Karen Fraser Woodland Trail

Phase III Feasibility
City of Olympia

FINAL REPORT
APRIL 2018

SCJ ALLIANCE
CONSULTING SERVICES

Feasibility Study

Project Information

Project:	**Karen Fraser Woodland Trail Phase III**
Prepared for:	**City of Olympia** Olympia Parks, Arts and Recreation

Reviewing Agency

Jurisdiction:	City of Olympia

Project Representative

Prepared by:	**SCJ Alliance** 8730 Tallon Lane NE, Suite 200 Lacey, WA 98516 360.352.1465 scjalliance.com
Contact:	Whitney Holm, PE

Project Reference:	SCJ #630.05 Path: N:\Projects\0630 City of Olympia\0630.05 Olympia 2016-2017 On-Call General Engineering Services\Phase 23 - OWT Phase III Feasibility\Phase 05 Final Report\Karen Fraiser Woodland Trail-Final Report.docx

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1. INTRODUCTION

The purpose of this report is to analyze the feasibility of Segment III of the Karen Fraser Woodland Trail. This report refreshes work from the December 1998 Olympia Woodland Trail Feasibility Study and considers an additional alignment for the trail segments from Henderson Boulevard to Eastside Street. This segment is identified as Trail Segment 4 in the 1998 Feasibility Study and Phase III in the 1999 Olympia Woodland Trail Master Plan. The name of the trail changed from the Olympia Woodland Trail to the Karen Fraser Woodland Trail in September 2017.

Two alignments were analyzed, Alignments 1 and 2. Both alignments begin as at-grade crossings of Henderson Boulevard and end at Eastside Street. Both alignments have alternate endings, A and B. See Appendix A for proposed trail alignments.

2. TRAIL ALIGNMENTS

2.1 ALIGNMENTS

Alignment 1

Alignment 1 begins at grade at Henderson Boulevard. It continues along the City Center off-ramp and then descends to the downhill side of a tall embankment retaining wall (Hilfiker wall). From this point, the trail continues along heavy vegetated areas of Watershed Park where it will cross Moxlie Creek via an elevated boardwalk/bridge combination. The trail then climbs at a maximum 5% grade via a switchback trail along the steep hillside. The top of the trail can follow two alignments: Alternative A follows close to the Interstate 5 right of way and meets Eastside Street near the existing crossing. Alternative B goes through the City-owned parcel and is adjacent to the Watershed Park entrance. See Figure 1 for a comparison of all of the alignments. Full exhibits of these alignments are in **Appendix A**.

Alignment 2

Alignment 2 begins at grade at Henderson Boulevard. It continues along the City Center off-ramp and then descends into Watershed Park. The trail crosses the Watershed Park wetlands and Moxlie Creek through a combination of boardwalk and bridge. The trail then follows near the existing Watershed Park trail to the top of the hill near Eastside Street. The top of the trail can follow two alignments. Alternative A follows close to the Interstate 5 right of way and meets Eastside Street near the existing crossing. Alternative B goes through the City-owned parcel and is adjacent to the Watershed Park entrance. The

maximum grade of Alignment 2 is also 5%. See Figure 1 for a comparison of all of the alignments. Full exhibits of these alignments are in **Appendix A**.

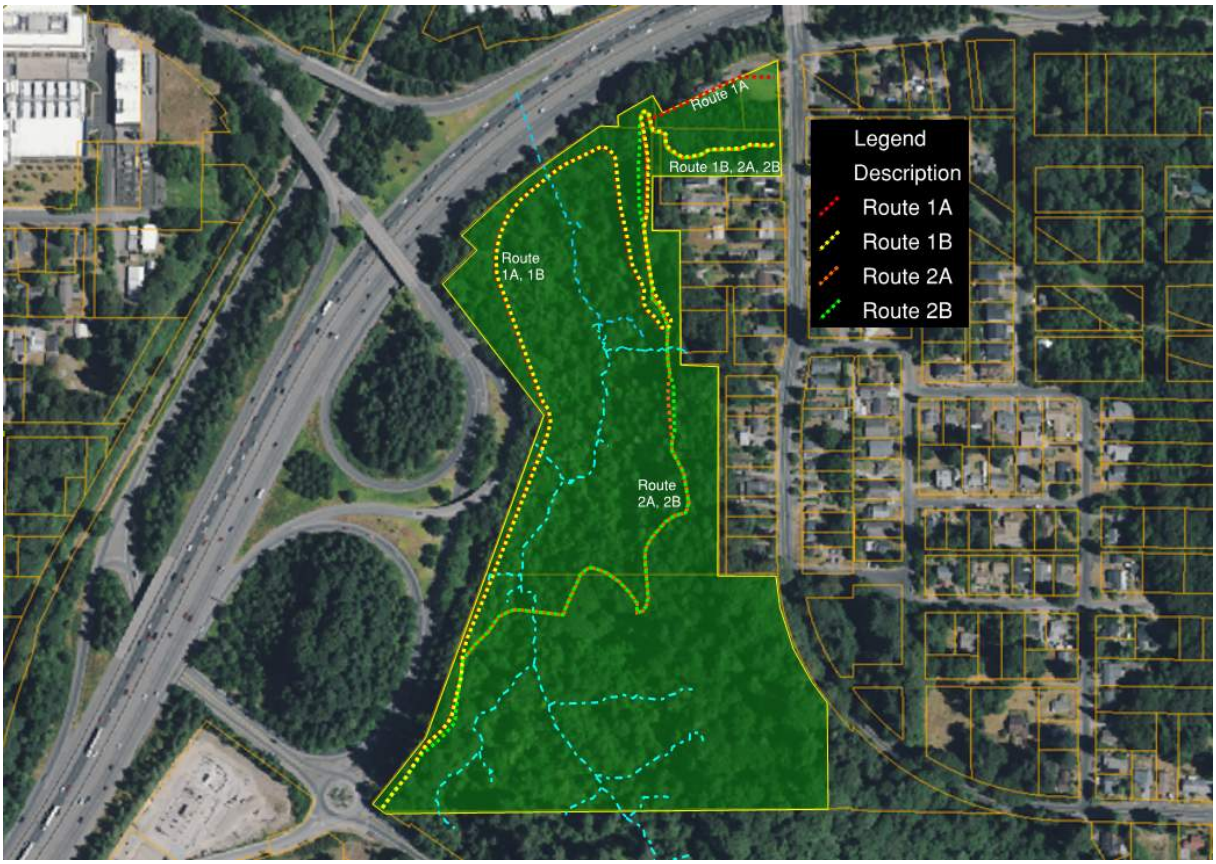


Figure 1. Showing the four alternate trail routes.

2.2 Design Features

The trail path will be 10 feet wide and paved with asphalt. The trail will contain 2-foot-wide gravel shoulders where practical. As mentioned above, certain locations would require bridge and boardwalk. Retaining walls will also be necessary to avoid excessive cuts and fills and minimize impact. Hand railings will need to be installed along various portions. The railings are required for trail user safety because of steep terrain and the placement of the elevated trail on the bridge structures. The hand railings would be installed at a minimum height of 4.5.

Design guidance for design speeds of shared-use paths identifies a 20 mph design speed (WSDOT Design Manual 1515.04). This segment of the Olympia Woodland Trail faces challenges with steep grades and environmental impacts due to wetlands and Moxlie Creek. To provide a design speed of 20 mph would be cost prohibitive and/or without ADA accessibility. We used a general design speed of 15 mph. This allows the path to follow the terrain of the park, maintain accessibility, and reduce costs. At trail termini and at switchbacks the design speeds are closer to 10 mph. Due to the slower design speeds used to make the trail feasible, we recommend the ultimate design to include advisory signs for curves and grades. It is anticipated that the unique feel of going through Watershed Park combined with tighter geometry would encourage cyclists to slow down.

3. STRUCTURAL

3.1 STRUCTURAL CONCLUSION

Structural alternatives were analyzed for the four trail alignments to establish feasibility. All alternatives will use a combination of elevated boardwalks and retaining walls. These combinations were evaluated for constructability, environmental impacts, and maintenance. The full structural memorandum is in **Appendix B.**

Boardwalks

Boardwalks will need to be constructed on pin pier foundations to limit environmental impacts. The boardwalks can be constructed of wood or aluminum, depending on maintenance and cost strategies of the City.

Wood Boardwalks

- Less expensive up-front cost
- Higher maintenance costs and demand over time
- City staff can typically perform maintenance
- Can be slippery

Aluminum Boardwalks

- More expensive up-front cost
- Lower maintenance costs
- Not slippery
- In secluded settings, prone to theft of individual members

3.2 WALLS

All four alternatives will require a combination of retaining walls. Three types of walls are recommended because of their constructability and ability to minimize environmental impact:

Soldier Pile Walls

Soldier Pile Walls are recommended for cut walls along the WSDOT ROW. These walls are preferred by WSDOT and allow for top down construction, which limits impacts to the surrounding environment.

Structural Earth Walls

Structural Earth Walls are recommended for the fill walls along the trail. They take advantage of layers of anchored geosynthetic fabric integrated into fill lifts. These walls are built as fill is put down and can be constructed with small units, allowing for smaller equipment and reduced manual labor.

Soil Nail Walls

Soil Nail Walls are recommended for cut walls not adjacent to the WSDOT ROW. Like Soldier Pile Walls, Soil Nail Walls are also completed in a top down construction method. The equipment necessary to install Soil Nail Walls is relatively small and will be able to navigate the terrain of the trail.

4. ENVIRONMENTAL

4.1 ENVIRONMENTAL REPORT CONCLUSIONS

The four trail alignments were assessed to compare potential benefits and costs from an environmental impacts perspective. Alignments 2A and 2B result in the least new impacts to both wetlands and buffers when compared to Alignments 1A and 1B. However, Alignments 1A and 1B, on average impact lower quality habitats. All four alignments appear to fall within the range of impacts allowed under a federal (ACOE) Nationwide Permit, and therefore may be considered effectively equivalent from a permitting complexity standpoint.

City of Olympia code encourages minimization of new impacts. Therefore, unless Alignments 1A and 1B are found to have distinct advantages over 2A or 2B, then due to less square footage of direct impact, Alignments 2A and 2B would be favored.

The costs to build Alignments 1A or 1B might be greater than 2A or 2B, partly due to construction of more linear feet of trail in areas with steep side slope terrain. This may also result in wider fill trail footprints for the 1A/1B alignment and therefore require even more mitigation than the estimates described in Table 2 of the Environmental Evaluation Report.

The differences between the 2A and 2B are minor from a mitigation and habitat impacts perspective. A more precise comparison of those relative impacts will only be possible from detailed assessment of minor changes in trail terrain to improve either trail gradients or maintenance issues.

It may be important to note that Alignments 2A and 2B are in close proximity to the existing foot trail, and therefore will be impacting an area already somewhat impacted by past construction and by continuing use of the existing trail system. Therefore, entirely new habitat impacts are expected to be relatively minor. The full Environmental Evaluation Report is in **Appendix C**.

5. ESTIMATE OF PROBABLE COSTS

5.1 ESTIMATE OF PROBABLE COSTS

Conceptual estimates were prepared for each of the four alternatives. The main cost drivers for the project will be the boardwalk and the retaining walls. There are two sets of totals for each option: one for a timber boardwalk and one for an aluminum boardwalk.

Alternative	***Timber***	***Aluminum***
Alignment 1A	$4,460,000	$5,130,000
Alignment 1B	$4,650,000	$5,400,000
Alignment 2A	$4,460,000	$5,020,000
Alignment 2B	$4,710,000	$5,340,000

6. CONCLUSION

6.1 CONCLUSION

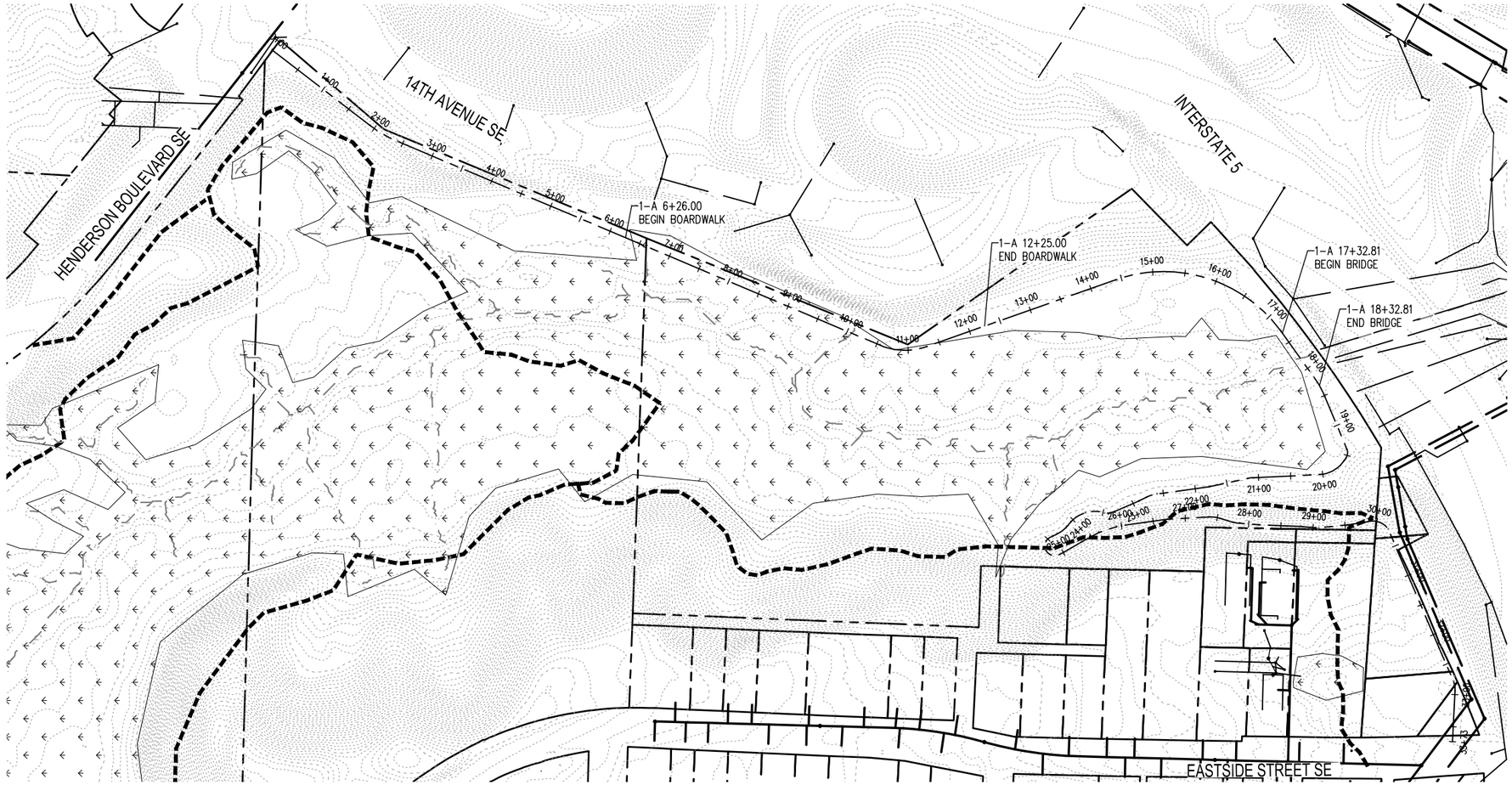
Alignments 1 and 2 are both feasible. Both alignments will require environmental mitigation because of impacts to the wetlands and to Moxlie Creek. Alignments 2A and 2B have smaller environmental impacts. Construction of Alignment 1 will have increased difficulty because the portion of trail between the wetland boardwalk and the Moxlie Creek crossing will have limited access via the newly constructed boardwalks.

