day FTE, 1.5 swing shift FTE, and 0.5 weekend.
		Incident Response		270,876					270,876	
Maintenance										
	01300.001	Tunnel Trades Lead (1 FTE)	12.00 MO	61,368	-	-	-	5,114.00 /MO	61,368	
	01300.001	Tunnel Trades Tech (Plumber) (2 FTE)	24.00 MO	116,544	-	-	-	4,856.00 /MO	116,544	
	01300.001	Tunnel Trade (Millwright) (2 FTE)	24.00 MO	113,784	-	-	-	4,741.00 /MO	113,784	
	01300.001	Tunnel Roads Lead (1 FTE)	12.00 MO	61,464	-	-	-	5,122.00 /MO	61,464	
	01300.001	Tunnel Maintenance Tech (3 FTE)	36.00 MO	164,664	-	-	-	4,574.00 /MO	164,664	
	01300.001	Tunnel Systems Lead (1 FTE)	12.00 MO	67,020	-	-	-	5,585.00 /MO	67,020	
	01300.001	Tunnel Systems Specialist (7 FTE)	84.00 MO	350,784	-	-	-	4,176.00 /MO	350,784	
	01300.001	Tunnel Trade (Helper) (2 FTE)	24.00 MO	100,224	-	-	-	4,176.00 /MO	100,224	
	01300.001	Tunnel Systems Specialist (Helper) (2 FTE)	24.00 MO	100,224	-	-	-	4,176.00 /MO	100,224	
		Maintenance		1,136,076					1,136,076	
Operations										
	01300.001	Tunnel Operations Lead (1 FTE)	12.00 MO	56,448	-	-	-	4,704.00 /MO	56,448	
	01300.001	Tunnel Operators (24/7) (5.1 FTE)	61.20 MO	251,654	-	-	-	4,112.00 /MO	251,654	
		Operations		308,102					308,102	
Project-wide Items										
	01830.000	Roadway - Landscape (allowance)	7.03 ACRE	-	-	98,420	-	14,000.00 /ACRE	98,420	Allowance based on 20 ft. segment for at-grade section only.
	01830.000	Stormwater Detention System Battery Street Tunnel, per Vault	2.00 EA	-	-	100,000	-	50,000.00 /EA	100,000	Outfalls into Elliot Bay by Others.
	01830.000	Stormwater Detention System Waterfront Tunnel, per Vault	4.00 EA	-	-	200,000	-	50,000.00 /EA	200,000	Outfalls into Elliot Bay by Others.
	01830.000	Roadway - Repaving, Sweeping, CB Cleaning, Etc.	25.13 LAMI	-	-	213,605	-	8,500.00 /LAMI	213,605	Quantity is inclusive all new work which includes tunnel, aerial, retained cur or fill, and at-grade roads.
		Project-wide Items				612,025			612,025	
Repaired & Replaced										
	01540.601	Vehicles (allowance)	1.00 LS	-	-	40,000	-	40,000.00 /LS	40,000	
	02580.300	Rebroadcast	1.00 LS	-	-	36,167	-	36,166.80 /LS	36,167	
	02580.300	CO System	1.00 LS	-	-	11,262	-	11,262.05 /LS	11,262	
	02580.300	Master Computer VAX	1.00 LS	-	-	146,512	-	146,512.15 /LS	146,512	
	02580.300	Automatic Transfer Switches	1.00 LS	-	-	25,200	-	25,200.00 /LS	25,200	
	02580.300	PLC Replacement	1.00 LS	-	-	56,904	-	56,903.75 /LS	56,904	
	02580.300	MIL CCTV	1.00 LS	-	-	49,252	-	49,252.35 /LS	49,252	
	02580.300	Security System	1.00 LS	-	-	32,500	-	32,500.00 /LS	32,500	
	02580.300	Variable Frequency Drive Replacement	1.00 LS	-	-	31,250	-	31,250.00 /LS	31,250	
	02580.300	Tunnel Phones	1.00 LS	-	-	15,000	-	15,000.00 /LS	15,000	
	02580.300	Maintenance Management System Update	1.00 LS	-	-	784	-	784.00 /LS	784	
	02580.300	Vent Fan Control & Monitor	1.00 LS	-	-	32,500	-	32,500.00 /LS	32,500	
	02580.300	Fire Heat Detectors	1.00 LS	-	-	1,500	-	1,500.00 /LS	1,500	
	05830.000	Expansion Joint Repair (allowance)	1.00 LS	-	-	50,000	-	50,000.00 /LS	50,000	Elevated
	13930.001	Fire Protection System	1.00 LS	-	-	84,652	-	84,652.20 /LS	84,652	
		Repaired & Replaced				613,483			613,483	
Seawall										
	01830.000	Seawall - Routine Maintenance, Inspection, and Studies	1.00 LS	-	-	200,000	-	200,000.00 /LS	200,000	
	01830.000	Seawall - Cathodic Protection, Anode Replacement	1.00 LS	-	-	40,000	-	40,000.00 /LS	40,000	
	01830.000	Seawall - Rip-rap Placement	1.00 LS	-	-	125,000	-	125,000.00 /LS	125,000	Reduced to reflect tunnel segment which serves as seawall to Union St.
		Seawall				365,000			365,000	
Utilities										
	02580.000	Utilities - Power	1.00 LS	-	-	540,375	-	540,375.00 /LS	540,375	

