Stormwater Management Plan

OR DOT CRGNSA 100(1)
Historic Columbia River Highway State Trail (Segments A-D)
Columbia River Gorge National Scenic Area
Task Order No. T-13-001, Modification 004, Task 6.4
Multi-Discipline IDIQ Contract No. DTFH70-10-D-00020

Hood River County

Prepared for:

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1.0 PURPOSE AND BACKGROUND

1.1 Purpose

This report is a Stormwater Management Plan prepared for the proposed Wyeth Trailhead to Starvation Creek section (Segments A-D) of the Historic Columbia River Highway State Trail (HCRHST). The report includes the design calculations for the stormwater quality and quantity facilities, and outlines the overall drainage concept for Segments A-D including drainage patterns and outfalls. Hydraulic analysis for major drainages are not included in this report. The proposed Wyeth Trailhead to Starvation Creek trail section is located on the south side of Interstate 84 (I-84), starting at the Wyeth parking area and terminating at Starvation Creek State Park in Hood River County, Oregon (Figure 1).

1.2 Background

The proposed Wyeth Trailhead to Starvation Creek trail project area traverses land owned by the State of Oregon (Oregon Department of Transportation (ODOT) right of way and Oregon Parks and Recreation Department), and federal land managed by the USDA Forest Service (USFS). The entire trail section is within the Special Management Area (SMA) for natural resources of the Columbia River Gorge National Scenic Area (CRGNSA). Projects in the SMA of the CRGNSA must comply with the CRGNSA Management Plan (Plan; CRGC 2007) and the Hood River County Zoning Ordinance, Article 75 (Hood River County 2009). As such, a National Scenic Area Permit (NSAP) will be required.

The proposed Wyeth Trailhead to Starvation Creek trail is part of a larger effort to connect intact and abandoned segments of the Historic Columbia River Highway (HCRH) for recreational use, as called for in the 1986 CRGNSA Act. Portions of the HCRH have been abandoned, removed, and segmented by the construction of I-84. The CRGNSA Management Plan specifically calls for the following within the SMA:

> "Intact and usable highway segments should be connected with recreation trails to create a continuous route through the Columbia River Gorge that links local, state, and federal recreation and historic sites" (CRGC 2011).

Segments A-D of the proposed Project will follow the HCRH State Trail Guidelines (ODOT 2011), and include the following components:

- Grading, base, paving and drainage for a paved 3.93-mile-long pedestrian/bicycle path, 10-12 feet wide with two 2-foot shoulders, with grades generally up to 5% (occasionally up to 8%).
- Incorporation of remnant sections of the HCRH.
- Trailhead improvements at Wyeth, just east of the Exit 51 interchange of I-84.
- Rock fall protection.
- Rock through-cut, including blasting.
- Retaining walls.
- Viaduct.
- Traffic barriers to separate the proposed trail from adjacent I-84.
- New pedestrian/bicycle bridge over Warren Creek.
- Extension of an existing culvert at Summit Creek.

- Viewing areas and scenic spur trails.

2.0 PROJECT DESCRIPTION

The Project is located on the Oregon side of the Columbia River Gorge in Hood River County (Figure 1). The Project parallels existing I-84, between approximate mile points (MP) 51 and 55. The Area of Potential Impact (API) crosses two fish-bearing streams—Lindsey and Warren Creeks—and four non-fish-bearing streams (Summit, Wonder, and Cabin Creeks, and one unnamed creek), all tributaries of the Columbia River. The Columbia River flows westerly and is located north of the API. The API is separated from the Columbia River by I-84 and the Union Pacific Railroad (UPRR).

The Project is located within the Western Cascades Lowlands and Valleys level IV ecoregion (Thorson, et al. 2003), typified by lush, western hemlock/Douglas-fir stands. This ecoregion is found on the lower slopes of the Cascades, and contains steep valleys with high-gradient rivers and streams that support cold-water salmonids (Thorson, et al. 2003). The climate of the ecoregion is characterized as wet and mild (Thorson, et al. 2003).