The cost driver for both alignments will be the structural items: boardwalk and retaining walls. Alignments 1A and 2A cost less than alternatives 1B and 2B, respectively, due to the necessary retaining wall at the terminus of the B alternatives. Alignment 2A is the least expensive alternative for both the timber and aluminum scenarios.

APPENDIX A
ALIGNMENT PLANS

LEGEND

- WATERSHED TRAIL
- CREEK
- WETLAND



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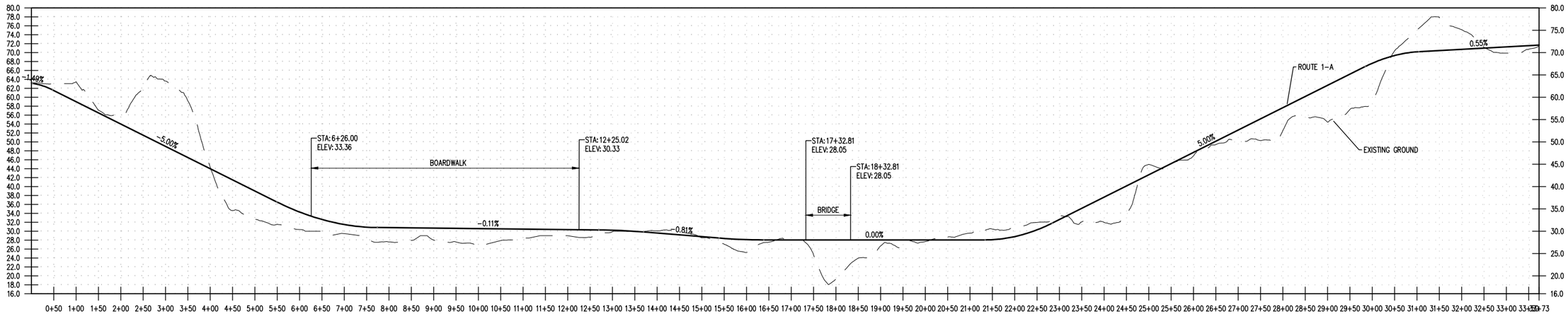

REVISIONS	DATE	BY

DESIGNED BY: W HOLM
DRAWN BY: M KNECHT
CHECKED BY: S SAWYER
ISSUE DATE: -
JOB No.: 0630.05
DRAWING FILE No.: 0630.05-PP

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SCJALLIANCE.COM

OLYMPIA - WOODLAND TRAIL
PHASE III - FEASIBILITY STUDY
CITY OF OLYMPIA

ALTERNATIVE 1 HORIZONTAL PLAN

DRAWING No.: PP-1
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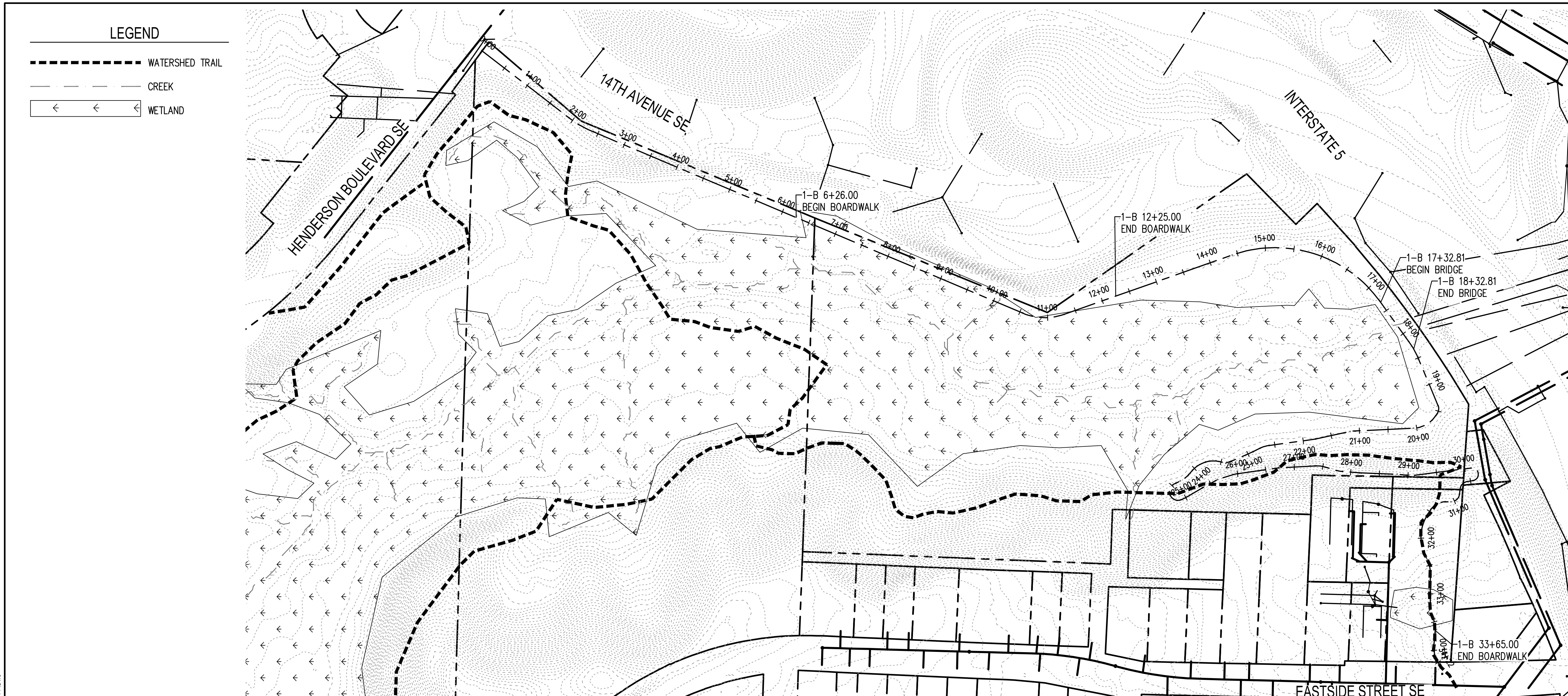

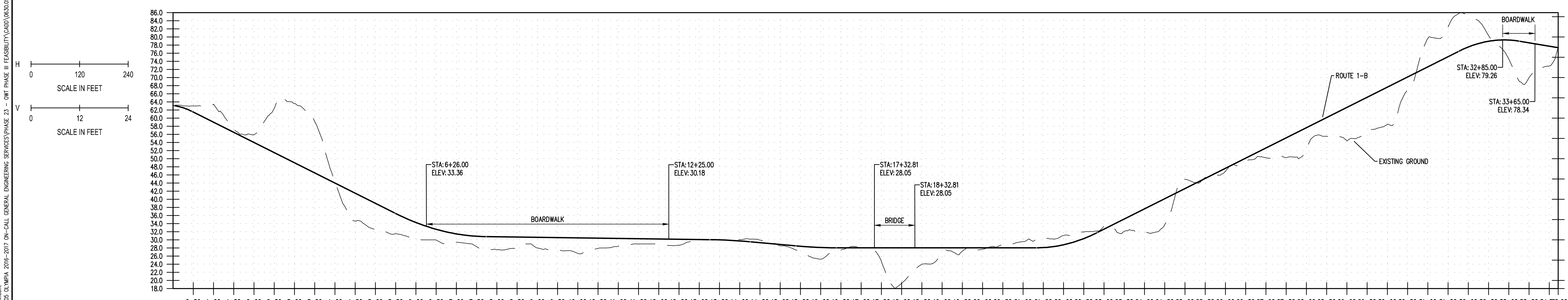

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PHASE III - FEASIBILITY STUDY
CITY OF OLYMPIA

ALTERNATIVE 1B HORIZONTAL PLAN

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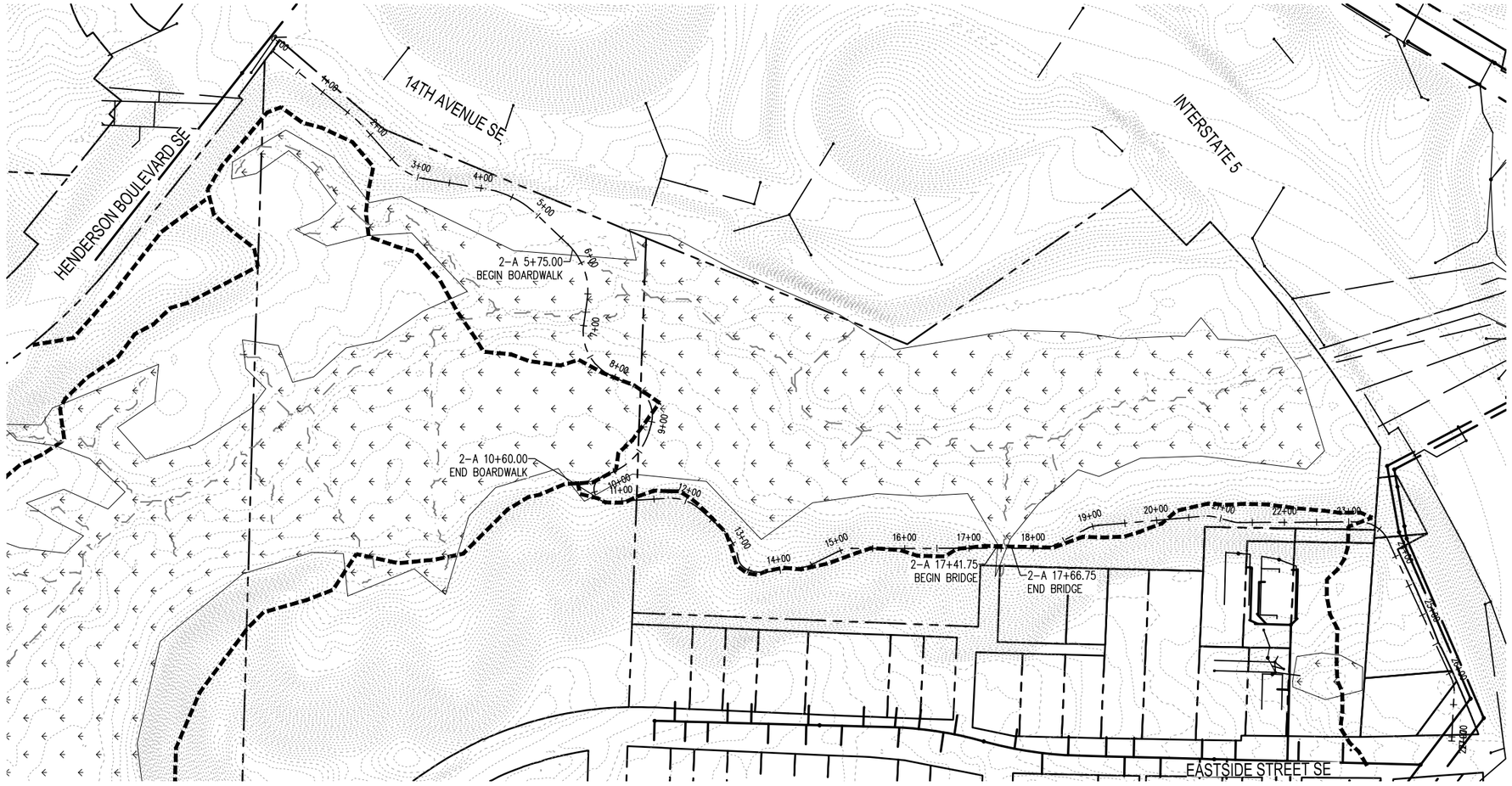
LEGEND

- WATERSHED TRAIL
- CREEK
- WETLAND



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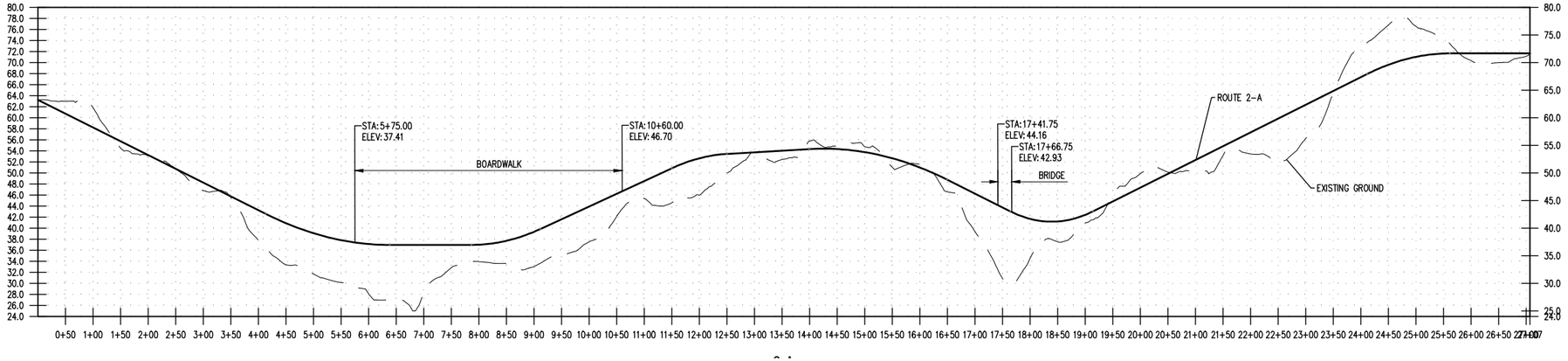

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ISSUE DATE: -
JOB No.: 0630.05
DRAWING FILE No.: 0630.05-PP

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ALTERNATIVE 2 HORIZONTAL PLAN