Work Type	Phase	Description	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Total Cost/Unit	Total Amount	Notes
Utilities										
	02580.000	Utilities - Telephone\ Communications	1.00 LS	-	-	19,197	-	19,197.00 /LS	19,197	
	02580.000	Utilities - Water\ Others	1.00 LS	-	-	14,904	-	14,904.00 /LS	14,904	
		Utilities				574,476			574,476	

Estimate Totals

Description	Amount	Totals	Rate
Labor	1,909,922		
Material			
Subcontract	2,164,984		
Equipment			
Other			
	<u>4,074,906</u>	4,074,906	
		4,074,906	
Design Contingency	<u>814,981</u>		20.00 %
	814,981	4,889,887	
Total		4,889,887	

***ELEVATED STRUCTURE
O & M CONCEPTUAL ESTIMATE***

Project name	O&M AWVSRP
Job size	1 Year
Duration	1 Year
Notes	<p>This is a preliminary estimate for Operations and Maintenance Costs for the AWVSRP Project. Please note the following items:</p> <ol style="list-style-type: none">1. Seawall costs are based on SDOT information contained in the "Without Project Conditions Study" dated 3-06.2. Non-mainline segment costs are included (at-grade, bridge, retained cut or fill).3. FTE's are based on information provided by the AWVSRP Team.4. All costs are typically for 1 Year.5. Labor rates used were based on information obtained from 2006 City of Seattle Salary Schedule.6. Costs are in \$2006.7. See narrative for additional information.
Report format	Sorted by 'Work Type' 'Detail' summary

Work Type	Phase	Description	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Total Cost/Unit	Total Amount	Notes
Seawall										
	01830.000	Seawall - Routine Maintenance, Inspection, and Studies	1.00 LS	-	-	200,000	-	200,000.00 /LS	200,000	
	01830.000	Seawall - Cathodic Protection, Anode Replacement	1.00 LS	-	-	40,000	-	40,000.00 /LS	40,000	
	01830.000	Seawall - Rip-rap Placement	1.00 LS	-	-	250,000	-	250,000.00 /LS	250,000	
		Seawall				490,000			490,000	
Utilities										
	02580.000	Utilities - Power	1.00 LS	-	-	132,000	-	132,000.00 /LS	132,000	
	02580.000	Utilities - Telephone\ Communications	1.00 LS	-	-	12,798	-	12,798.00 /LS	12,798	
	02580.000	Utilities - Water\ Others	1.00 LS	-	-	1,800	-	1,800.00 /LS	1,800	
		Utilities				146,598			146,598	

Estimate Totals

Description	Amount	Totals	Rate
Labor	1,596,974		
Material			
Subcontract	1,626,819		
Equipment			
Other			
	3,223,793	3,223,793	
		3,223,793	
Design Contingency	644,759		20.000 %
Total		3,868,552	