The Project begins at the existing Wyeth parking lot, located several hundred feet east of I-84 Exit 51. Upon completion, the proposed 3.93-mile trail will cross over remnant sections of the HCRH and existing access roads, through ODOT right-of-way (ROW) with roadside vegetation; State of Oregon park land with mixed deciduous/coniferous forest, scattered mid-size coniferous trees, rocky outcrops, and doghair coniferous forest; and USFS property with riparian forest, conifer forest with non-native components, and ruderal forest openings.

The proposed trail will be constructed completely adjacent to or over head of I-84 or within earshot of I-84 behind vegetative screening. The highway road shoulders are sparsely vegetated, dominated by non-native species, periodically mowed, and provide minimal habitat for wildlife or plant species due to the proximity to I-84. These sections occupy most of the trail length. A few of these sections will be located behind existing retaining walls or at the base of cut slopes. Some of the rocky slopes are actively creeping or are depositional areas.

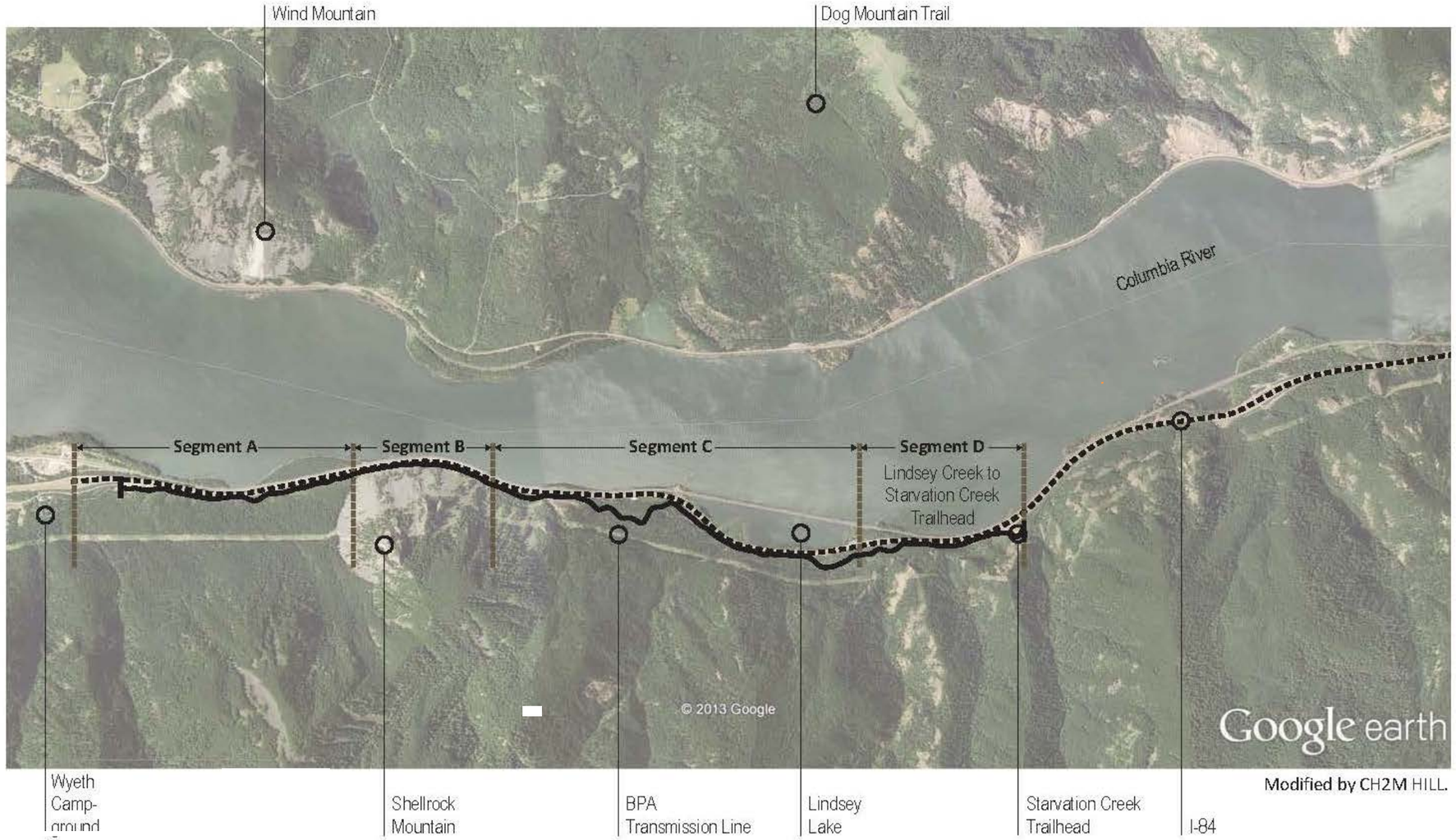
The following summaries of each trail segment are derived from The Historic Columbia River Highway State Trail Plan—Wyeth to Hood River (Quatrefoil, Inc. 2010).