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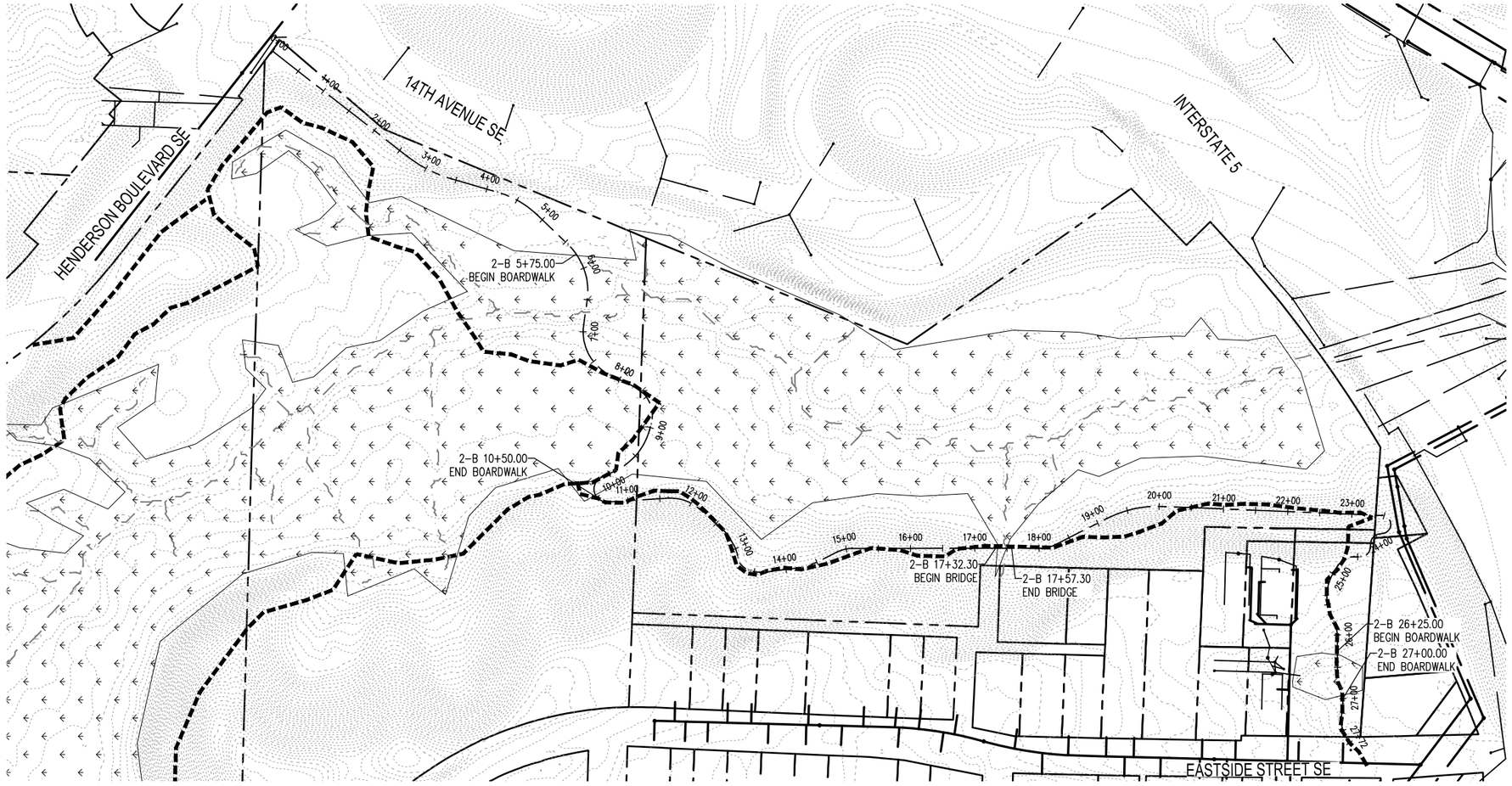
LEGEND

- WATERSHED TRAIL
- CREEK
- WETLAND



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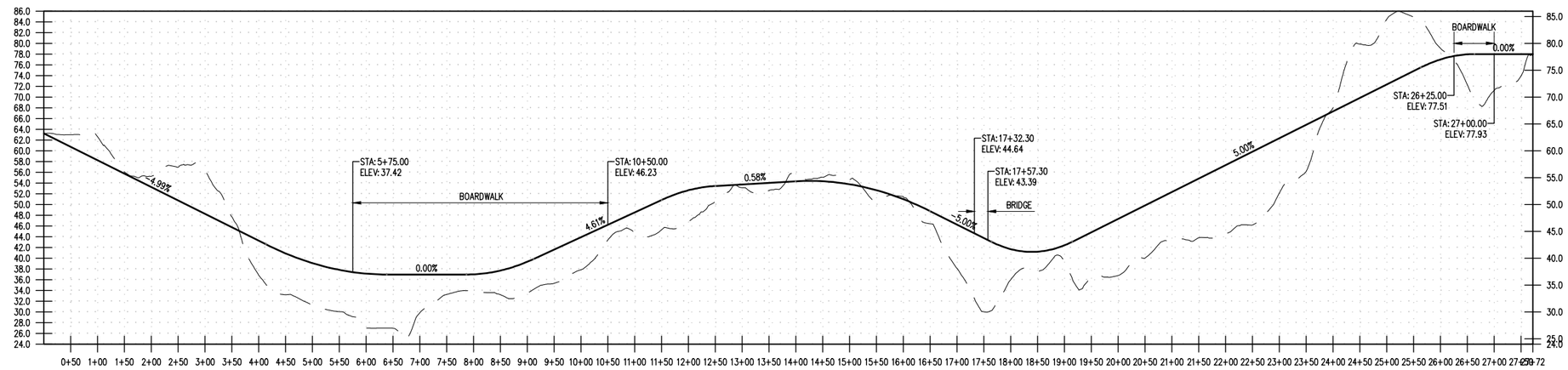

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DRAWN BY: M KNECHT	JOB No.: 0630.05
CHECKED BY: S SAWYER	DRAWING FILE No.: 0630.05-PP

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ALTERNATIVE 2B HORIZONTAL PLAN

DRAWING No.: PP-2B

SHEET No.: 4 OF 5

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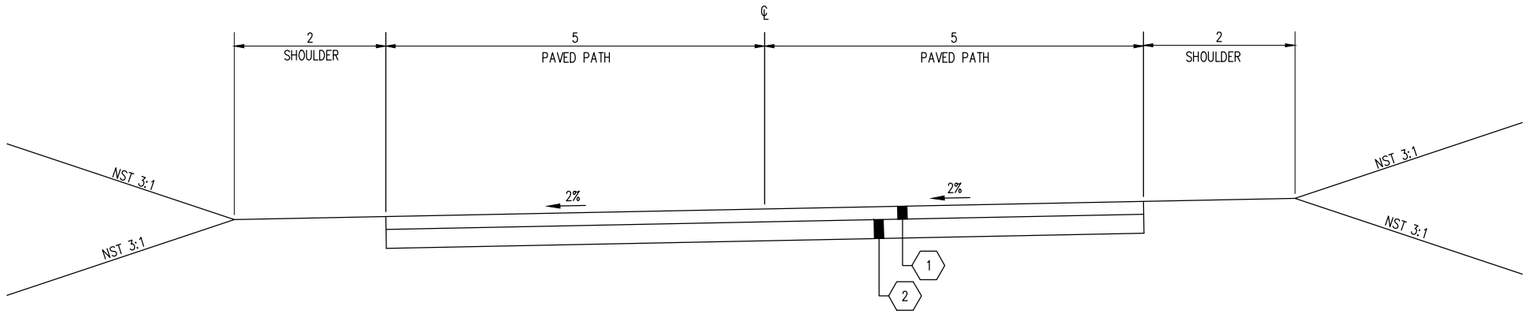
ROADWAY SECTION KEY NOTES:

(1) 0.17' COMMERCIAL HMA

(2) 0.25' CRUSHED SURFACING TOP COURSE. (CSTC)

NOTES:

1. ALL SURFACING AND PAVING DEPTHS ARE COMPACTED DEPTHS
2. NST = NO STEEPER THAN



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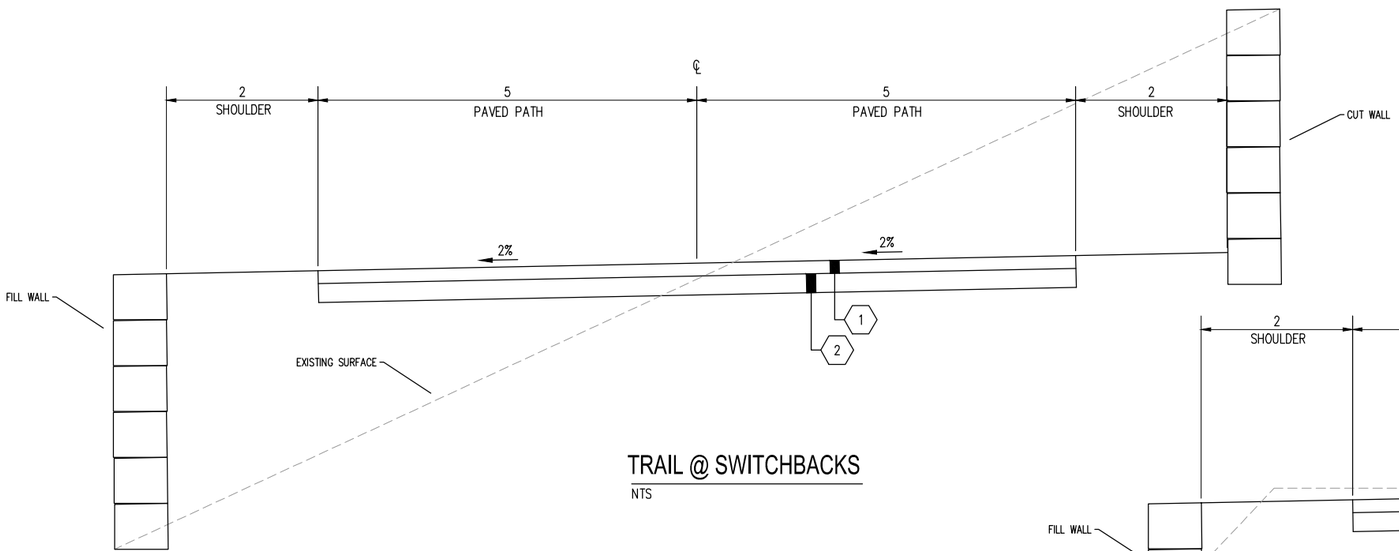

TRAIL @ SWITCHBACKS
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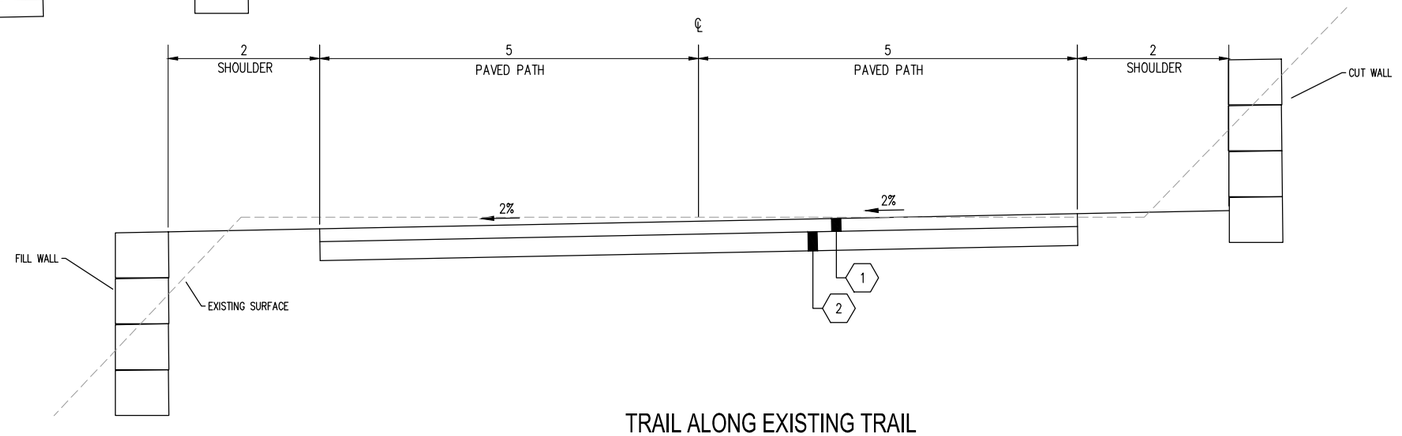

TRAIL ALONG EXISTING TRAIL
NTS

△	REVISIONS	DATE	BY

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DRAWN BY: M KNECHT
CHECKED BY: S SAWYER
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DRAWING FILE No.: 0630.05-XS

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TYPICAL CROSS SECTION

DRAWING No.: XS-01

SHEET No.: 6 OF ##

APPENDIX B
STRUCTURAL MEMORANDUM

Sargent Engineers, Inc.
320 Ronlee Lane NW
Olympia, Washington 98502-9241
Tel 360 867-9284
Fax 360 867-9318
www.sargentengineers.com

April 17, 2018

Mr. Patrick Holm, PE
SCJ Alliance
8730 Tallon Lane NE, Suite 200
Lacey, WA 98516

RE: Karen Frasier Woodland Trail - Structural Feasibility
Project No.: A17190.00

Dear Mr. Holm,

We have reviewed the four alternative routes for Segment 3 of the Karen Frasier Woodland Trail with the purpose of developing structural alternatives for the elevated boardwalks and retaining walls. We identified several alternatives and vetted them against constructability, environmental impact, and maintenance considerations. For the boardwalks, our two preferred alternatives are boardwalks consisting of all timber construction or boardwalks consisting of aluminum framing with FRP decking. For the retaining walls, we are proposing a mix of soldier pile, soil nail, and structural earth walls.

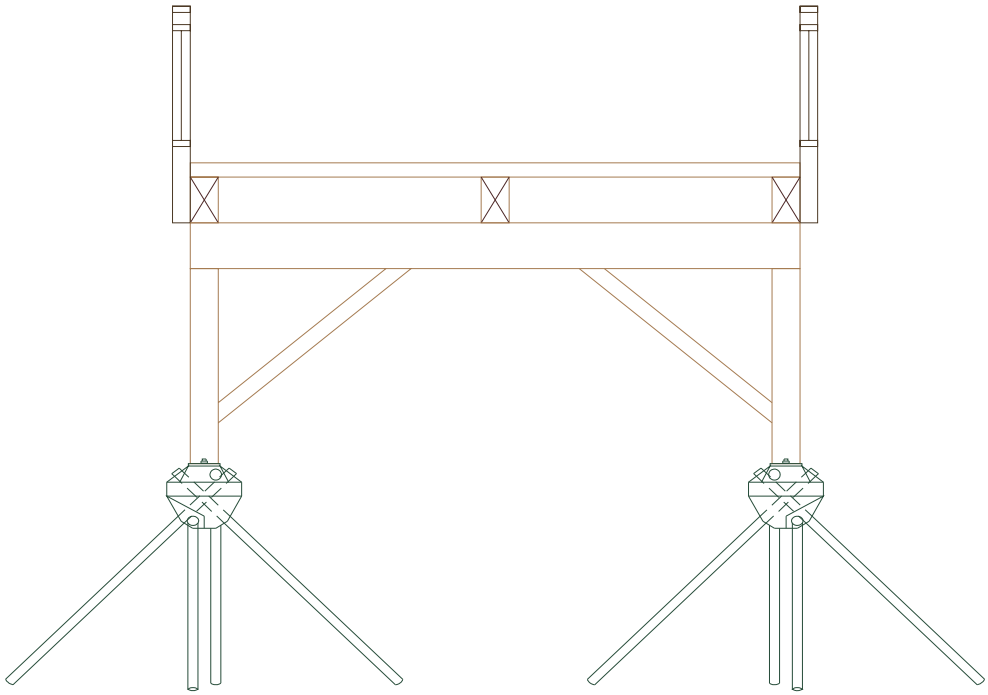
BOARDWALK CONSIDERATIONS

Elevated boardwalks are proposed for all four alternative routes to minimize the impact to the wetlands crossed by the trail in several locations. The soils in these areas are soft and often waterlogged. The access to the boardwalk locations is limited, with the trail ideally being used as the main construction access. These factors combined make a light-framed structure more desirable because of the lighter foundation loads and smaller size of construction equipment required.

