City of Everett Edgewater Creek Bridge Replacement Type, Size, & Location Study (TS&L) Report

Prepared for:
City of Everett Public Works - Engineering
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Executive Summary

This project will replace the existing City of Everett's (City) Edgewater Creek Bridge on the Mukilteo Blvd. corridor with a new multi-span bridge.

The design team developed a list of critical project criteria with guidance from the City to steer the improvements and impacts from the project. In addition, through a public outreach program led by the City, three aesthetic options that fit the bridge functions, were proposed to the project stakeholders. Based on public input, and the project criteria, a final list of three viable bridge alternatives has been evaluated.

The three viable alternatives evaluated are:

1. Three-span pre-cast concrete girder
2. Three-span weathering steel plate girder
3. One-span weathering steel plate girder with precast concrete girder approaches

The study presented in this report leads to the conclusion that Alternative 1 best meets the selected project criteria. The total project cost of this alternative is the lowest of all alternatives at approximately $20.8M.

The team's recommendation is to advance Alternative 1 to construction documents.

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Appendices

1. INTRODUCTION

This project will replace the existing City of Everett's (City) Edgewater Creek Bridge in Mukilteo Blvd. corridor with a new multi-span bridge.

The existing Edgewater Creek Bridge was constructed in 1946 and is a vital link in a chain of three bridges that provide the only access to neighborhoods located along the Mukilteo Boulevard, an NHS route between the cities of Everett and Mukilteo. The other two bridges are Maple Heights (SID 08560500) and Merrill & Ring (SID 08560600) and both have projects proposed to deal with their existing deficiencies.

The Mukilteo Boulevard traverses deep ravines and winds along steep hillsides. It also serves over 6000 vehicles per day in its load restricted conditions. If any two of these three bridges were to fail during a seismic event there is no other access to the areas isolated by the bridge failures.

The existing Edgewater Bridge structure is a 5-span 352 feet (52':78.5':91':78.5: 52') and 37 feet wide (26' curb-to-curb) cast-in-place non-redundant two girder concrete Tee-beam bridge that is deficient in both shear and flexural capacities. The bridge is designed for an H-15 loading and is showing signs of distress under modern loads, even with its load posted status. The bridge is not only at risk seismically but is also functionally obsolete with its narrow traffic lanes and narrow sidewalks.

The physical condition of this bridge has been deteriorating in recent years which requires constant maintenance and occasional closures by the City maintenance team.

The City has been successful in securing federal grant to replace this deficient bridge.

This report describes bridge replacement alternatives that are based on considerations of budget, environmental criteria, right-of-way, mobility of traffic and other City-desired goals that are investigated as part of this Type, Size, & Location (TS&L) report.

2. TYPE, SIZE & LOCATION (TS&L) STUDY

For this TS&L study report to be prepared, many design team members in various engineering disciplines provided valuable contributions to support this effort. In the following, a summary of these engineering activities is provided while detailed reports are available in the appendices of this report.

2.1 SURVEYING

This work element is performed by our design team member 1 Alliance. Their contribution to this project was providing the topo map of the site. These maps are presented in Appendix A.

2.2 GEOTECHNICAL

This work element is performed by HWA. In the following a summary of the geotechnical engineering efforts is provided. A detailed technical memo on this topic is provided in Appendix B.

HWA's work for this project included performing a site reconnaissance, preparing and conducting a site investigation program, performing geotechnical engineering analyses, and providing recommendations for geotechnical aspects of design. Their field work included drilling six (6) machine-drilled borings in support of bridge foundation design, three (3) machine-drilled borings in support of the wing wall design, and four (4) shallow hand borings to evaluate slope conditions. Additionally, HWA conducted a series of slope reconnaissance to evaluate the stability of the slope and verify the geometry of several critical slope features.

Appropriate laboratory tests were conducted on selected soil samples to determine relevant engineering properties of the subsurface soils. A preliminary geotechnical report was produced to summarize the subsurface and ground water conditions we observed, as well as preliminary design and construction recommendations for the bridge replacement.

HWA performed a variety of geotechnical design efforts associated with the proposed improvements. These analyses included:

- Determination of appropriate foundation elements to support the proposed bridge structure.
- Evaluation of the geotechnical viability of utilizing a temporary work trestle to access the interior pier locations.
- Conducting a global slope stability analysis to evaluate the existing slope conditions and the effects that construction of the proposed bridge structure may have on the project slopes.
- Conducting a near-surface slope stability analysis on critical failure scarps to determine the effects that Construction of the bridge foundations and the temporary work trestle may have.
- Provided recommendations associated with a slope stabilization system required to stabilize the near-surface soils along the slope.