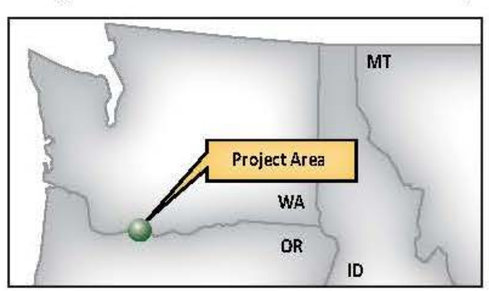
Segment A (Wyeth to Shellrock Mountain). The existing Wyeth Trailhead site is undeveloped, but highly disturbed with old concrete foundations and remnants of past development. The existing USFS property (tax lot 020801 00200) will be avoided. Invasive species are abundant. Wetlands and waters are generally off-alignment, and direct impacts will be avoided as much as possible. The trail will follow an existing embankment fill of unknown origin, then travel through doghair conifer forest on a talus cut slope. (A few hundred small conifers would need to be cleared for the trail to traverse through the doghair stand.) Some of the trail will travel alongside I-84.

Segment B (Shellrock Mountain to Summit Creek). This segment will wind for about 3,000 feet around the unstable, uniform talus slopes of Shellrock Mountain that extend about 1,500 feet above the river. For the most part, the trail will be adjacent to I-84 or behind bin walls, and will cross Summit Creek over the existing culvert under I-84 (which will need to be lengthened).

Segment C (Summit Creek to Lindsey Creek). This trail segment will transition from roadway-adjacent to the remnant historic highway by way of a concrete viaduct, then follow a 2,000-footlong section of remnant historic highway lined by a mature forest stand with a diversity of native vegetation. At the eastern end of the existing section of historic highway, the trail will climb a hill over an existing ridge and bench cut into existing rock, avoiding most large trees. The trail descends via rocky sloped terraces with stunted conifers to the riparian area along Lindsey Creek.

Segment D (Lindsey Creek to Starvation Creek State Park). This segment follows a constructed embankment at the west and an old section of highway at the east before reaching the Starvation Creek State Park parking area. Between the two ends, the trail crosses the Warren Creek/Wonder Creek riparian floodplain on USFS-managed land, then a historic site notable for its non-native vegetation.





LEGEND

Proposed Project Route

I-84

North

0 — 1 Mile

Approximate scale

FIGURE 1
Vicinity Map

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CH2MHILL.

3.0 REGULATORY FRAMEWORK AND PERMITTING

The trail will run along the south side of the Columbia River and will cross two fish-bearing streams—Lindsey and Warren Creeks—and five non-fish-bearing streams (Summit, Wonder, and Cabin creeks, and two unnamed creeks). The portion of the Columbia River, River Mile (RM) 51 to 55, adjacent to the project area falls in the Main Stem Columbia Basin as defined by the Oregon Department of Environmental Quality (DEQ). This section outlines the regulations that currently protect water quality in the Main Stem of the Columbia Basin and the permits required due to the projects vicinity and potential impact on them.