TIMBER BOARDWALK

Our proposed timber boardwalk consists of timber deck planks supported on timber stringers, caps and columns. The foundation system would be DiamondPier® pinned foundations. The spans range from 8-feet for typical boardwalk segments to 15-feet at the creek crossings.

A boardwalk of timber construction has the advantages of being light, constructed of smaller elements that are easily moved in with small equipment, and having a wide variety of contractors available for construction. A timber boardwalk will be relatively higher maintenance over the lifespan of the structure due to decaying elements that need replacing; however this maintenance work could easily be carried out by City forces. Timber decking will tend to be slippery when moist, which can be minimized with grit-impregnated sealers or traction paper. The DiamondPier® foundations eliminate cast-in-place concrete and are installed manually or with small equipment.



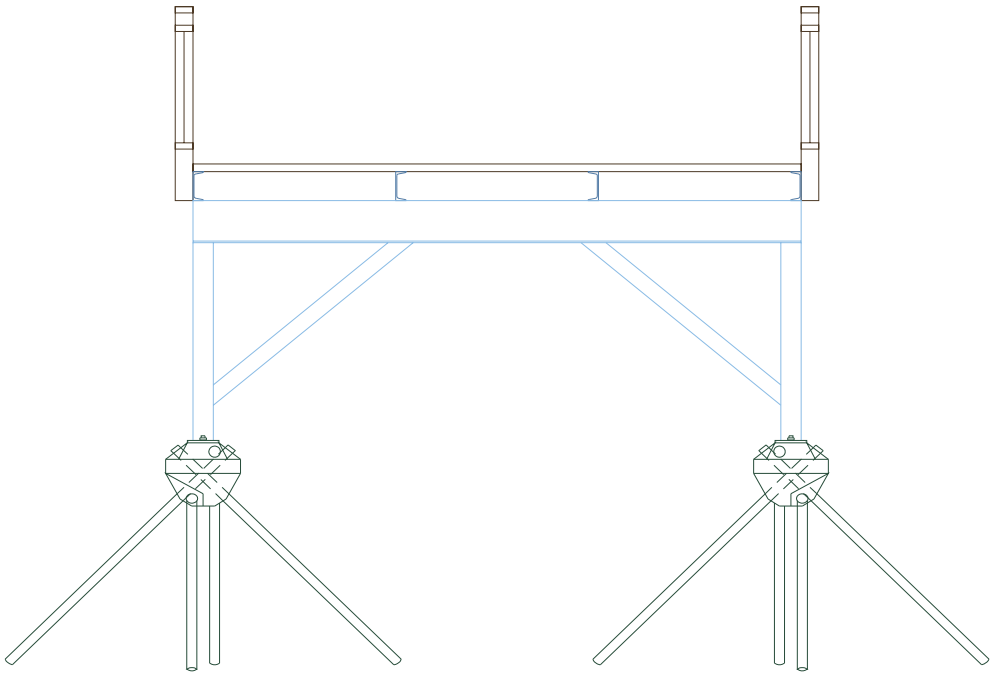
Timber Boardwalk Section

ALUMINUM BOARDWALK

Our proposed aluminum boardwalk consists of wood-look FRP planks supported on aluminum stringers, caps and columns. The foundation system would be DiamondPier® pinned foundations. The spans range from 8-feet for typical boardwalk segments to 15-feet at the creek crossings.

A boardwalk of FRP and aluminum construction has many of the advantages of a timber boardwalk with the added advantage that it will be very low maintenance over the life of the structure. Aluminum has a big advantage over steel framing in this environment because it is lighter and because it does not require coatings which will eventually breakdown and require repainting, a process that would be very difficult to carry out and obtain permits for in this setting. The FRP decking gives the look of wood, but will not decay or become slippery in the forest setting.

The biggest disadvantage to aluminum is the initial cost. There is also concern over theft in locations like Watershed Park, where there are windows of time where somebody could dismantle and remove pieces unnoticed.



Aluminum Boardwalk

RETAINING WALLS

Retaining walls are also proposed for all four alternative routes to achieve the grades needed for ADA compliance while limiting the footprint of the trail. The retaining walls are placed primarily on the steeper slopes of the ravine where creating temporary cuts for placement of retaining structures is very difficult, and shoring is impractical due to limited access. Portions of the retaining walls near the Henderson Boulevard and Eastside Street access points will also be supporting WSDOT Right-of-Way, making these walls subject to WSDOT approval.

WALLS ADJACENT TO WSDOT R/W

For the retaining walls directly adjacent to the WSDOT R/W, we propose soldier-pile walls with concrete fascia panels. This type of wall is constructed from the top down, greatly minimizing the construction footprint by eliminating overexcavation. This will allow the walls to be constructed with minimal disturbance to traffic, and they are also one of WSDOT's preferred retaining wall types.

FILL WALLS

For the walls along the trail that will be retaining fill, we propose structural earth walls be utilized. These walls consist of layers of geosynthetic that are anchored into the fill material, and are faced with precast concrete blocks of varying form. This type of wall is very efficient in fill situations because the reinforcing layers are placed along with the fill material. These walls are also advantageous for sites with limited access because they are constructed of smaller units that can be moved in with small equipment and manual labor.

CUT WALLS

For walls along the trail that will be retaining new cuts, we propose soil nail walls be used. This type of retaining wall is built from the top down, with soil nails and facing treatment being installed to restrain the face of the cut as the work progresses downward. The facing treatment usually consists of either precast panels or shotcrete; panels would be the recommended alternative for this site due to access considerations. The equipment to install the soil nails is small and can navigate sites with restricted access easily.

PROJECT COSTS

The structural costs for the four different routes came in very close to each other. Route 1A & 1B generally have more boardwalk expense and less retaining wall expense, while Route 2A & 2B have higher retaining wall cost and lower boardwalk cost. Please refer to tabulated costs in the Appendices for detailed information.

CONCLUSIONS

Our study of different boardwalk structure types quickly identified the need to utilize light framing systems that could easily be constructed using manual labor and small equipment to minimize the foundation demands and the environmental impact of construction. Retaining wall options along the trail were also limited to those that could be constructed of smaller elements, and limited temporary construction cuts that quickly eat up space and natural vegetation. Along WSDOT R/W, the retaining walls need to be of a type acceptable to WSDOT, as well as have very limited construction footprints to minimize the disturbance to traffic.

It has been my pleasure providing this information to you. Please feel free to contact me with questions or other options you would like to explore.

Respectfully,
Sargent Engineers, Inc.

Digitally signed by Jessica S. Soward
Date: 2018.04.17 12:44:42 -07'00'

Jessica Soward, PE, SE
Principal

JSS
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SARGENT
Sargent Engineers, Inc.
320 Ronlee Lane NW
Olympia, WA 98502
Tel 360-867-9284

CONSTRUCTION COST ESTIMATE 1A - ALUMINUM

ITEM NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	COST
	STRUCTURE				
	HANDRAIL	L.F.	1400	$ 150.00	$ 210,000
	DECKING	S.F.	7000	$ 50.00	$ 350,000
	FRAMING	LB	24000	$ 12.00	$ 288,000
	PIERS	EA	180	$ 600.00	$ 108,000
				SUBTOTAL	$ 956,000
				TOTAL	$ 956,000

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CONSTRUCTION COST ESTIMATE 1A - TIMBER

ITEM NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	COST
	STRUCTURE				
	HANDRAIL	L.F.	1400	$ 150.00	$ 210,000
	DECKING	S.F.	7000	$ 30.00	$ 210,000
	FRAMING	M.B.F.	22	$ 4,500.00	$ 99,000
	PIERS	EA	180	$ 600.00	$ 108,000
				SUBTOTAL	$ 627,000
				TOTAL	$ 627,000

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CONSTRUCTION COST ESTIMATE 1A

ITEM NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	COST
	STRUCTURE				
	SOLDIER PILE WALL	S.F.	4225	$ 200.00	$ 845,000
	SOIL NAIL WALL	S.F.	1500	$ 130.00	$ 195,000
	MSE WALL	S.F.	5150	$ 60.00	$ 309,000
				SUBTOTAL	$ 1,349,000
				TOTAL	$ 1,349,000

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CONSTRUCTION COST ESTIMATE 1B - ALUMINUM

ITEM NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	COST
	STRUCTURE				
	HANDRAIL	L.F.	1560	$ 150.00	$ 234,000
	DECKING	S.F.	7800	$ 50.00	$ 390,000
	FRAMING	LB	27300	$ 12.00	$ 327,600
	PIERS	EA	200	$ 600.00	$ 120,000
				SUBTOTAL	$ 1,071,600
				TOTAL	$ 1,071,600

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Olympia, WA 98502
Tel 360-867-9284

CONSTRUCTION COST ESTIMATE 1B - TIMBER

ITEM NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	COST
	STRUCTURE				
	HANDRAIL	L.F.	1560	$ 150.00	$ 234,000
	DECKING	S.F.	7800	$ 30.00	$ 234,000
	FRAMING	M.B.F.	25	$ 4,500.00	$ 112,500
	PIERS	EA	200	$ 600.00	$ 120,000
				SUBTOTAL	$ 700,500
				TOTAL	$ 700,500

SARGENT
Sargent Engineers, Inc.
320 Ronlee Lane NW
Olympia, WA 98502
Tel 360-867-9284

CONSTRUCTION COST ESTIMATE 1B

ITEM NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	COST
	STRUCTURE				
	SOLDIER PILE WALL	S.F.	3225	$ 200.00	$ 645,000
	SOIL NAIL WALL	S.F.	3000	$ 130.00	$ 390,000
	MSE WALL	S.F.	5150	$ 60.00	$ 309,000
				SUBTOTAL	$ 1,344,000
				TOTAL	$ 1,344,000

SARGENT
Sargent Engineers, Inc.
320 Ronlee Lane NW
Olympia, WA 98502
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CONSTRUCTION COST ESTIMATE 2A - ALUMINUM

ITEM NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	COST
	STRUCTURE				
	HANDRAIL	L.F.	1020	$ 150.00	$ 153,000
	DECKING	S.F.	5100	$ 50.00	$ 255,000
	FRAMING	LB	20200	$ 12.00	$ 242,400
	PIERS	EA	130	$ 600.00	$ 78,000
				SUBTOTAL	$ 728,400
				TOTAL	$ 728,400

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CONSTRUCTION COST ESTIMATE 2A - TIMBER

ITEM NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	COST
	STRUCTURE				
	HANDRAIL	L.F.	1020	$ 150.00	$ 153,000
	DECKING	S.F.	5100	$ 30.00	$ 153,000
	FRAMING	M.B.F.	18	$ 4,500.00	$ 81,000
	PIERS	EA	130	$ 600.00	$ 78,000
				SUBTOTAL	$ 465,000
				TOTAL	$ 465,000

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CONSTRUCTION COST ESTIMATE 2A

ITEM NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	COST
	STRUCTURE				
	SOLDIER PILE WALL	S.F.	2740	$ 200.00	$ 548,000
	SOIL NAIL WALL	S.F.	2490	$ 130.00	$ 323,700
	MSE WALL	S.F.	11100	$ 60.00	$ 666,000
				SUBTOTAL	$ 1,537,700
				TOTAL	$ 1,537,700

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CONSTRUCTION COST ESTIMATE 2B - ALUMINUM

ITEM NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	COST
	STRUCTURE				
	HANDRAIL	L.F.	1170	$ 150.00	$ 175,500
	DECKING	S.F.	5850	$ 50.00	$ 292,500
	FRAMING	LB	23200	$ 12.00	$ 278,400
	PIERS	EA	150	$ 600.00	$ 90,000
				SUBTOTAL	$ 836,400
				TOTAL	$ 836,400

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CONSTRUCTION COST ESTIMATE 2B - TIMBER

ITEM NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	COST
	STRUCTURE				
	HANDRAIL	L.F.	1170	$ 150.00	$ 175,500
	DECKING	S.F.	5850	$ 30.00	$ 175,500
	FRAMING	M.B.F.	21	$ 4,500.00	$ 94,500
	PIERS	EA	150	$ 600.00	$ 90,000
				SUBTOTAL	$ 535,500
				TOTAL	$ 535,500

SARGENT
Sargent Engineers, Inc.
320 Ronlee Lane NW
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CONSTRUCTION COST ESTIMATE 2B

ITEM NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	COST
	STRUCTURE				
	SOLDIER PILE WALL	S.F.	2600	$ 200.00	$ 520,000
	SOIL NAIL WALL	S.F.	3175	$ 130.00	$ 412,750
	MSE WALL	S.F.	10525	$ 60.00	$ 631,500
				SUBTOTAL	$ 1,564,250
				TOTAL	$ 1,564,250

APPENDIX C
ENVIRONMENTAL EVALUATION REPORT

Woodland Trail Alternate Routes Environmental Evaluation Report

Olympia, WA
Eastside to Henderson



February 2018

SCJ ALLIANCE
CONSULTING SERVICES

Woodland Trail Alternate Routes Environmental Evaluation

Project Information

Project:	**Olympia Woodland Trail Phase III Feasibility**
Prepared for:	**Jake Lund, P.E.** City of Olympia Parks, Arts and Recreation 222 Columbia St NW Olympia, WA 98501

Reviewing Agency

Jurisdiction:	City of Olympia 601 4th Ave East Olympia, WA 98501

Project Representative

Prepared by:	**SCJ Alliance** 8730 Tallon Lane NE, Suite 200 Lacey, WA 98516 360.352.1465 scjalliance.com
Contact:	Lisa Palazzi, CPSS, PWS

Project Reference:	SCJ #0630.05, Phase 23, Task 4

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1. INTRODUCTION

1.1 PROJECT OVERVIEW

The Woodland Trail Project Site is located between Eastside Street and Henderson Boulevard within Watershed Park, affecting 6 parcels owned by the City and 2 privately-owned parcels (Figure 1). The intent of this report is to assess wetland, stream and upland conditions along four alternate potential bicycle commuter trail routes designed to connect between the northeast Eastside Street entrance to Watershed Park and the roundabout at the Henderson Boulevard I-5 on-ramp. The bicycle trail will parallel and/or partially share an existing foot trail in some areas. The intent pf this report is to describe relative environmental impacts and permitting complexity for the alternate trail pathways. Figure 1 shows a representation of all four potential routes overlaid on one map.