HWA is currently in the process of conducting supplementary slope explorations to determined subsurface soil and groundwater conditions at critical slope areas. The results of this exploration and associated analysis will be used to further refine the geotechnical recommendations associated with the bridge foundations and associated wing walls.

2.3 PERMITTING

This work element is performed by Perteet. In the following a summary of the preliminary permitting activities for the project is provided. Two exhibits that delineate wetlands of the project site are provided in Appendix C.

Replacement of the Edgewater Bridge utilizes both federal and local funding. Federal funding requires documentation under the National Environmental Policy Act (NEPA) administered by the Washington State Department of Transportation (WSDOT) for this project, and State Environmental Policy Act (SEPA) evaluation by the City of Everett. Local permits will also be required from the City of Everett and a Hydraulic Project Approval (HPA) will be required by the Washington Department of Fish and Wildlife (WDFW) for work to occur above, but not within, Edgewater Creek.

Under NEPA, this project is assumed to meet the classification criteria of a Documented Categorical Exclusion (DCE). Review of NEPA documentation for this action will be conducted by WSDOT Local Programs, acting on the behalf of the Federal Highway Administration (FHWA). An early-coordination meeting was held on October 21, 2019 with WSDOT, City staff, and members of the project team to preliminary consider the project context and level of NEPA documentation likely to be required. The NEPA context has been preliminarily evaluated and documentation will be produced and submitted to WSDOT post 30% design. These documents are assumed to include:

- WSDOT Categorical Exclusion (CE) Form
- Cultural Resources Assessment
- Hazmat Memo
- Environmental Justice Technical Memorandum
- ESA No-Effect Checklist
- Parks 4(f) Technical Memorandum

Issuance of SEPA and related local permitting will be conducted by the City of Everett. The City of Everett is expected to be the lead agency under SEPA and local permits issued by Everett are expected to be adopted by the City of Mukilteo. The majority of project work will occur in the City of Everett and some work within the City of Mukilteo is also required for road and utility modifications at the west end of the bridge.

Based on the project alternatives evaluated, limited and necessary impacts related to demolition and construction are expected to occur to the vegetated buffer of Edgewater Creek, which also overlaps with wetland buffers of two small wetlands Perteet identified and delineated. No in-water work within Edgewater Creek or wetlands will be permitted to occur and water quality protection and containment measures for the bridge demolition/construction will be required. Temporary impacts to Edgewater Park (a City of Everett Park) will also occur to utilize the area of the park for construction staging or other project-related functions.

Restoration for project impacts will include revegetation of the Edgewater Creek buffer and site preparation for Edgewater Park to be re-designed and constructed by the City of Everett under a separate project. See Appendix C for wetland and stream map.

2.4 COMMUNITY OUTREACH

This work element is performed by EnviroIssues. In the following a summary of the community outreach activities for the project is provided. More detailed description of the performed activities is provided in Appendix D.

EnviroIssues outreach is in a three-phase format.

During Phase 1, EnviroIssues focused on building relationships with key stakeholders, establish local avenues for project communications and develop a plan for outreach. EnviroIssues then developed initial project messaging and materials. Phase 1 outreach included interviews and briefings with key stakeholders and community organizations to gather initial feedback about the project, potential solutions, decision criteria and tradeoffs and outreach approach.

In summer 2020, the Edgewater Bridge Replacement Project launched a second phase of public engagement. We focused on updating stakeholders and introducing the project to project neighbors, including bridge design, construction phasing and expected detours. We also asked for input on three bridge aesthetic design options. Due to the COVID-19 pandemic, most engagement was digital.

Prior to this period, we engaged stakeholders directly in our first phase of outreach. During this time, we held stakeholder briefings in an effort to understand preliminary comments and concerns. We created a summary for the first phase in August 2020, which is accessible on our website. The following is a summary of our Phase 2 outreach efforts and findings.

Key Audiences

Below is a list of stakeholder groups that the City attempted to engage directly. See Appendices for a more detailed list of project area stakeholders:

- School districts, schools and parent groups.
- City of Mukilteo
- Neighborhood groups.
- Major employers.
- Paine Field/Propeller Airports.
- Community-based organizations that serve historically underrepresented communities and/or communities that speak a language other than English.
- Commuting/traveling general public, including people walking and biking.
- Near neighbors.