The Clean Water Act (CWA) requires Oregon to undertake specific activities to protect the quality of its rivers, estuaries, and lakes. Every two years, DEQ assesses water quality and reports to EPA on the condition of Oregon's waters (DEQ, 2010b). DEQ prepares an integrated report that meets the requirements of the CWA for Section 305(b) and Section 303(d). CWA Section 305(b) requires the preparation of report on overall condition of state waters. Whereas, Section 303(d) requires that the state identify waters that do not meet water quality standards and thus require a Total Maximum Daily Load. When a TMDL is established for a given parameter, the water body is removed from the CWA Section 303(d) list for this parameter, though it may remain on the list for other water quality issues.

The Main Stem Columbia Basin has TMDLs needed for Temperature and Arsenic and approved for DDT. From RM 35.2 to 98.0, the Columbia River is listed on DEQ's CQA Section 303(d) list of impaired water for Polychlorinated Biphenyls (PCB). No TMDLs were found for the streams that the trail will be crossing.

Beneficial uses for both water bodies are listed in Oregon Administrative Regulations (OAR) 340, Division 41. OAR 340, Division 41 is designed to protect beneficial uses of water bodies from new or increased point and nonpoint pollution sources. The OAR 340-041 beneficial uses for the Main Stem Columbia Basin and Hood Basin are listed in Table 1.

Both the Oregon Fill and Removal Law and Section 404 of the federal Clean Water Act require that water quality impacts associated with construction be addressed. Section 401 of the federal Clean Water Act requires DEQ certification that the project will not violate water quality standards. Section 401 of the federal Clean Water Act requires that DEQ certify that water quality standards are not violated, which necessitates that stormwater management and construction practices be addressed. Typically, the permit requires concurrence from NMFS on

TABLE 1
OAR 340-01 Beneficial Uses

Beneficial Use	Main Stem Columbia River Basin (RM 86-309)	Hood Basin
Public Domestic Water Supply	X	X
Private Domestic Water Supply	X	X
Industrial Water Supply	X	X
Irrigation	X	X
Livestock Watering	X	X
Wildlife and Hunting	X	X
Fishing	X	X
Boating	X	X
Water Contact Recreation	X	X
Aesthetic Water Quality	X	X
Hyrdo Power	X	X
Commercial Navigation & Transportation	X	X

Source: OAR-340-01-0101 and OAR-340-01-0160, 2012

the appropriate management of stormwater and construction activities. Current standards are contained in the *Endangered Species Act Programmatic Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Federal-Aid Highway Program in the State of Oregon* (NMFS No: 2011/02095). ODOT stormwater guidance regarding both quantity and quality will be used for the stormwater analysis and design.

Major areas of concern during construction are anticipated to be erosion prevention and sediment control. For construction activities, DEQ is responsible for issuance and enforcement of their NPDES 1200-C permits. The NPDES 1200-C permit identifies, for construction activities disturbing in excess of 1 acre of land, activities during construction to assure an acceptable standard of water quality. It is anticipated that the construction will be covered under the Oregon Department of Transportation's 1200-CA Permit.

Erosion prevention and sediment control (EPSC) will need to be addressed during construction. The project will need Oregon DEQ erosion and sediment control plans prior to the start of any construction. EPSC measures will include sediment fence and wattles for disturbed areas; inlet protection for storm systems; protection of engineered water quality facilities during construction; gravel construction entrances; wheel washes; and vegetative cover of disturbed areas. The contractor will also be required to maintain a spill control kit to be used in case of a material spill.

4.0 SITE CHARACTERIZATION

4.1 Zoning

The Project area is located in Hood River County, Oregon, immediately south of the Columbia River and north of the Cascades mountain range. The project area and the land immediately surrounding it are a mixture of open space, parks, industrial and commercial. Most of the land is federal or state owned.

4.2 Climatic Data

The local climate is predominantly influenced by marine air that flows through the Columbia River Gorge from the west and continental weather patterns from the east. The marine air contributes to moderate temperatures throughout the year. However, continental weather patterns can cause extreme temperatures in the summer and winter months. The Dalles is the closest NOAA station to the project site. It has a recorded high of 112 F and a low of -21 F (Western Regional Climate Center).