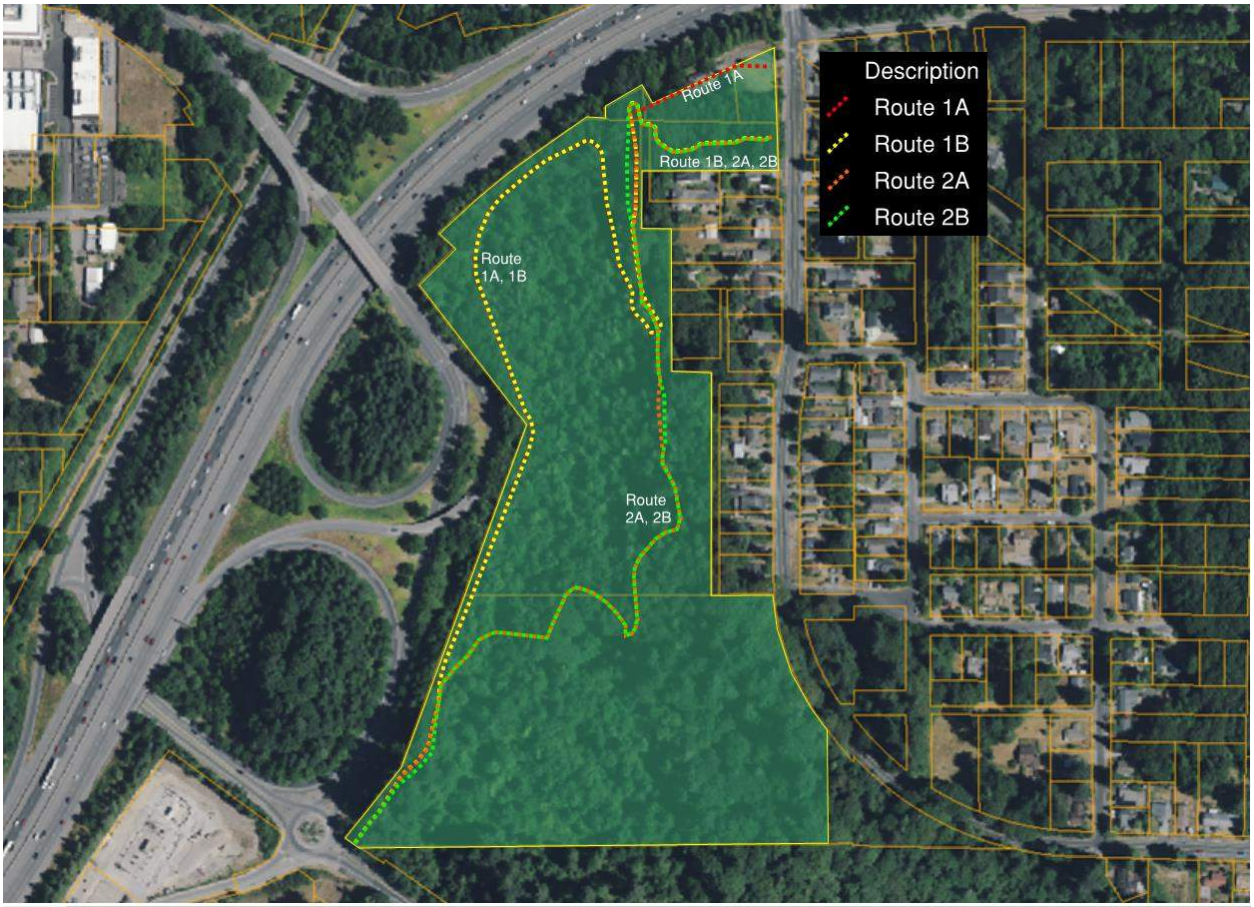

Figure 1. Site location map, showing project site parcels and 4 alternate trail routes.

An earlier regional trail report -- The Olympia Woodland Trail Feasibility Study -- was prepared in 1998 by a team led by SCA Engineering (SCAE). That study provided engineering and feasibility information on seven different trail segments in Olympia intended to interconnect with other existing City trails, and to potentially connect to other existing or developing regional trail systems in Tumwater. The trail segments assessed in the 1998 report are briefly listed below:

- *Trail Segment 1 — Tumwater Historical Park to Capitol Blvd. Bridge*
- *Trail Segment 2 — Capitol Blvd. Undercrossing*
- *Trail Segment 3 — Capitol Blvd. to Hillside Drive (Moss Lake)*
- *Trail Segment 4 — Henderson Blvd. to Eastside St. (Watershed Park)***
- *Trail Segment 5 — Eastside Street to Boulevard Road (Indian Creek)*
- *Trail Segment 6 — BNRR Railbed, Boulevard Road to Fones Road*
- *Trail Segment 7 — BNRR, Fones Road to Chehalis Western*

** Only Trail Segment 4 from that report is addressed in this report.

SCJ Alliance staff (Scott Sawyer, P.E., Whitney Holm, P.E., Lisa Palazzi, CPSS, PWS) and the City Parks Department Engineer (Jake Lund, P.E.) walked the routes onsite on November 29, 2017. The weather on the day of the field visit was slightly cold, but sunny. Hydrology in the onsite wetlands and streams was fully developed. Conditions for evaluating wetlands and streams were good. No wetlands were delineated, but potential crossing locations and approximate boundaries were noted.

2. METHODS AND MATERIALS

2.1 WETLAND REGULATIONS (FEDERAL AND STATE)

Under the Washington Administrative Code (WAC) section 173-22-035, the Washington State Department of Ecology (Ecology) requires wetland identification and delineation be completed following the approved federal wetland delineation manual and applicable regional supplements, including but not limited to the 1987 Corps of Engineers Wetland Delineation Manual and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0)* (U.S. Army Corps of Engineers 2010).

2.2 WETLAND RATING, CLASSIFICATION, AND BUFFERS

City of Olympia Municipal Code defines Wetland Protection Standards in Chapter 18.32, which includes requirements for rating the wetland and making buffer width determinations based on rating score results. As required by City of Olympia code, wetlands are rated according to the 2014 WRSWW (Ecology Publication #14-06-029, replacing #04-06-025). This system scores wetlands based on the functions of water quality, hydrology, and habitat. The Rating Manual also provides a process for assessing the wetland's sensitivity to disturbance and identifies rare or non-replaceable wetland characteristics.

The City has provided guidance for assigning updated buffers to the wetland, using results from the updated rating system in Exhibit A OMC 18.32.

Wetlands on the Project Site would be classified according to the USFWS Cowardin classification system (Cowardin et al. 1979) and the USACE Hydrogeomorphic (HGM) classification system (Brinson 1993).

No wetlands or streams were delineated for this phase of the project, but existing information from the Thurston County GeoData system and other mapping resources were used to develop a reasonably accurate assessment of where wetlands and stream systems would be impacted by the proposed trail alignments.

2.3 BACKGROUND MATERIALS

To help determine the site conditions that might affect delineation and rating results, SCJ Alliance staff reviewed the following information to provide site information:

- Thurston County GeoData mapping system (Thurston County 2018).
- City of Olympia Municipal Code – Chapter 18.32, and associated updates
- US Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) map (USFWS 2018).
- US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic database online Web Soil Service. (WEBS Soil Survey 2018).
- Precipitation data (US Climate Data 2018).
- Washington State Department of Fish and Wildlife (WDFW) Priority Habitat and Species (PHS). Database (WDFW PHS 2018).
- Washington State Department of Natural Resources (DNR) FPARS stream mapping system (DNR 2018).
- Google Earth historic timeline aerial photos of the project area.

3. RESULTS AND DISCUSSION

3.1 PROJECT AND SITE DESCRIPTION OVERVIEW

The 40.88-acre Project Site includes 8 parcels located between Eastside and Henderson, south of at 3000 Marvin Road NE, Lacey WA, (Figure 1, TPN 11802310200). Four optional trail routes are being considered to access Watershed Park between Eastside Street (from the northeast entrance) and Henderson Boulevard roundabout at the I-5 onramp. Watershed Park already has a foot trail system, but this new paved bicycle trail will connect to the Henderson Roundabout, which will facilitate future connections to other similar existing or developing trail systems farther west.

Table 1. Parcels potentially affected by the trail project.

Tax Parcel Number	Acreage	Ownership	Zoning
76301600000	11.73 Acres	City of Olympia	R-4-8
09690042000	27.48 acres	City of Olympia	R-4-8
09690034000	0.05 acres	City of Olympia	R-4-8
09690033000	0.8 acres	City of Olympia	R-4-8
78306500100	0.38 acres	James S. Wege	R-4-8
78306500400	0.23 acres	James S. Wege	R-4-8
78306000500	0.09 acres	City of Olympia	R-4-8
78306000600	0.12 acres of 8.55 acres[1]	City of Olympia	R-4-8

[1] Most of this parcel lays north of I-5, in the City of Olympia maintenance yard.

Research for this report was carried out to document baseline environmental conditions along the proposed trail alignments, and to describe key permitting issues, addressing City, state and federal regulations and related agency review complexity.

3.1.1 1998 Feasibility Assessment Review

This report adapts some of the information provided in the 1998 report, to provide continuity and context for this trail assessment update. A greatly abridged summary of the information for Trail Segment 4 from the 1998 report is provided below, as may be relevant to the current design work and analysis. Trail Segment 4 from the 1998 report was intended to solve some of the same problems as the currently proposed alternate alignments, which are described in more detail in the following sections.

"Feasibility" of Trail Segment 4 in the 1998 report was based primarily on:

- Whether the trail could be designed to meet federal, state and local bicycle and Americans with Disabilities Act (ADA) design standards;
- Whether the trail could be designed to comply with the City of Olympia Critical Area Ordinance and other environmental standards and regulations;
- Whether there were specific design features necessary to safely accommodate trail users when crossing bridges or raised trails over streams and wetland areas;

Based on the 1998 report, Trail Segment 4 had the following challenges:

- Difficult to design and construct trail sections due to steep terrain, wetland crossings and other factors
- Wetland, stream and buffer restoration or enhancements were needed
- Limitations for bicycle use due to needing to share the trail in some areas, steep slopes and blind corners
- A need to maintain aesthetics by minimizing trail impacts to natural scenery
- Difficulty with management of stormwater in accordance with the Olympia Stormwater Manual.

Route Analysis (1998 Project Issues)

"A portion of Trail Segment 4 is located along WSDOT right-of-way, but the majority of the segment will be situated within a pristine area of Watershed Park[2]."

Key 1998 project issues:

- *There are unavoidable impacts to wetland or stream areas from trail construction.*
- *Design standards to accommodate the elevation differences between the lowest area of Watershed Park and Eastside Street are difficult, but can be met.*
- *A bridge structure is needed to span the wetland areas.*
- *Careful construction methods will be required to build a trail in this steep and sensitive landscape.*

[2] To clarify, some of this alignment was to fall within the DOT ROW, while the trail alignments being evaluated below for this report are all inside the Park, outside of the ROW, but parallel to some of this 1998 alignment.

1998 Trail Segment 4 Alignment Alternatives

Two alternative trail alignments were considered for Segment 4. The two alignments were identical from Henderson to the crossing of Moxlie Creek. After the crossing, Alternative 1 stayed close to I-5 while Alternative 2 moved farther south. Both alignments are described below:

- Alternatives 1 and 2: Start at the Henderson Blvd. intersection with the I-5 City Center ramp[3], then continue northeast along the eastern edge of the freeway ramps within the ROW, then move into the park "*along heavy vegetated areas of Watershed Park where [the trail] will cross Moxlie Creek via a 250-foot low level bridge*[4]".
- Alternative 1: After the bridge, the Alternative 1 alignment would continue east along I-5 up a steep gradient (>8.33%), then in the ROW to Eastside Street.
- Alternative 2: After the bridge, the alignment runs slightly south of Alternative 1 "*through a wooded area of Watershed Park* [to] *Eastside Street at the current Watershed Park walking trail entrance*. The trail gradient would be at or exceed the maximum 8.33% slope.

The steep grades after the Moxlie Creek crossing would require landing areas for trail sections exceeding 5% -- i.e., 6 landing areas for Alternative 1 and 7 landings for Alternative 2.

Other Proposed 1998 Design Features

The proposed trail was to be 12' wide with a paved surface. 4.5-ft height hand railings would be required for trail user safety on sections with steep terrain beside the trail or on bridge structures. Low level lighting was proposed at the bridge abutments to illuminate approaches.

1998 Structural Analysis: Bridge and Trail Design Alternatives

- A 200-ft (up to 4-ft high) retaining wall would be needed to construct the western section of the trail along the City Center off-ramp. A traffic barrier would be needed on the top of the loop ramp.
- A low, 250-ft bridge would be required to cross Moxlie Creek and associated wetlands. A series of 50-ft spanning wood bridge sections were considered appropriate.
- East of the Moxlie Creek bridge, the Alternative 1 trail alignment would require a 200-ft long retaining wall up to 15-ft high.
- East of the bridge, the Alternative 2 trail route option would require a "through-cut" up to 25-ft deep. 2: 1 side slopes would require clearing and grading out to 120-ft of width. Cantilever retaining walls and 1.5/1 cut slopes were suggested to reduce the width of the cut impact by about half. Slopes would be vegetated to reduce erosion and to stabilize the deep cut.

1998 Environmental Considerations

Wetlands, Upland Buffers, and Other Vegetation

Much of Trail Segment 4 would run through upland buffers next to wetland systems, and Class II wetlands would be directly impacted by the trail footprint at three locations.

[3] The Henderson roundabout was not yet built in 1998.

[4] Moxlie Creek flows under I-5 about midway between the City Center ramp bridge and the Eastside Street bridge.

Under regulations in place in 1998, a 100-foot wetland buffer was assumed, based on the trail system being considered low intensity development. A conditional-use permit would have been required from the City. Presumably, mitigation would be required.

Vegetation Community Description Along the Trail

From Henderson Boulevard northeast for about 600-ft, the trail would cross landscaped upland and wetland buffers areas within the ROW. This section of Trail Segment 4 was described as "*dominated by various young ornamental trees, shrubs, and grasses associated with the interchange landscaping*", and included a stormwater detention basin.

The trail then moved into the Park and continued through an Alder-dominated Palustrine Forested wetland (PFO) at the base of the freeway ramp retaining wall. The trail continued through somewhat weedy wetland buffer ("*dominated by red alder, horsetail (Equisetum sp.), Scotch broom, and reed* canarygrass") and other upland areas dominated by red alder and swordfern.

The trail crossing at Moxlie Creek at the base of the freeway retaining wall was dominated by reed canarygrass and other herbaceous species. Other wetland areas farther away from the freeway but in the same wetland system were described as "*a Class II palustrine and riverine wetland"*.

After crossing the creek wetlands, the trail continued up a steep grade to the northeast. The Alternative 1 trail alignment paralleled I-5 in existing WSDOT landscaping "*dominated by various species of young (20-foot-tall) conifers such as western red cedar and Douglas-fir. Hardwood tree species"*. About 0.1 acres of treed area would be cleared.

The Alternative 2 alignment passed through mature, high quality upland forest habitat "*typical of western Washington composed of large coniferous and deciduous trees (e.g., Douglas-fir, hemlock, big leaf maples) and an understory of swordfern, Oregon grape, and salal".* About 0.74 acres treed area would be cleared.

Wildlife/Habitat

Disturbance along the freeway had already reduced viable habitat. Vegetation was dominated by "*ornamental, early successional, and/or invasive species such as Scotch broom, horsetail, and reed canarygrass"*. Habitat was suitable for *small rodents, birds, and small reptiles* [amphibians?]. Most wildlife use was expected to occur farther south within Watershed Park, away from the freeway.