Because of the COVID-19 pandemic, we were not able to complete an in-person open house, as originally planned. Our team decided to create an online project update and survey site, where folks would be able to learn about the project in its entirety. Our online project update and survey site included information about the project background, detours, timeline, construction, design options and aesthetic options. We also asked for public input on aesthetic options to supplement the City's decision-making process.

Our online project update and survey site was open from Aug. 17 to Aug. 30. The site received 524 sessions (individual visits to the site), 432 users (people who came to the site) and 106 completed surveys. The majority of site visitors identified themselves as living in Boulevard Bluffs, with many others from Mukilteo and other surrounding areas, and reported using the bridge for driving to and from Mukilteo, travel for work or school, exercise on foot or bike, and crossing for errands.

Survey Results: Design Concepts and Comments
The survey portion of the online project update presented three bridge aesthetic options and asked users to provide comment on each. Below are summaries of the responses to each design:

Aesthetic One: "Concrete Barrier with Custom-Cut Metal Infill Railing Panels"

- Many users commented on the Everett sign gateway element, with more favoring it than disliking it.
- Positive responses found this design "clean," "modern," "sleek" and "blends well."
- Negative responses found this design "blocky" or "too solid."
- Some concern that the concrete barriers would be a target for graffiti.

Aesthetic Two: "Steel Traffic Barrier and Railing"

- The majority of users disliked this option compared to the other two concepts.
- Positive responses found this design "more open" and "simple."
- Negative responses found this design "boring," "industrial," "not pretty" and "too plain."
- Users who commented on the illuminated E sign did not favor its design.
- Some concern that the see-through bridge railing makes the bridge feel less safe.

Aesthetic Three: "Cast-in-Place (CIP) Concrete Traffic Barrier Railing"

- Users who commented on the lighting columns preferred these to the lighting options in the other designs.
- Positive responses found this design "retro," "classic '30s-'40s look," "cool and regal," and "vintage."

- Negative responses found this design “alien-like,” “too old-world” and “too old-fashioned.”
- Several users expressed concern about maintenance or vandalism with this design.

The survey included an option for users to provide additional comments. Themes that emerged from these responses included:

- Appreciation for the new bridge’s bike lane and wider sidewalk, and request for more physical separation between the bike and travel lanes.
- Concern with the bridge closure and questions surrounding the detour – are there opportunities for a temporary bridge during construction, or only a partial closure?
- Questions about design and maintenance costs.

Webinar
We held an interactive webinar on August 25 from 6 – 7 p.m. as an opportunity for folks to engage in real time with the project team. Project staff provided a 30-minute presentation and then facilitated a 20-minute Q&A session. Twenty-four (24) people attended the webinar.

Webinar: Themes and Requests
Comments and questions during the webinar included several themes, listed below. See Appendices for a comprehensive list of questions.

2.5 MOBILITY OF TRAFFIC

This work element is performed by GTC. In the following a summary of the Mobility of Traffic activities for the project is provided. Exhibits for travel time delays associated with the project are presented in Appendix E.

Gibson Traffic Consultants, Inc. (GTC) has provided a travel time comparison for existing and detour routes associated with the Edgewater Bridge Replacement project. Ten locations in the local area were selected based on their magnitude of trip generation/attraction and decision points where drivers will take detours during construction. These ten locations are listed below:

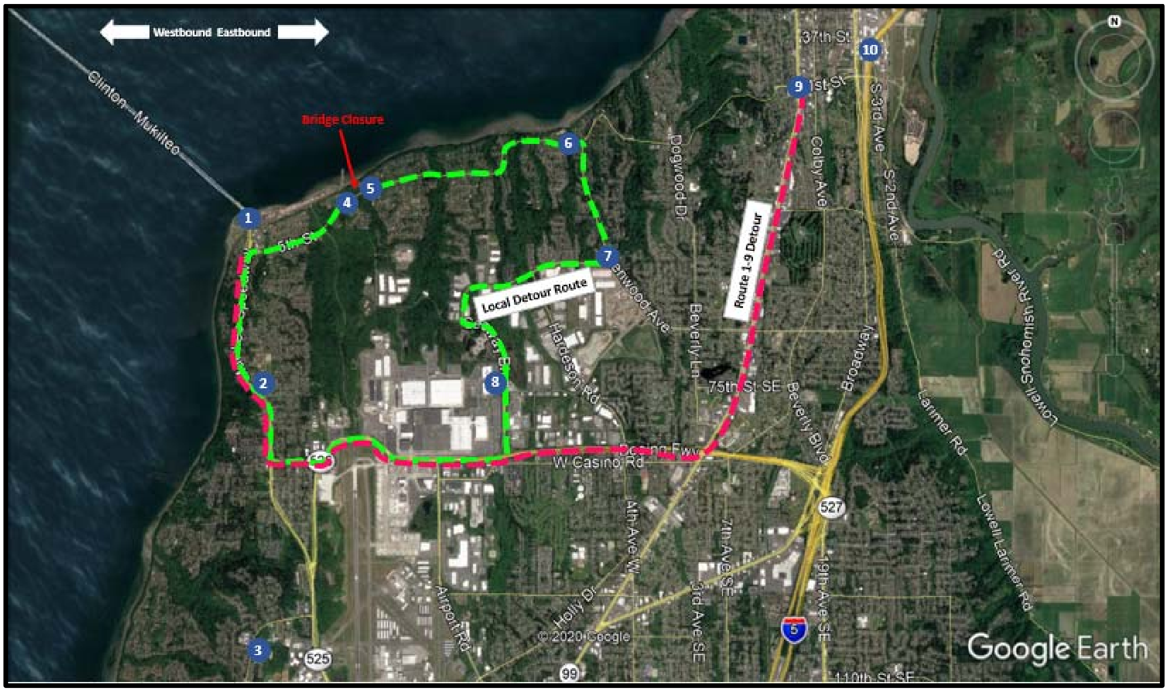
1. SR-525 at Mukilteo Ferry Dock
2. Olympic View Middle School
3. Kamiak High School
4. West End of the Edgewater Bridge
5. East End of the Edgewater Bridge
6. Glenwood Avenue at Mukilteo Boulevard
7. Glenwood Avenue at Merrill Creek Parkway
8. Seaway Boulevard at 75th Street (Boeing entrance)
9. Evergreen Way at 41st Street
10. I-5 north of 41st Street Ramps

Existing travel times between these points that would be affected by the closure of the Edgewater Bridge were estimated using point-to-point travel times from Google Maps real time data. Field travel times were not collected due to reduced traffic volumes and reduced congestion during the Covid-19 pandemic at the time of the analysis. Based on local expertise and expected congestion showed on streets in Google Maps, the projected travel times from Google Maps are based on data before Covid-19 volumes impacts. The high estimate from the range of travel times provided by Google Maps were used for both the existing, non-closure routes as well as the detoured, with-closure route as a way to ensure travel times reflected non-Covid conditions.

Four different time periods were selected to coincide with peak periods of the day in the area: 1) 7 AM/Morning Commuter Peak/School Arrival, 2) Noon, 3) 2 PM/Boeing Peak/School Dismissal, and 4) 5 PM/Traditional Afternoon Commuter Peak.

Detour routes for point-to-point combinations were selected by choosing the shortest alternative path and/or fastest path. Detour routes typically utilized the Glenwood Avenue/Merrill Creek/Seaway Boulevard/SR-526 route as the local detour route. The detour route for points #1-#9 assumed use of SR-526 and Evergreen Way rather than the local street system. Points #1-#10 assumed routes on both 41st Street/Mukilteo Boulevard and I-5/SR-526 based on local travel patterns. The #1-#10 route via I-5/SR-526 is not expected to have a noticeable increase in travel time as the route would be unaffected by the bridge closure. The 41st Street/Mukilteo Boulevard route assumed a diversion to Evergreen Way/SR-526. However, it is expected some current drivers on the 41st

Street/Mukilteo Boulevard route will divert to the I-5/SR-526 route as well. Figure 1 shows the locations used in the travel time analysis as well as the expected local detour routes.



2.6 AESTHETICS

This work element is performed by Makers. In the following a summary of the Aesthetics activities for the project is provided. The aesthetic concepts developed for the project in close coordination with the City are provided in Appendix F.

The Edgewater Creek Bridge Architectural Design Element addresses the visual and functional characteristics of the bridge's railing and entry gateway features and integrates bridge lighting systems. Regarding these elements, the primary objectives are to:
Ensure the safety and comfort of those using the bridge, including pedestrians, cyclists, and vehicle drivers

- Construct durable, attractive and easily maintainable railings and entry features
- Reflect the local community's aesthetic values
- Provide for effective illumination

The design team prepared three alternative design concepts. All featured the following common elements addressing maintenance and safety objectives:

- A crash tested vehicle barrier at least 32" high.
- A pedestrian railing 42" high.
- A bicycle railing 54" high.
- Galvanized steel or concrete surfaces – no applied color.
- Lighting will be incorporated but will depend on the concept selected.