The Dalles is located in a semi-arid climate with moderate temperatures. Table 2 summarizes monthly normal for maximum, minimum, and mean temperatures. The annual average precipitation for The Dalles is 14.55 inches of rainfall. The Dalles also receives an average of 5.1 inches of snow annually (National Climatic Data Center). The majority of the rain and snowfall occurs in November through January.

TABLE 2

National Climatic Data Center Monthly Normal Temperatures- The Dalles, OR

Mean, Maximum, Minimum Normal Temperatures (1981-2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max Temp (F)	43.4	49.3	58.3	65.4	73.4	80	88.2	88.5	81.3	67.6	51.9	42.1
Min Temp (F)	29	29.5	34.4	39.2	46.3	52.5	57.8	56.7	48.7	39.3	33.4	28.7
Mean Temp (F)	36.2	39.4	46.3	52.3	59.8	66.3	73	72.6	65	53.4	42.6	35.4

Source: NOAA National Climatic Data Center, 1981-2010 Normals

4.3 Soils

The project area is located in Hood River County. An on-line soil survey within the Project Area is not available on the USDA Soil Survey (*Web Soil Survey*, USDA Natural Resource Conservation Service). No field soil surveys have been conducted to date to identify soil types in the project area.

4.4 Hydrology & Floodplain

The entire project area is located outside and south of the Federal Emergency Management Area (FEMA) 100-year floodplain. FEMA publishes Flood Insurance Rate Maps that delineate the 100-year floodplains and floodways. Figure 2 (FEMA, 1984) shows that the project area is outside the Zone A flood area. The Columbia River has a 100-year floodplain and flood flow associated with them. Table 3 shows the FEMA flood flows for the Columbia River.

TABLE 3

Federal Emergency Management Agency Flood Flows

Water Body	Drainage Area (sq mi)	10-yr Event (cfs)	50-yr Event (cfs)	100-yr Event (cfs)	500-yr Event (cfs)
Columbia River	237,000	500,000	600,000	700,000	800,000

Source: Flood Insurance Study, City of the Dalles, Oregon, Wasco County, FEMA, 1983