The highest quality habitat along this trail segment was described as being located within Alignment 2 at the eastern end, in the area "*dominated by mature conifers and hardwoods with an understory of swordfern, Oregon grape, and salal*". Clearing necessary for Alternative 2 would eliminate a great portion of this more valuable habitat.

Proposed Buffer Mitigation

Because so much of Segment 4 was near the freeway, it was proposed to mitigate for wetland buffer impacts at a different location – at Moss Lake, west of Henderson Blvd.

Proposed Wetland Mitigation

The bridge crossing of Moxlie Creek was described as mitigation, as it was an improvement necessary to transport bicycles through this section (presumably to avoid impacts that might occur without a bridge). The impact to vegetation was to be minimized by elevating the bridge deck rather than placing fill in the wetland.

The bridge crossing was also at the narrowest section – which was assumed to result in the least overall area of wetland impact compared to other crossing areas. This also made wetland creation

near the crossing easier, in that construction equipment could more easily grade upland areas near the bridge crossing during construction to create additional wetland area at the 1.5:1 ratio required at the time of the 1998 study.

It was also proposed to transplant the 20 to 30 trees that would be displaced by clearing in uplands along the Alternative 1 trail alignment. No proposal was provided for impacts to trees from the Alternative 2 alignment.

1998 Soil & Slope Analysis

The western section of the trail within the ROW would be constructed over stable granular fill material placed for the road embankment construction supported by existing retaining walls. Several small retaining walls would be required in some areas along the trail.

"*The Hilfiker retaining wall presents the most significant construction issues along this portion of the alignment. Construction impacts can be minimized however, by construction of the proposed trail above the top strip of reinforcing for the wall. A cantilever soldier pile retaining wall that avoids temporary cuts into the roadway will be required along most of this section of the trail."*

Northeast of the "Hilfiker" wall, the trail would cross a natural, east sloping hillside. The soils in this area are formed in sandy, glacial drift sediments, and erosion control would be important. This soil type should be suitable as a base for the trail. associated structures.

The soils in the base of the Moxlie Creek Valley are Shalcar Mucks, a deep, very poorly drained organic silt. These soils would be soft and wet – offering minimal support for the trail and structures. However, it was assumed that pier/pile foundations could be established at a reasonable depth.

East of Moxlie creek, on the steeper sloped areas, the soils are fine sandy loams, which were expected to provide excellent support for the trail. The Alternative 1 alignment in this area would require small retaining walls. Slope stability was not expected to be a problem. The Alternative 2 alignment might require the use of multiple switchbacks or a deep cut at the east crest of the hill.

1998 Construction Methods and Techniques

Temporary construction access would be required from each side of the stream to construct the bridge abutments, and as a result, there would be temporary impacts to the wetland. Elevated pile supported construction decks could be used to limit impacts, but are very expensive. Using hand construction methods would minimize damage to the environment.

1998 Estimate of Probable Costs

The 1998 costs are no longer directly applicable, but Alternative 2 was about 12% more costly than Alternative 1 due to difficult construction work areas and unique methods of construction required to minimize environmental impacts.

1998 Mitigation Measures/Permit Requirements

Impacts to wetlands and buffer areas had to be mitigated, although using different standards than would apply today. Buffer impacts were proposed to be mitigated at Moss Lake. Wetland creation areas were identified in Watershed Park near the bridge crossing.

The permits and regulatory approvals below were assumed to be needed to construct Alternative 1:

- *Hydraulics Permit to construct the bridges*
- *SEPA/NEPA Documentation*
- *WSDOT Olympic Region & OSC Design Approval*

- *WSDOT Bridge Office Design Approval*
- *FHWA Design Approval*
- *Compliance with City of Olympia Critical Areas Ordinance for Wetland and Buffer Enhancement*

In summary, Alternative 1 in 1998 had the lowest cost and least disturbance to the environment. Some sections of the potential Trail Segment 4 alignments evaluated in 1998 are somewhat similar to sections of the four alternate alignments considered within this report. The information gathered in 1998 that is still relevant to varying degrees is applied below.

3.2 CURRENT TRAIL DESIGN AND ALIGNMENT ALTERNATIVES

Four alternate bicycle trail routes are considered for this report – labeled 1A, 1B, 2A, and 2B in the maps and discussion below. All four alignments start at the Henderson Blvd. Roundabout to the south, and all four alignments end at the NE entrance to Watershed Park at Eastside Street. See Figure 2 for a depiction of the four possible trail alignments. The proposed paved trail surface width is 10 feet, with 2 feet of sloped fill on both sides on average; therefore, for purposes of calculating potential fill impacts, a 14-foot average trail width is assumed. Fill may be limited or not allowed in wetland and stream crossing areas.

3.2.1 Alignments 1A and 1B

Alignments 1A and 1B would require construction of about 2,500 to 2,700 feet of entirely new trail in areas not currently impacted by the existing foot trail system in the Park. About 2/3rds of the proposed alignment does not parallel existing foot trails. Only the final 600 to 900 feet at the northeastern end of the 1A and 1B alignments (respectively) would parallel an existing foot trail.

1A and 1B follow a route somewhat similar to that described for the two alternate Trail 4 Segments in the 1998 report (summarized above). However, rather than running within the public ROW for several hundred feet at the southern end of the trail (from Henderson Boulevard), 1A and 1B instead enter the park immediately at the southern corner, running inside of the western fenced Park boundary along a mild side slope east of the City Center ramps. The combined 1A/1B trail alignment continues north for about 1600-ft inside the western edge of the Park, then turns northeast along the base of the freeway retaining wall. The 1A/1B trail would cross Moxlie Creek about 200 to 300 feet after the turn, where the creek is directed under the freeway in a culvert. Because the creek runs in a ditch that parallels the retaining wall for some distance (about 75 to 100 feet), the exact point of crossing would need to be determined later and might require slight realignment of the creek bed.

After the creek crossing, the 1A/1B trail would continue along the retaining wall for about 100-ft to the toe of a steep slope, then would turn south to cross along the side slope for about 600-ft to create a switchback turn and then parallel an existing foot trail up the hill. The trail would diagonal up the hillside to the north, and Alignment 1B would turn east to follow the existing foot trail alignment all the way to Eastside Street through Watershed Park property. The 1A alignment continues to the northern edge of the park, then turns east passing through private property (in a future easement) along the edge of the freeway ROW to the Eastside Street entrance.

3.2.2 Alignments 2A and 2B

Alternate trail alignments 2A and 2B follow the same route as 1B from the switchback turn north to the Eastside Street entrance (described above). The rest of the 2A and 2B alignments parallel the existing foot trail to the south then southwest for the most part, with a couple of minor reroutes along the way until about the last 600 to 700 feet of the trail, where the new bicycle trail alignment turns west to a new Moxlie Creek crossing, and then uphill to exit the park at the Henderson Boulevard Roundabout. The foot trail continues south along Henderson to a trailhead exit about 700-ft SE of the roundabout.

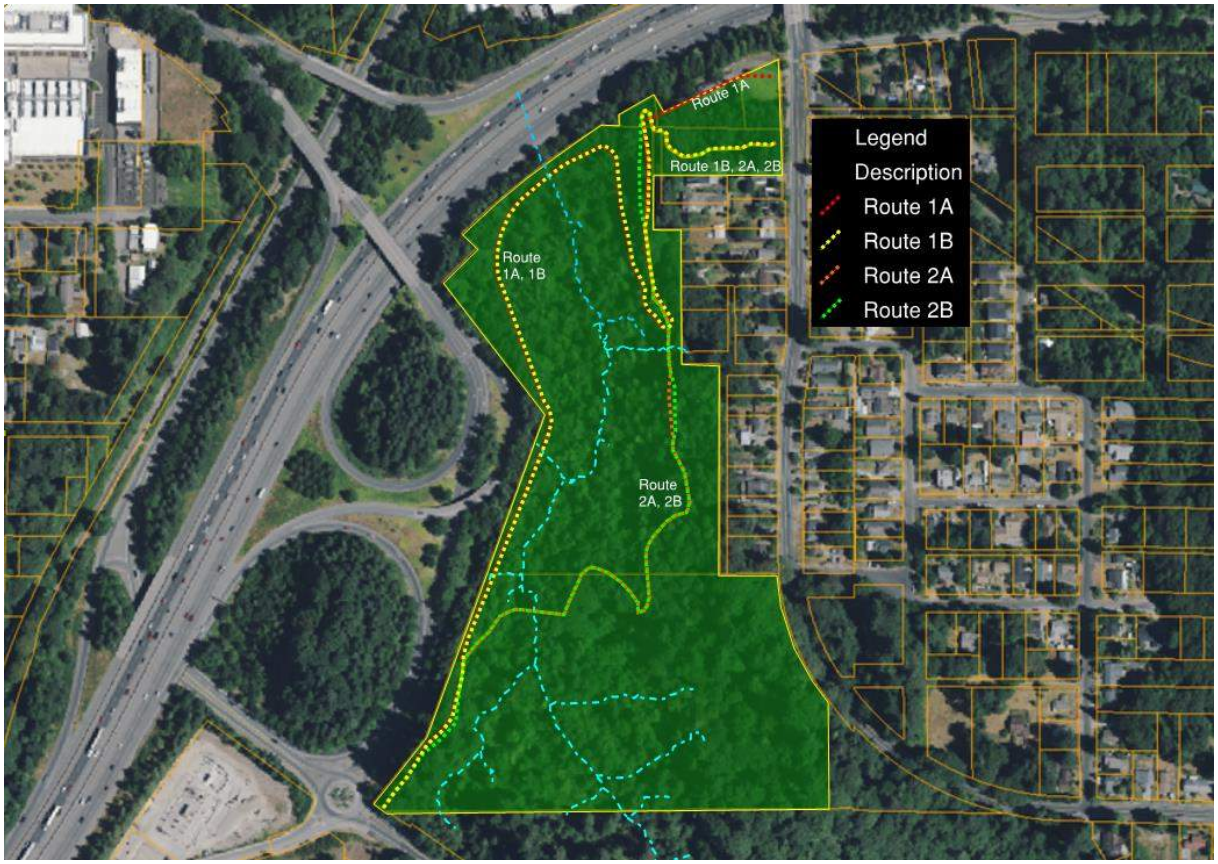

Figure 2. Showing the four alternate trail routes.

3.3 WETLAND, STREAM AND BUFFER IMPACTS OF THE ALTERNATE ALIGNMENTS

All four proposed trail alignments are entirely within the standard buffer of the Project Site wetlands or streams. This assumes a stream buffer of 250 feet (described more below) and a wetland buffer width of 300-ft. This is the estimated wetland buffer width, based from a preliminary rating score that defines the wetland complex in Watershed Park as a Category 1 wetland with a habitat score of 9 points.

Based on SalmonScape maps, the main channel of Moxlie Creek and some of the side channels are fish-bearing. The species listed include Fall chinook, coho, and Fall chum (documented presence and spawning) and winter steelhead (modeled presence), despite there being a partial blockage noted at the culvert below the freeway to the north. Therefore, for purposes of planning, the stream channel is

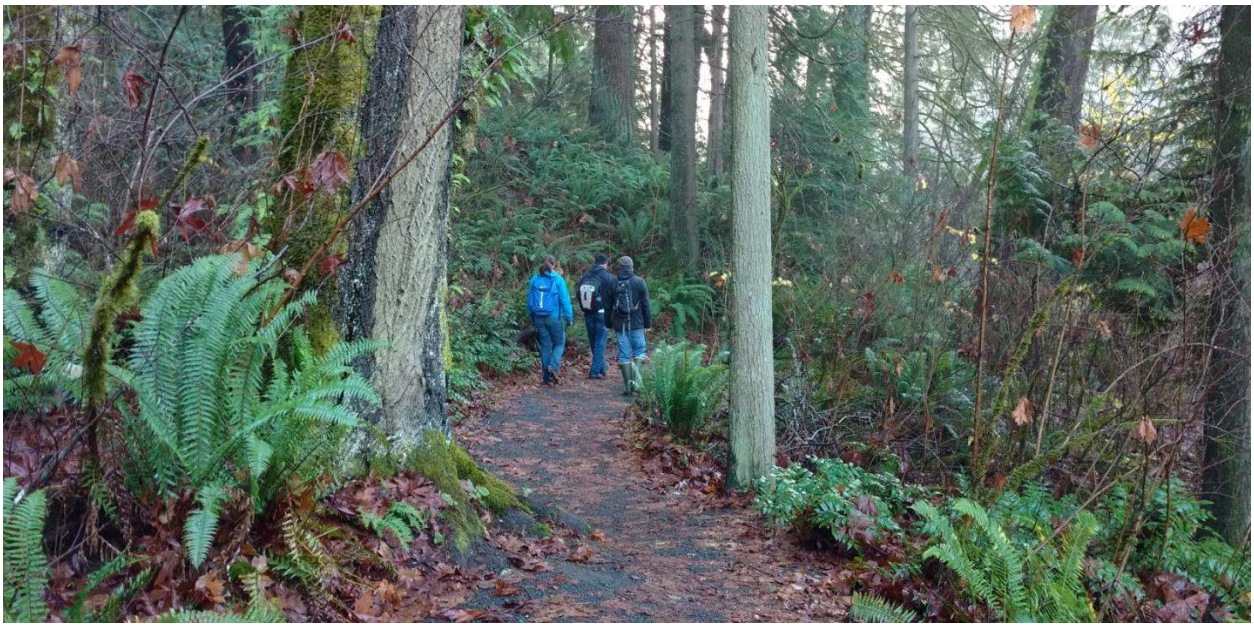

Figure 3. An example of existing trail section near the Eastside entrance.

assumed to contain critical salmon habitat, and thus has a 250-ft standard buffer, measured landward from the OHWM.

The existing foot trail has a gravel or compacted dirt surface about 6 to 10 feet wide in upland buffer areas (Figure 3). The walking surface width and trail conditions are highly variable, but in good condition for the most part. At stream and wetland crossings, the existing foot trail surface narrows to about 4-ft in width -- a wooden boardwalk in wetland areas or small spanning bridge at flowing stream crossings. This bridge width and design is not adequate for foot traffic to share with bicycles (Figure 4).

Figure 4. Showing of 4-5-ft wide bridged crossing at Moxlie Creek and associated wetlands.