Alternative Concept 1: Concrete Barrier with custom-cut metal in-fill railing, featured:

- Concrete exterior traffic barrier with galvanized steel panels
- Light poles spaced every 20 feet
- Corresponding gateway with a concrete and galvanized steel pillar with Everett/Mukilteo internally lit names.

Alternative Concept 2: Steel traffic barrier and railing, featured:

- Galvanized steel railing with additional verticals
- Equally spaced light poles set behind horizontal rails
- Corresponding gateway with a galvanized steel post design and internally illuminated city initials

Alternative Concept 3: Cast-in-place (CIP) concrete traffic barrier railing, featured:

- Classic-looking concrete barrier and galvanized steel rail
- Concrete pylons supporting light poles
- Gateway feature of a concrete pilon with illuminated City name

Through many outreach activities, that included an on-line open house, participants and stakeholders generally preferred Alternatives 1 and 3.

2.7 CIVIL/ROADWAY/ DRAINAGE

This work element is performed by Perteet. In the following a summary of the Civil/ Roadway/ Storm design activities for the project is provided. Developed exhibits for Roadway and Stormwater Management are provided in Appendix G.

2.7.1 ROADWAY DESIGN CRITERIA

The proposed project will include a new two-lane arterial bridge with new sidewalks and bike lanes on both sides of the bridge, and reconstruction of the storm drainage system within the project limit. Roadway design criteria was based on the City of Everett's Design and Construction Standards and Specifications for Development, the 2018 American Association of State Highway Transportation Officials (AASHTO) publication *A Policy on Geometric Design of Highways and Streets*, the latest editions and amendments of the Washington State Department of Transportation (WSDOT) *Design Manual* (M22-01.18), WSDOT *Local Agency Guidelines* (LAG), and AASHTO *Guide for the Development of Bicycle Facilities*. A roll plot exhibit of the proposed project footprint can be found in Appendix G-1.

Geometric Design Parameters

Design criteria for Mukilteo Blvd are consistent with the proposed roadway classification, existing and projected traffic volumes and movements, non-motorized needs, land use, and desired safety improvements. Table 2.7.1 below lists a summary of the design criteria for the project, and this is followed by additional detail regarding the basis of the selection.

TABLE 2.7.1

MUKILTEO BLVD DESIGN CRITERIA

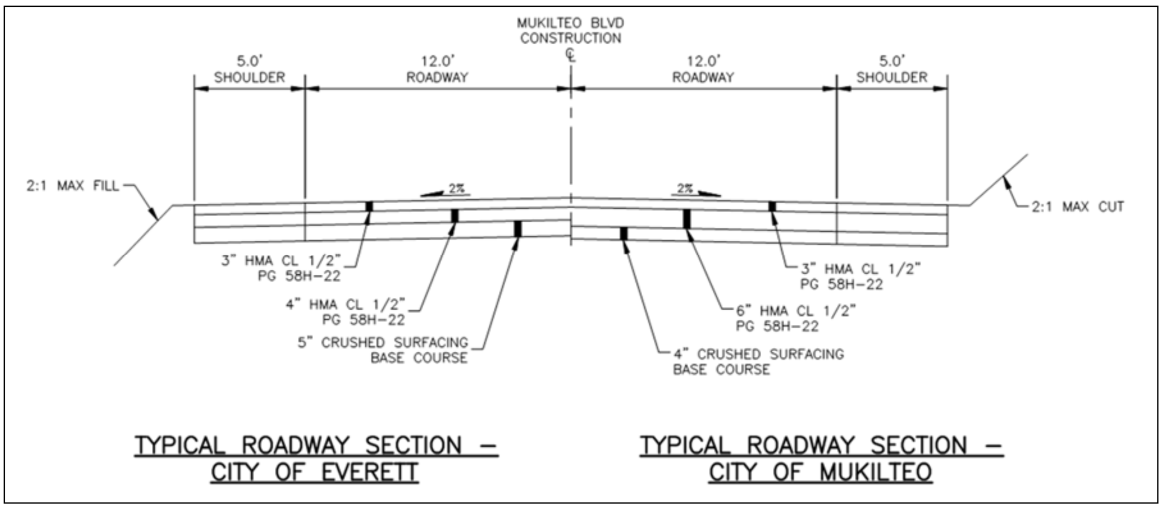
Posted Speed	35 MPH
Design Speed	35 MPH
Stopping Sight Distance	250-feet
Profile Grade	8% maximum, 0.5% minimum.
Travel Lane Width	12-feet
Bicycle Lane Width	5-feet
Sidewalk Width	6.5-feet
Shoulder Width	5-feet
Roadway Cross Slope	2% typical