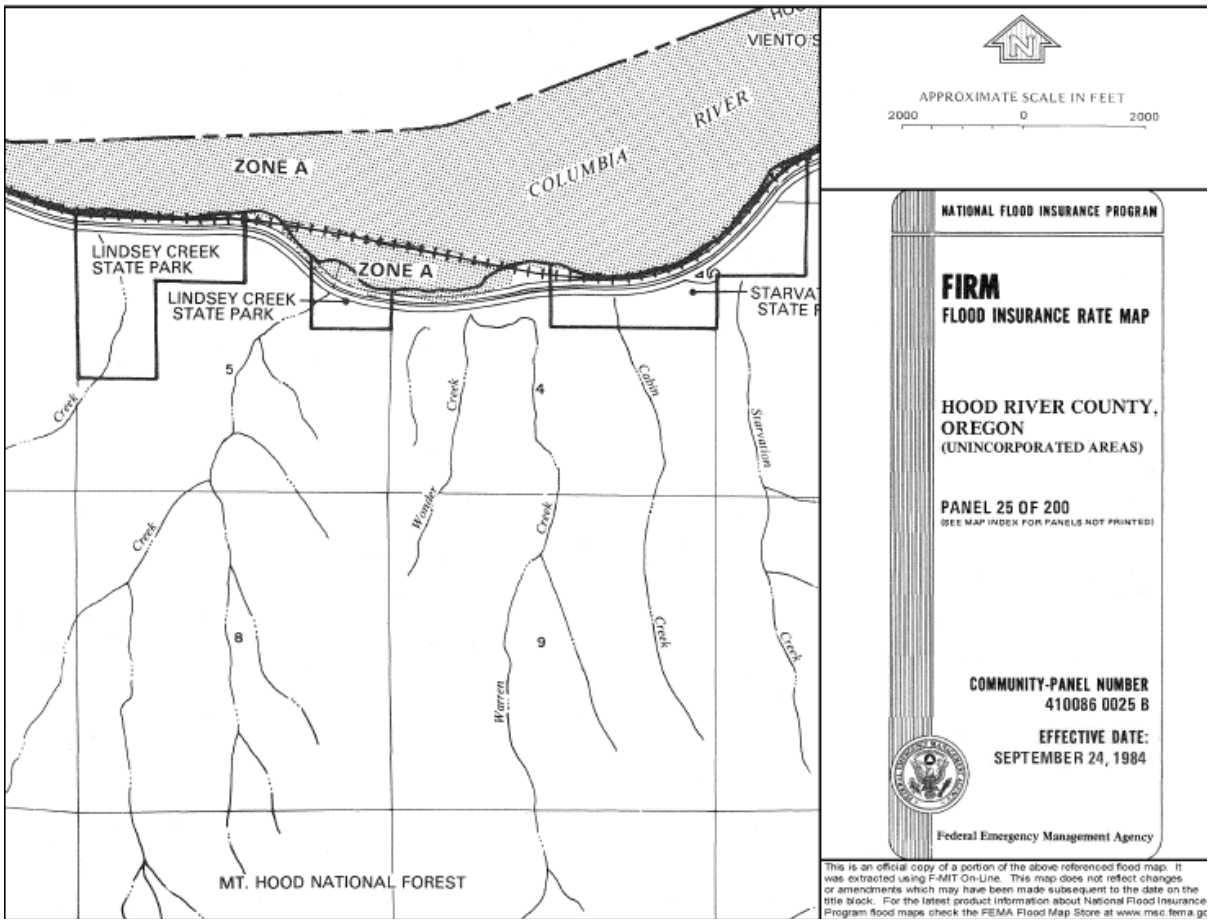

Figure 2 – FEMA Flood Insurance Rate Map for the Project Area.

4.5 Groundwater Quality

A search of the DEQ website (http://www.deq.state.or.us/wq/groundwater/docs/mapgwmas.pdf) for water quality confirms that the project area is not located in a groundwater management area or in an EPA-designated sole source aquifer area.

4.6 Surface Water Quality

In order to assess ambient water quality in the Columbia River monitoring data were retrieved from DEQ's Laboratory Analytical Storage and Retrieval (LASAR) Web application (DEQ, 2010a). These water quality data were collected on the Columbia River. Table 4 summarizes information about the station locations, the station identifiers DEQ uses and the period of record.

TABLE 4

Oregon Department of Environmental Quality Water Quality Sampling Stations

Station ID	River	Lat/Long	Period of Record
29459	Starvation Creek State Park	45.6888 / 121.7652	Jan 1997 –June 2003
12042	Columbia River	45.6992 / 121.6647	June 1993 – Sept 2008

Source: DEQ, 2012

In order to characterize the current water quality conditions, data from DEQ (DEQ, 2010a) were analyzed and compared to the Basin-Specific Water Quality Criteria for the Main Stem Columbia River (RM 51) and Hood Basin outlined in OAR 340, Division 41. These water quality standards are not to be exceeded in order to protect aquatic life and human health and are listed in Table 5.

Table 6 summarizes DEQ LASAR averages for pertinent water quality data in the Columbia River. Table 6 also includes data for Starvation Creek. Only three samples were collected there and analyzed for Nitrate-N. Limited data was available for this analysis and no fresh water quality criteria is available for comparison to OAR-340-0101 standards for the Columbia River for pH, 5-day BOD, total suspended solids (TSS), and total dissolved solids (TDS).