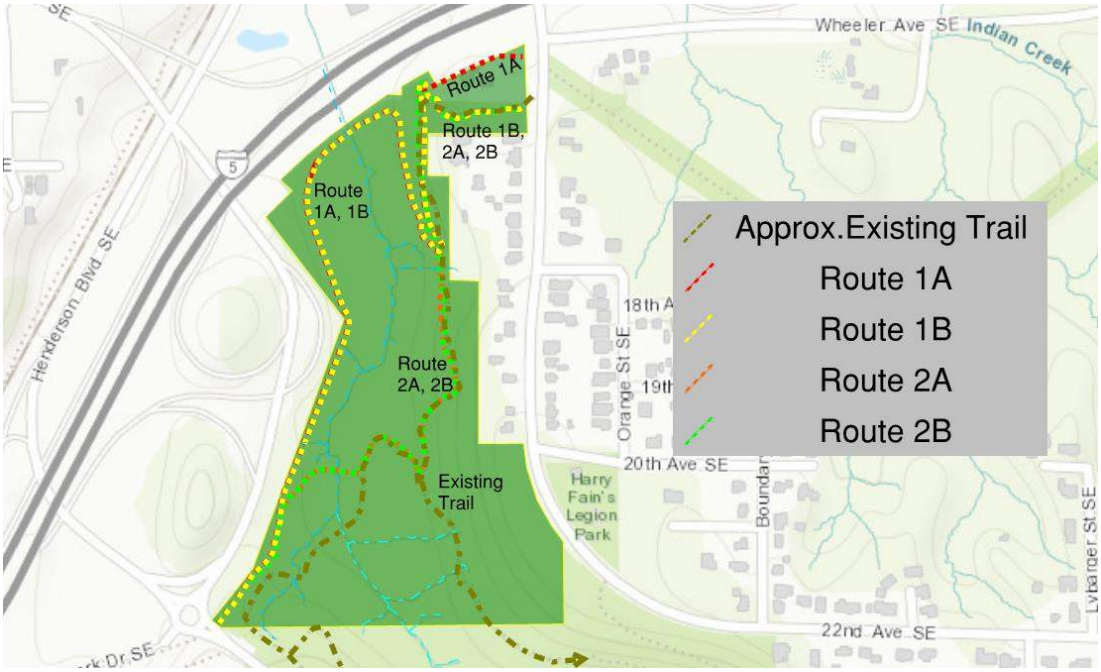

Figure 5. Existing and proposed trail alignments

New paved bicycle trail sections are proposed to have a 10-ft wide surface with 2-ft sloped shoulders on each side – an average fill footprint 14-ft in width.

Figure 5 shows the four proposed bicycle trail alignments in relation to the approximate location of the existing foot trail system. Figure 6 shows where there would be entirely new fill impacts to wetlands and streams away from existing foot trail impact areas. In some places, the trail alignment may be shifted slightly upslope or downslope to improve safety or reduce future trail damage potential.

As described above, Alignments 1A and 1B require building about 2,500 linear feet of trail in areas not currently impacted by the existing foot trail, including about 665 linear feet of new crossings through wetlands and across Moxlie Creek. Alternate 1B and 2B/ 2A follow a similar alignment as the existing foot trail at the far north end of the park, but may require additional widening at the shared entrance near Eastside Street. The primary difference between Alignment 1A and 1B is at the north end, with 1A paralleling the northern park boundary instead of the existing foot trail, approaching the Eastside Street entrance. 1A runs along the I-5 ROW while 1B parallels the existing foot trail to the south.

Alignments 2A and 2B for the most part parallel existing foot trails in Watershed Park, except for the southern end of the proposed bicycle trail alignment. About 600-ft north of the proposed Henderson roundabout park entrance, the new 2A/2B bicycle trail alignment turns west from the existing foot trail and continues to the western park boundary, then south along the boundary to the new proposed park entrance at the roundabout. This new alignment would result in a new wetland and Moxlie Creek stream crossing about 160-ft long. The primary difference between alignments 2A and 2B for the other parts of the proposed route is in small shifts in alignment in three different sections – two shifts in the existing trail alignment in the eastern part of the project area, and one shift in the new proposed route trail near the southern entrance. These shifts are intended to make better use of existing terrain. In general, these shifts are mostly within sloped buffer areas, and therefore do not result in additional impacts to wetlands.

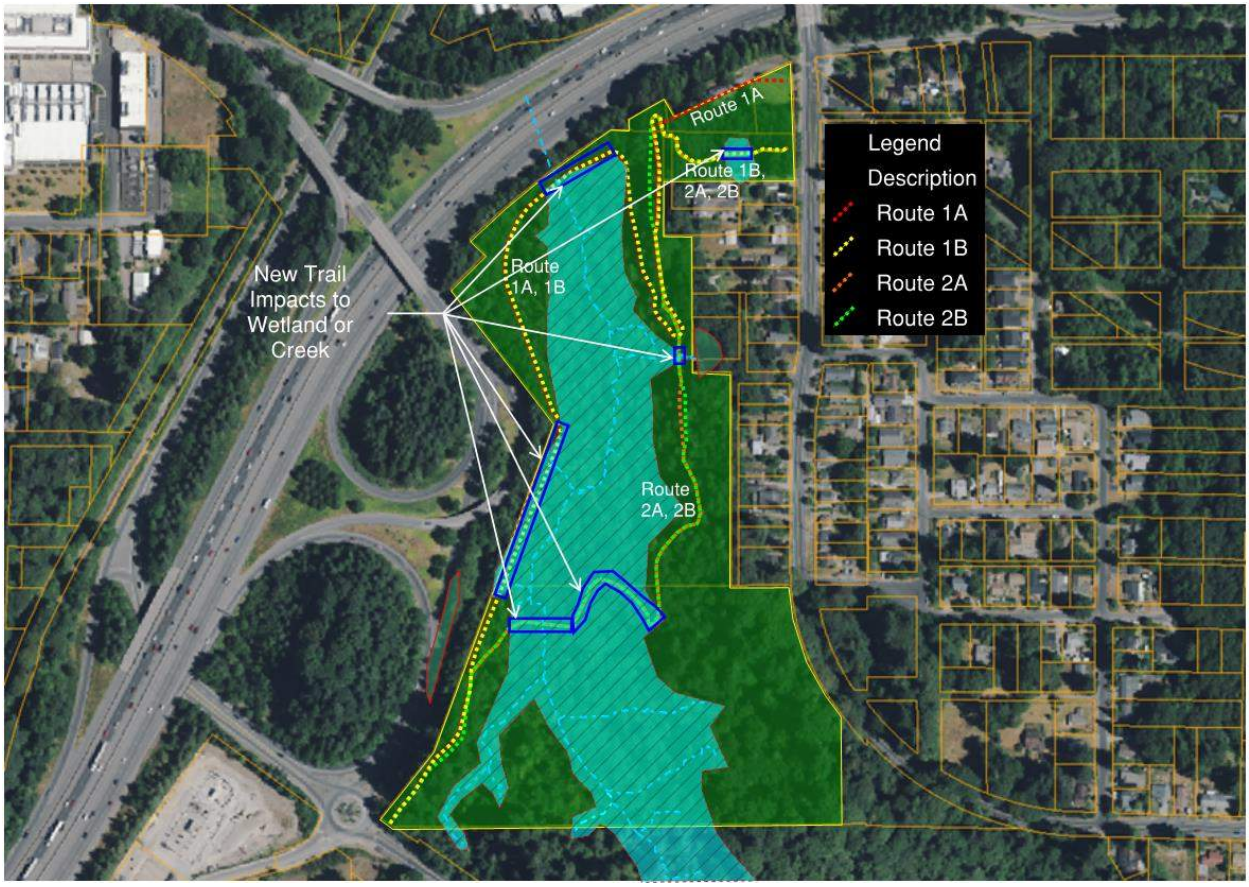

Figure 6. Showing new impacts at wetland and stream crossings. All other section are new impacts to buffers, although Routes 2A and 2B are mostly parallel to existing impacts

Other new fill impacts to wetlands, streams and buffers along the existing trail sections may be needed where the trail is slightly widened or shifted for functional or safety reasons, or where a new culvert might be required. Detailed trail designs are not yet finalized, but those site-specific impacts will be addressed cumulatively once final design defines the preferred alignment and determines final fill volumes in wetland and buffer areas.

As described above, the new trail system will have a 10-ft wide surface and on average, about 2-ft of sloped shoulder on each side, i.e., a 14-ft total fill pad width was used to estimate potential trail impacts to wetlands, streams and buffers. These estimated impacts are provided in Table 2 below. Using this average width dimension, Trail Alignments 1A and 1B would result in about 9,310-sqft and 10,262-sqft of new permanent wetland/stream fill impacts respectively. These two alignments would require a new bridge crossing at Moxlie Creek at the north end of the park. Trail Alignments 2A and 2B would both result in about 8,498-sqft of new permanent wetland/stream fill impacts. These two alignments would require a new bridge crossing at Moxlie Creek near the southern end of the new trail section.

Any crossings of Moxlie Creek will most likely need to be bridges that span at least the bank-full width, and possibly the entire Ordinary High Water Mark (OHWM) zone. Bridged crossings are a standard permit requirement for salmon-bearing streams. Because there will be no fill, the bridged section will be narrower than the fill pad, limited to the 10-ft paved surface width, and could be designed to be even narrower within safety limits, if needed to reduce impacts and required mitigation area. The impact

area is calculated by the fill footprint, or by the area of the bridge section overlaying the wetland and stream surface.

Wetland fill, or bridge impacts must be mitigated by creation of new wetland or by enhancement of existing wetland at ratios prescribed in code, as relates to the quality of the system being impacted. The wetland vegetation community at the proposed 1A/1B alignment crossing location is low quality – dominated by reed canarygrass and other weedy species. Therefore, there are many enhancement opportunities that could be proposed to improve nearby wetland and stream habitats. However, the wetland and stream crossing location near the south end of the 2A/2B alignment is relatively high quality. Therefore, mitigating for impacts to that area will be more costly, because replacement ratios may be higher, and there are fewer nearby opportunities for habitat improvement.

Construction impacts will be minimized as much as possible. However, it is difficult to build a trail without impacting some rea outside of the trail footprint. Therefore, for purposes of this report, temporary construction impacts are estimated to impact an additional 5-ft on both sides of the trail in buffer areas and on one side of the trail at wetland/stream crossings – under the assumption that most work can be accomplished from within the trail fill zone. Code requires that all temporary impact areas be restored to the pre-impact condition or better in wetland, stream and buffer areas.

At any new stream crossing location, construction will be limited to months with minimal impacts to the resident fish and seasonally resident salmonids.

Table 2. Estimated permanent and temporary wetland and buffer impact areas from the four alternate trail alignments.

Critical Area	Alternate 1A	Alternate 1B	Alternate 2A	Alternate 2B
New Wetland/ Stream Impacts (fill or bridge)	9,310 sqft (665-ft x 14-ft)	10,262 sqft (733ft x 14ft)	8,498-sqft (607-ftx14-ft)	8,498-sqft (607-ftx14-ft)
New Buffer impacts (trail fill)	33,208-sqft (2,372-ftx14-ft)	33,236-sqft (2,374-ftx14-ft)	30,524-sqft (2,181-ftx14-ft)	30,524-sqft (2,181-ftx14-ft
Temporary Wetland/ Stream impacts (during construction)	3,325-sqft (665-ftx5-ft)	3,665-sqft (733-ftx5-ft)	3,035-sqft (607-ftx5-ft)	3,035-sqft (607-ftx5-ft)
Temporary Buffer impacts (during construction)	23,720-sqft (2,372-ftx10)	23,740-sqft (2,374-ftx10)	21,810-sqft (2,181-ftx10-ft)	21,810-sqft (2,181-ftx10-ft)
Combined impacts	69,563-sqft	70,903-sqft	63,867-sqft	63,867-sqft

3.4 Buffer And Wetland Impacts and Conceptual Mitigation

Development of a detailed mitigation plan is not possible without a detailed site development proposal. However. but we briefly discuss mitigation options under current code. Because new fill volumes are in excess of 0.1 acres, federal (ACOE and others) review and permits will also be needed prior to project approval. If total fill volumes can be limited to less than 0.5 acres, the project may be reviewed through an ACOE Nationwide Permit process rather than an individual permit process – which will be more predictable and less expensive. Mitigation required under City regulations is usually either equivalent or greater than what is required under federal regulations. Therefore, the discussion below focuses on typical City mitigation requirements, and under the assumption that total fill and construction impacts to wetlands and streams are less than 0.5 acres.

Wetland crossing/fill: Any loss of wetland acreage must be mitigated for by creation (or re-establishment) of an equal or greater area of wetland and/or enhancement of habitat. In some cases, wetland rehabilitation or enhancement (rather than creation) may be used to compensate for fill impacts, but the ratios for those are higher than for creation, as they will result in a net loss of wetland acreage despite potentially improving existing wetland functions and values.

Therefore, the wetland replacement ratio is dependent on the quality of the wetland being impacted and the type of mitigation proposed. The City of Olympia uses replacement ratios defined in Table 8c-11, Appendix 8-C, of Wetlands in Washington State - Volume2: Guidance for Protecting and Managing Wetlands (2005) Ecology publication #05-06-008 (as amended or revised), which we provide below in Figure 7. The ratios for impacts to a Category I wetland range from 1:1 to 24:1. Because the range of potential replacement ratios is so wide, the exact mitigation method and ratio must be determined on a site-specific basis after detailed information about locally impacted wetland vegetation community, and related functions and values are defined.

Stream crossings: In general, any stream crossing in Watershed Park that is potentially fish-bearing must be bridged rather than filled and culverted, and the construction is limited to times of the year with least potential for impact to the species in question. The species documented in Watershed Park are Fall chinook, coho, and Fall chum (documented presence and spawning), and winter steelhead are considered to potentially be present (modeled presence). Therefore, construction activities would typically be limited to late spring and early to mid-summer, as prescribed by WDFW during the permit review process. Stream structure and associated habitat around the bridge will most likely require restoration or enhancement after construction is complete.

If a culvert is allowed at a stream crossing by WDFW, it is expected that an open-bottom arch culvert will be required, to ensure that the stream bed is formed in natural gravels. WDFW will review and approve culvert and bridge design through the HPA process.

Wetland or Stream Buffer Impacts:

Typically, wetland or stream buffer impacts are mitigated by enhancing and/or replanting an equivalent area (1:1 ratio) of existing buffer near to the impact area by planting with a suite of native plants comparable to what grows nearby in healthy buffer areas.

Required Mitigation Reports:

All mitigation areas and processes must be defined and described in a detailed mitigation planting plan, which includes maps showing areas of impact; locations of mitigation planting areas; and locations of mitigation structures (such as a public overlook, signs or fenced zones). This detailed mitigation plan must also include a description of processes that will be used to monitor and maintain the planted mitigation areas for 5-10 years, to ensure that the planned mitigation is successful. The Plan must also include a contingency plan, which describes what will be done if planted areas fail, or some aspect of mitigation does not perform to meet the standards defined in the mitigation plan. For wetland creation areas, the duration of monitoring is typically ten years; for buffer areas, duration may be less – 3 to 5 years. These details will be defined during the permitting and review process.

Figure 7. Table 8C-11, copied from Appendix 8-C, of Wetlands in Washington State - Volume2: Guidance for Protecting and Managing Wetlands (2005) Ecology publication #05-06-008

Table 8C-11. Mitigation ratios for projects in western Washington.