Functional Class
Mukilteo Blvd: Urban Principal Arterial (WSDOT Functional Class Map)

Design Speed
Mukilteo Blvd will be posted with a speed limit of 35 MPH, matching the existing conditions.

Typical Pavement Section
Figure 2.7.1 below shows the assumed sections for Mukilteo Blvd within the City of Everett and City of Mukilteo, respectively. The City of Everett section is based on the City of Everett Standard Drawing No. 301, revising the ATB layer to be HMA. The City of Mukilteo section is based on Table 15 of the City of Mukilteo 2017 Development Standards, 2019 Amendment, also revising the ATB layer to be HMA.

FIGURE 2.7.1



Stationing
Construction Stationing will be established commencing approximately 400' southwest of the beginning of the bridge, using an arbitrary Station of 10+00. Stationing will then increase to the northeast.

Design Vehicle
A WB-40 design vehicle will accommodate most trucks that are expected to represent the principal "heavy" vehicles utilizing the Mukilteo Blvd corridor. The design will accommodate the occasional WB-50 or WB-67 that may utilize the roadway and will remain on Mukilteo Blvd and not access the local roads. Fully accommodating these large interstate vehicles to be able to turn from an arterial to local road is not common practice because of the unlikely nature of the traffic movement.

Profile Grades
Maximum: 8% for Principal Arterials (City of Everett Standard Drawing No. 300)

Minimum: 0.5% (AASHTO *A Policy on Geometric Design of Highways and Streets,* Page 3-130)

Horizontal Curves (Minimum Radius)
The minimum curve radius for horizontal curves will be determined by Table 3-13 on page 3-54 of the AASHTO *A Policy on Geometric Design of Highways and Streets.* The design will use a design speed of 35 MPH and a normal crown section will be used for the minimum radius.

Vertical Curves
Crest Vertical Curve. The length of vertical curve for crest conditions will be determined by Equations 3-44 and 3-45 on page 3-167 of the AASHTO *A Policy on Geometric Design of Highways and Streets.* These equations for vertical curves provide sufficient distance for a driver to come to a stop if an obstacle is within the roadway.
Sag Vertical Curve. The length of vertical curve for sag conditions will be determined by Equations 3-48 to 3-51 on page 3-173 of the AASHTO *A Policy on Geometric Design of Highways and Streets.* This will not require that the sags be illuminated, as there will be sufficient sight distance provided by vehicles headlights' alone for stopping sight distance purposes.

Cross-Slope
All traffic lanes will have a design cross slope of 2.00% on the roadway and bridge structure. Sidewalks will have a design cross slope of 1.50% and will be designed to meet PROWAG ADA guidelines, or to the maximum extent feasible.

Side Slopes
All slopes will be 2:1, and when necessary to minimize right-of-way acquisition, walls will be incorporated.

Grade Line
All facilities:

Pivot Point: At construction centerline
Profile Grade: At construction centerline

Non-Motorized Facilities
Non-motorized facilities for the project will consist of sidewalks for pedestrians and bicycles lanes on the bridge structure. The sidewalk width will be 6.5 feet and the bicycle lane width will be 5 feet. There will be a 5-foot wide shoulder on the roadway off the bridge structure. There will be curb ramps designed to meet PROWAG ADA guidelines that will provide pedestrians access to the sidewalk on the bridge to the shoulder.

2.7.2 DRAINAGE DESIGN CRITERIA

The proposed project has been assessed for surface water Minimum Requirements based on the City of Everett *2020 Design and Construction Standards and Specifications* (DCSS) as well as the Washington State Department of Ecology *2019 Stormwater Management*

Manual for Western Washington (SWMMWW). The project will include storm drain pipe, catch basins, and bridge scuppers. The DCSS and Washington State Department of Transportation *2019 Hydraulics Manual* (HM) will be the regulatory manuals for conveyance design. For more information, please see the detailed Pre-Design Record included in Appendix G-2.