Category and Type of Wetland Impacts	Re-establishment or Creation	Rehabilitation Only[4]	Re-establishment or Creation (R/C) and Rehabilitation (RH)[4]	Re-establishment or Creation (R/C) and Enhancement (E)[4]	Enhancement Only[4]
All Category IV	1.5:1	3:1	1:1 R/C and 1:1RH	1:1 R/C and 2:1 E	6:1
All Category III	2:1	4:1	1:1 R/C and 2:1 RH	1:1 R/C and 4:1 E	8:1
Category II Estuarine	Case-by-case	4:1 Rehabilitation of an estuarine wetland	Case-by-case	Case-by-case	Case-by-case
Category II Interdunal	2:1 Compensation has to be interdunal wetland	4:1 Compensation has to be interdunal wetland	1:1 R/C and 2:1 RH Compensation has to be interdunal wetland	Not considered an option[5]	Not considered an option[5]
All other Category II	3:1	6:1	1:1 R/C and 4:1 RH	1:1 R/C and 8:1 E	12:1
Category I Forested	6:1	12:1	1:1 R/C and 10:1 RH	1:1 R/C and 20:1 E	24:1
Category I based on score for functions	4:1	8:1	1:1 R/C and 6:1 RH	1:1 R/C and 12:1 E	16:1
Category I Natural Heritage site	Not considered possible[6]	6:1 Rehabilitation of a Natural Heritage site	R/C Not considered possible[6]	R/C Not considered possible[6]	Case-by-case
Category I Coastal Lagoon	Not considered possible[6]	6:1 Rehabilitation of a coastal lagoon	R/C not considered possible[6]	R/C not considered possible[6]	Case-by-case
Category I Bog	Not considered possible[6]	6:1 Rehabilitation of a bog	R/C Not considered possible[6]	R/C Not considered possible[6]	Case-by-case
Category I Estuarine	Case-by-case	6:1 Rehabilitation of an estuarine wetland	Case-by-case	Case-by-case	Case-by-case
NOTE: Preservation is discussed in the following section.					

[4] These ratios are based on the assumption that the rehabilitation or enhancement actions implemented represent the average degree of improvement possible for the site. Proposals to implement more effective rehabilitation or enhancement actions may result in a lower ratio, while less effective actions may result in a higher ratio. The distinction between rehabilitation and enhancement is not clear-cut. Instead, rehabilitation and enhancement actions span a continuum. Proposals that fall within the gray area between rehabilitation and enhancement will result in a ratio that lies between the ratios for rehabilitation and the ratios for enhancement.

[5] Due to the dynamic nature of interdunal systems, enhancement is not considered an ecologically appropriate action.

[6] Natural Heritage sites, coastal lagoons, and bogs are considered irreplaceable wetlands because they perform some special functions that cannot be replaced through compensatory mitigation. Impacts to such wetlands would therefore result in a net loss of some functions no matter what kind of compensation is proposed.

4. CONCLUSIONS

Four trail alignments are assessed to compare potential benefits or costs from an environmental impacts perspective. Alignments 2A and 2B result in the least new impacts to both wetlands and buffers when compared to Alignments 1A and 1B. However, Alignments 1A and 1B impact lower quality habitats on average. All four alignments appear to fall within the range of impacts allowed under a federal (ACOE) Nationwide Permit, and therefore, may be considered effectively equivalent from a permitting complexity standpoint.

City of Olympia code encourages minimization of new impacts. Therefore, unless Alignments 1A and 1B are found to have distinct advantages over 2A or 2B, then due to less square footage of direct impact, Alignments 2A and 2B would be favored.

The costs to build Alignments 1A or 1B might be greater than 2A or 2B, partly due to needing to construct more linear feet of trail in areas with steep side slope terrain. This may also result in wider fill trail footprints for the 1A/1B alignment and therefore, require even more mitigation than the estimates described in Table 2.

The differences between the 2A and 2B are minor from a mitigation and habitat impacts perspective. A more precise comparison of those relative impacts will only be possible from detailed assessment of minor changes in trail terrain to improve either trail gradients or maintenance issues.

It may be important to note that Alignments 2A and 2B are in close proximity to the existing foot trail, and therefore will be impacting an area already somewhat impacted by past construction and by continuing use of the existing trail system. Therefore, entirely new habitat impacts are expected to be relatively minor.

5. REFERENCES

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APPENDIX D
COST ESTIMATES

SCJ ALLIANCE
CONSULTING SERVICES

City of Olympia
Karen Fraser Olympia Woodland Trail - Segment III
Conceptual Level Estimate Summary - Timber

Concept Description		Total
Alignment 1A		$4,460,000
Alignment 1B		$4,650,000
Alignment 2A		$4,460,000
Alignment 2B		$4,710,000

SCJ ALLIANCE
CONSULTING SERVICES

Element	Element Based Upon	Unit	Unit Cost	Karen Fraser Olympia Woodland Trail Segment III Alignment 1A Estimate Measurement	
Trailwork	**Estimated Quantities**				**$ 2,699,015**
	Mobilization	LS	8%	1	$ 254,255
	Clearing and Grubbing	ACRE	$30,000	2.00	$ 60,000
	Roadway Excavation Incl Haul	CY	$30	3,700	$ 111,000
	Select Borrow	CY	$25	5,450	$ 136,250
	Shared Use Path	LF	$33	2,670	$ 88,110
	Erosion Control	LF	$11	3,400	$ 37,400
	Handrails (Fill Walls)	LF	$80	450	$ 36,000
	Wall	LS	$1,349,000	1	$ 1,349,000
	Boardwalk	LS	$627,000	1	$ 627,000
Environmental					**$ 270,000**
	Wetland Mitigation	ACRE	$1,000,000	0.22	$ 220,000
	Environmental Permitting	LS	$50,000	1	$ 50,000
Engineering	**25%**				**$ 674,754**
	Design and Permitting		15%	1	$ 404,852
	Construction Management		10%	1	$ 269,902
	Subtotal				$ 3,643,769
	Miscellaneous/Contingency (30%)				$ 809,705
	Total				**$ 4,460,000**

SCJ ALLIANCE
CONSULTING SERVICES

Karen Fraser Olympia Woodland Trail Segment III Alignment 1B

Element	Element Based Upon	Unit	Unit Cost	Estimate Measurement	
Trailwork	**Estimated Quantities**				**$ 2,810,916**
	Mobilization	LS	8%	1	$ 264,796
	Clearing and Grubbing	ACRE	$30,000	2.00	$ 60,000
	Roadway Excavation Incl Haul	CY	$30	4,000	$ 120,000
	Select Borrow	CY	$25	5,950	$ 148,750
	Shared Use Path	LF	$33	2,590	$ 85,470
	Erosion Control	LF	$11	3,400	$ 37,400
	Handrails (Fill Walls)	LF	$80	625	$ 50,000
	Wall	LS	$1,344,000	1	$ 1,344,000
	Boardwalk	LS	$700,500	1	$ 700,500
Environmental					**$ 290,000**
	Wetland Mitigation	ACRE	$1,000,000	0.24	$ 240,000
	Environmental Permitting	LS	$50,000	1	$ 50,000
Engineering	**25%**				**$ 702,729**
	Design and Permitting		15%	1	$ 421,637
	Construction Management		10%	1	$ 281,092
	Subtotal				$ 3,803,646
	Miscellaneous/Contingency (30%)				$ 843,275
	Total				**$ 4,650,000**

SCJ ALLIANCE
CONSULTING SERVICES

Karen Fraser Olympia Woodland Trail Segment III Alignment 2A

Element	Element Based Upon	Unit	Unit Cost	Estimate Measurement	
Trailwork	**Estimated Quantities**				**$ 2,711,805**
	Mobilization	LS	8%	1	$ 255,460
	Clearing and Grubbing	ACRE	$30,000	1.67	$ 50,100
	Roadway Excavation Incl Haul	CY	$30	2,800	$ 84,000
	Select Borrow	CY	$25	5,550	$ 138,750
	Shared Use Path	LF	$33	2,215	$ 73,095
	Erosion Control	LF	$11	2,700	$ 29,700
	Handrails (Fill Walls)	LF	$80	975	$ 78,000
	Wall	LS	$1,537,700	1	$ 1,537,700
	Boardwalk	LS	$465,000	1	$ 465,000
Environmental					**$ 250,000**
	Wetland Mitigation	ACRE	$1,000,000	0.20	$ 200,000
	Environmental Permitting	LS	$50,000	1	$ 50,000
Engineering	**25%**				**$ 677,951**
	Design and Permitting		15%	1	$ 406,771
	Construction Management		10%	1	$ 271,180
	Subtotal				$ 3,639,756
	Miscellaneous/Contingency (30%)				$ 813,541
	Total				**$ 4,460,000**

SCJ ALLIANCE
CONSULTING SERVICES

Karen Fraser Olympia Woodland Trail
Segment III
Alignment 2B

Element	Element Based Upon	Unit	Unit Cost	Estimate Measurement	
Trailwork	**Estimated Quantities**				**$ 2,871,692**
	Mobilization	LS	8%	1	$ 270,522
	Clearing and Grubbing	ACRE	$30,000	1.67	$ 50,100
	Roadway Excavation Incl Haul	CY	$30	2,350	$ 70,500
	Select Borrow	CY	$25	8,260	$ 206,500
	Shared Use Path	LF	$33	2,140	$ 70,620
	Erosion Control	LF	$11	2,700	$ 29,700
	Handrails (Fill Walls)	LF	$80	925	$ 74,000
	Wall	LS	$1,564,250	1	$ 1,564,250
	Boardwalk	LS	$535,500	1	$ 535,500
Environmental					**$ 250,000**
	Wetland Mitigation	ACRE	$1,000,000	0.20	$ 200,000
	Environmental Permitting	LS	$50,000	1	$ 50,000
Engineering	**25%**				**$ 717,923**
	Design and Permitting		15%	1	$ 430,754
	Construction Management		10%	1	$ 287,169
	Subtotal				$ 3,839,615
	Miscellaneous/Contingency (30%)				$ 861,508
	Total				**$ 4,710,000**

SCJ ALLIANCE
CONSULTING SERVICES

City of Olympia
Karen Fraser Olympia Woodland Trail - Segment III
Conceptual Level Estimate Summary - Aluminum

Concept Description		Total
Alignment 1A		$5,130,000
Alignment 1B		$5,400,000
Alignment 2A		$5,020,000
Alignment 2B		$5,340,000

SCJ ALLIANCE
CONSULTING SERVICES

Element	Element Based Upon	Unit	Unit Cost	Karen Fraser Olympia Woodland Trail Segment III Alignment 1A Estimate Measurement	
Trailwork	**Estimated Quantities**				**$ 3,134,349**
	Mobilization	LS	10%	1	$ 360,589
	Clearing and Grubbing	ACRE	$30,000	2.00	$ 60,000
	Roadway Excavation Incl Haul	CY	$30	3,700	$ 111,000
	Select Borrow	CY	$25	5,450	$ 136,250
	Shared Use Path	LF	$33	2,670	$ 88,110
	Erosion Control	LF	$11	3,400	$ 37,400
	Handrails (Fill Walls)	LF	$80	450	$ 36,000
	Wall	LS	$1,349,000	1	$ 1,349,000
	Boardwalk	LS	$956,000	1	$ 956,000
Environmental					**$ 270,000**
	Wetland Mitigation	ACRE	$1,000,000	0.22	$ 220,000
	Environmental Permitting	LS	$50,000	1	$ 50,000
Engineering	**25%**				**$ 783,587**
	Design and Permitting		15%	1	$ 470,152
	Construction Management		10%	1	$ 313,435
	Subtotal				$ 4,187,936
	Miscellaneous/Contingency (30%)				$ 940,305
	Total				**$ 5,130,000**

SCJ ALLIANCE
CONSULTING SERVICES

Karen Fraser Olympia Woodland Trail Segment III Alignment 1B

Element	Element Based Upon	Unit	Unit Cost	Estimate Measurement	
Trailwork	**Estimated Quantities**				**$ 3,296,459**
	Mobilization	LS	10%	1	$ 379,239
	Clearing and Grubbing	ACRE	$30,000	2.00	$ 60,000
	Roadway Excavation Incl Haul	CY	$30	4,000	$ 120,000
	Select Borrow	CY	$25	5,950	$ 148,750
	Shared Use Path	LF	$33	2,590	$ 85,470
	Erosion Control	LF	$11	3,400	$ 37,400
	Handrails (Fill Walls)	LF	$80	625	$ 50,000
	Wall	LS	$1,344,000	1	$ 1,344,000
	Boardwalk	LS	$1,071,600	1	$ 1,071,600
Environmental					**$ 290,000**
	Wetland Mitigation	ACRE	$1,000,000	0.24	$ 240,000
	Environmental Permitting	LS	$50,000	1	$ 50,000
Engineering	**25%**				**$ 824,115**
	Design and Permitting		15%	1	$ 494,469
	Construction Management		10%	1	$ 329,646
	Subtotal				$ 4,410,573
	Miscellaneous/Contingency (30%)				$ 988,938
	Total				**$ 5,400,000**

SCJ ALLIANCE
CONSULTING SERVICES

Element	Element Based Upon	Unit	Unit Cost	Karen Fraser Olympia Woodland Trail Segment III Alignment 2A Estimate Measurement	
Trailwork	**Estimated Quantities**				**$ 3,073,312**
	Mobilization	LS	10%	1	$ 353,567
	Clearing and Grubbing	ACRE	$30,000	1.67	$ 50,100
	Roadway Excavation Incl Haul	CY	$30	2,800	$ 84,000
	Select Borrow	CY	$25	5,550	$ 138,750
	Shared Use Path	LF	$33	2,215	$ 73,095
	Erosion Control	LF	$11	2,700	$ 29,700
	Handrails (Fill Walls)	LF	$80	975	$ 78,000
	Wall	LS	$1,537,700	1	$ 1,537,700
	Boardwalk	LS	$728,400	1	$ 728,400
Environmental					**$ 250,000**
	Wetland Mitigation	ACRE	$1,000,000	0.20	$ 200,000
	Environmental Permitting	LS	$50,000	1	$ 50,000
Engineering	**25%**				**$ 768,328**
	Design and Permitting		15%	1	$ 460,997
	Construction Management		10%	1	$ 307,331
	Subtotal				$ 4,091,640
	Miscellaneous/Contingency (30%)				$ 921,994
	Total				**$ 5,020,000**

SCJ ALLIANCE
CONSULTING SERVICES

Karen Fraser Olympia Woodland Trail Segment III
Alignment 2B

Element	Element Based Upon	Unit	Unit Cost	Estimate Measurement	
Trailwork	**Estimated Quantities**				**$ 3,279,339**
	Mobilization	LS	10%	1	$ 377,269
	Clearing and Grubbing	ACRE	$30,000	1.67	$ 50,100
	Roadway Excavation Incl Haul	CY	$30	2,350	$ 70,500
	Select Borrow	CY	$25	8,260	$ 206,500
	Shared Use Path	LF	$33	2,140	$ 70,620
	Erosion Control	LF	$11	2,700	$ 29,700
	Handrails (Fill Walls)	LF	$80	925	$ 74,000
	Wall	LS	$1,564,250	1	$ 1,564,250
	Boardwalk	LS	$836,400	1	$ 836,400
Environmental					**$ 250,000**
	Wetland Mitigation	ACRE	$1,000,000	0.20	$ 200,000
	Environmental Permitting	LS	$50,000	1	$ 50,000
Engineering	**25%**				**$ 819,835**
	Design and Permitting		15%	1	$ 491,901
	Construction Management		10%	1	$ 327,934
	Subtotal				$ 4,349,174
	Miscellaneous/Contingency (30%)				$ 983,802
	Total				**$ 5,340,000**