Water Quality and Flow Control Implementation

The project triggers Minimum Requirement #7, Flow Control, but not Minimum Requirement #6, Runoff Treatment per DCSS. The project will seek to locate a shared flow control facility on the adjacent Edgewater Park property during the redevelopment of the park following its use as a staging area for the bridge construction project.

Conveyance Implementation

Bridge scuppers will be used on either side of the crowned roadway at the low end of the bridge to capture runoff. WSDOT's gutter flow spreadsheet will be used to locate the scuppers to prevent excessive ponding in the flow line. Eight-inch ductile iron pipe will used on the bridge at the request of City of Everett maintenance staff. Ten-inch High Density Polyethylene Pipe (HDPE) will be used to connect to the outfall pipe, matching the diameter of the existing outfall pipe.

Downstream Outfalls

Existing storm drain pipe and associated outfalls under the bridge will be undisturbed to the greatest extent feasible.

2.8 STRUCTURAL

This work element is performed by TranTech. In the following a summary of the Structural concept development is provided.

The design team worked in close collaboration with the City to develop a list of critical project criteria and improvements/impacts for the project.

The design team worked through many structural bridge concepts and after careful examination of them made a final list of three viable structural bridge alternatives that best fit the project criteria as desired by the City. The three viable structural alternatives are:

1. Three-span precast concrete girder
2. Three-span steel plate girder
3. One-span steel plate girder with precast concrete girder approaches

The study presented in this report leads to the conclusion that Alternative 1 best meets the selected project criteria.

The construction cost of this alternative is the lowest of all alternatives at approximately $20.8M. The team's recommendation is to advance Alternative 1 to construction documents.

Structural concepts and preliminary structural calculations are presented in Appendix H.

2.9 CONSTRUCTABILITY & ESTIMATION

This work element is performed by Ott-Sakai. In the following a summary of the constructability investigations for the project is provided. More detailed description of the performed activities is provided in Appendix I.

The 3 bridge alternatives described in Section 2.8 are typical designs constructed by contractors in the local market. There are no "unusual" risk items that would impact the number of contractors submitting bids for this project. Currently, there is plenty of capacity in the bridge market and the City should expect 5 or 6 competitive bids. However, there are several challenges that will cause the prices to be higher than the typical bridge overpass.

- **Access** - This crossing of Edgewater Creek is over a steep canyon approximately 85' above the creek bottom. In addition, there are some wetland and unstable slope conditions that will affect the contractor's approach to the work. It has been determined that a work bridge be constructed for access from Abutment 1 to Piers 2 and Abut 4 to Pier 3 & avoid crossing the environmentally sensitive areas around the creek.

  Not having a continuous work bridge will have several impacts.
    - The contractor needs to have service cranes & support equipment on both work bridges. Increases equipment ownership costs.
    - Contractor's personnel will have to travel approximately 12 miles to get to the opposite bridge abutment. The estimates have a boom truck to transport materials between the East/ West work zones. For concept #1 the contractor will probably build a pedestrian bridge to allow access between the two work bridges that are only 108' apart. This access solution may not work for concepts #2 & #3.
    - The drilled shaft contractor will have a second mobilization to the other side of the canyon.

- **Drilled Shafts** - We had a local shaft drilling contractor visit the site and review our access plan. They did not have any concerns other than the work bridge needed to be designed for the forces applied by the oscillating equipment. Substantial bracing will be required for concept #1 work bridge where the piles extend 70' above the ground. Cost for additional bracing are addressed in all 3 estimates.

- **Girder Erection** - Girder Erection is challenging for all 3 concepts.

    - Concept 1 - There is no place for the girder delivery trucks to turn around at the jobsite. They will have to pull head on onto to work bridge and get the girders as close as possible to the 550T capacity erection crane. These concrete girders are heavy (65T) and require a second 175T crane to pick one end of the girder and set into position. A girder launching beam will be needed to "launch" Span 2 girder across the gap between the two work bridges so the crane on the opposite side can pick the end of the girder. Crane layout configurations are included in Appendix I.

  - Concept 2 - Steel girders are lighter (27T) and can be erected with a single 550T Crane.

  - Concept 3 - Steel girders are 265' long and have one splice at about approximately 106 feet from a pier. This will require a 70' high temporary bent located within the ravine. The heaviest girder segment weighs 40 tons and will require a 750T crane. There are a couple of these cranes in the area used for erecting wind turbines. They are expensive to mobilize and will require extra work trestle piles at their work location.

We have addressed all these issues and the added costs are reflected in our pricing of each alternative.

Means & Methods

We used the following assumptions for construction in preparing our estimates & schedules. These assumptions apply to all 3 alternatives.

- The project office & laydown area will be on the City furnished park property at the north end of the bridge.
- On the south side all construction materials will have to be "just in time delivery" due to the lack of laydown space.
- W. Mukilteo Blvd will need to be closed 225' south of the bridge abutment (first driveway on westside) in order to assemble cranes, stage delivery of work bridge piling & other materials.
- Bridge Demolition is the first order of work. Demolition & cleanup will be about 20 days.
- Crawler Cranes will be required for construction support since they travel with suspended loads.
- The work bridge construction will be supported by a 6 person pile driver crew. Construction will be 1 span per 10 hour shift. The north work bridge will be constructed first and then the same crew will move to the south.
- The Drilling subcontractor will construct the shafts starting at pier 2, backing out to pier 1 and then remobilize to the south side. Two crawler cranes, an oscillator drill & crew of 8 people will be required for this operation. Production rate is 3 days / shaft including mobilization & demobilization. Pile rebar cages will be tied on the work bridge.

- Substructure concrete construction will be supported by two 6 person carpenter/laborer crews working the abutments & piers concurrently. One set of abutment forms will be job built. Two steel column forms will be used to allow casting the columns in pairs. The pier caps will be cast on falsework supported by brackets attached to the columns. All concrete will be placed with a concrete boom pump. The work bridge service will crane support the column, cap, and abutment construction. Substructure construction will take about 2 months.
- Bridge girders will be placed using large capacity mobile cranes operating on the work bridge.
- The deck concrete forming will be the typical method of wood forms suspended from the top of girder flange. The 12-person crew supported by equipment on the work bridge will complete the deck construction in 3 months followed by pedestrian barrier & sidewalk.
- Work bridge removal will begin once the bridge deck concrete is poured
- Once the deck concrete is cured, the barrier / sidewalk construction will be supported by a forklift or boom truck from the bridge deck. This work can be completed in about 6 weeks.

Project Construction Cost Summary

A construction cost estimate was prepared for each of the 3 bridge configuration concepts. We prepared these estimates "contractor style". This process starts by performing a material quantity takeoff for all elements of the bridge. Crew size and work productions are based on our experience for similar work and are assigned to each work activity. The unit cost for materials is based on current market pricing and our experience is used to establish waste factors. Equipment costs are based on contractor's internal equipment rates. Large cranes for girder erection are based on local availability and current rate sheets. Subcontractor rates are based on pricing we have seen on recent bids for similar bridge work.

All this information is assembled using contractor's HCSS Heavy Bid estimating software. An example of a "contractors' style" estimate is shown in Appendix I.

The total price for each option includes the contractor's direct costs plus mobilization, jobsite overhead and risk. Jobsite overhead includes all bonds, insurances, taxes, project staffing & vehicle expenses and setting up & maintaining project office & yard.

This is the price that a contractor would bid for this project. The contingency covers "known unknowns" that exist at this stage of project development. All pricing is in today's dollars and no escalation is included.

2.10 ALTERNATIVE COMPARISON

Working closely with the City, the design team developed a list of critical project criteria for this bridge replacement project.

Table 1 presents a list of these criteria and the ordinal ranking of each of the three alternatives with respect to them. The three alternatives are:

1. Three-span precast concrete girder
2. Three-span steel plate girder
3. One-span steel plate girder with precast concrete girder approaches

It should be noted that per this ranking procedure, the alternative with the lowest composite score will be the top choice.

Table 1 – Edgewater Creek Bridge Replacement Alternative Comparison

Alternative	Alternative 1	Alternative 2	Alternative 3
Criteria (Ordinal)			
Cost	1	2	3
Constructability	1	1	2
Construction Duration	1	1	1
Future Maintenance	1	2	3
Environmental Impact	2	2	1
Total Score	**6**	**8**	**10**

3. CONCLUDING REMARKS AND RECOMMENDATIONS

As part of this report, three viable bridge replacement alternatives were studied in-depth. These alternatives are:

1. Three-span precast concrete girder
2. Three-span steel plate girder
3. One-span steel plate girder with precast concrete girder approaches

Through an ordinal ranking comparison process it is shown that Alternative 1 best meets the selected project criteria desired by the City.

The construction cost of this alternative is the lowest of all alternatives at approximately $20.8M.

The team's recommendation is to advance Alternative 1 to construction documents.