TABLE 5
Applicable Water Quality Criteria

Parameter	Main Stem Columbia Basin-Specific Fresh Water Quality Criteria	Hood Basin-Specific Fresh Water Quality Criteria
pH	7–8.5	6.5–8.5
Total Dissolved Solids	500.0 mg/L	500.0 mg/L
5-day BO	20 mg/L	10 mg/L
Total Suspended Solids	20 mg/L	10 mg/L

Source: OAR 340-041-0101 and OAR 340-041-0165

TABLE 6
DEQ Station Pollutant Concentration Ranges- Columbia River and Starvation Creek

	Units	Columbia River Station 12042	Starvation Creek Station 29459
E. coli	(MPN/100 ml)	2 to 4.1	
Enterococcus		<5 to 15	
Fecal Coliform	(MPN/100 ml)	4 to 79	
Conductivity@ 25°C	(µmhos/cm)	106 to 142	
Field DO	(mg/L)	6.88 to 9.43	
Field Temperature	(°C)	14.3 to 23.9	
Field Turbidity	(NTU)	1.22 to 9.32	
Nitrate – N	(mg/L)		0.01 to 0.06

Source: DEQ LASAR

Stormwater runoff from pedestrian and bike trails carries few of the pollutants that run off roads and highways, which carry a variety of pollutants that include suspended sediment, nutrients, oils and grease, and heavy metals.

Table 7 depicts the acute (short-term) and chronic (long-term) concentration criteria for dissolved metals not to be exceeded in waters of the state in order to protect aquatic life and human health. The values in Table 7, which are from “Table 20” of the Oregon Administrative Rules (OAR) 340, Division 41, have been converted to milligrams per liter (mg/L), allowing easier comparison to sampled and calculated data. Unfortunately, no data on dissolved metals concentration were available from the DEQ LASAR stations for analysis.

TABLE 7
Applicable Freshwater Water Quality Criteria

Parameter	Acute (mg/L)	Chronic (mg/L)
Cadmium	0.0039+	0.0011+
Chromium (III)	1.700+	0.210+
Copper	0.018+	0.012+
Lead	0.082+	0.0032+
Nickel	1.400+	0.160+
Selenium	0.260	0.035
Silver	0.0041+	0.00012
Zinc	0.120+	0.110+

+ Hardness Dependent Criteria 100 mg/L used
Source: Table 20, OAR 340-041

5.0 STORMWATER RUNOFF

5.1 Existing and New Impervious areas

This Segments A-D of the trail are approximately 3.9 miles in length. The section includes segments of the historic highway considered to be existing impervious area. The new impervious area includes trailheads and widened trail areas. Table 8 lists impervious areas by trail segment.

TABLE 8
New and Existing Impervious Areas

	New Impervious[1] (Ac)	Existing Impervious[2] (Ac)	Total Impervious (Ac)
Segment A (12+50 to 65+00)	1.46	0.04	1.50
Segment B[3] (65+00 to 107+00)	1.16	0.00	1.16
Segment C (107+00 to 152+00)	0.65	0.59	1.24
Segment D (152+00 to 218+46)	1.64	0.26	1.90
Total	4.91	0.89	5.80

[1] Includes pullouts, Starvation Creek Trailhead, widening at walls and barriers.
[2] Includes Historic Highway Segments, parking at Wyeth, and walks at Starvation Creek.
[3] Includes approximately 580 ft. of viaduct.

5.2 Constraints

The project has extremely limited usable right-of-way because it is sandwiched between Interstate-84 to the north and is at the toe of the gorge slope on the south. Areas of unstable slopes limits the ability to widen the trail footprint or shift the alignment to the south.

There are a number of creeks flowing to the Columbia River that must be accommodated. Summit Creek crossing in an existing 66-inch CMP culvert carrying this non-fish stream under I-84 and will be extended to carry the trail along the I-84 shoulder. Impacts to the stream will be temporary and controllable, and buffer impacts will be minimized by aligning the trail along the previously disturbed I-84 shoulder.

The trail will cross Lindsey Creek via the existing concrete box culvert that carries the creek under I-84. Therefore, direct impacts to this ESA-fish stream will be avoided, and riparian impact for trail construction will be minimized by generally following previously disturbed ground along the I-84 shoulder.

Warren Creek (ST-7) is an ESA-fish stream that appears to go dry at times. This stream will be crossed with a new bridge sized to span the channel and maintain fluvial function of the creek.

A few relatively minor and unnamed jurisdictional waters cross the trail alignment at various places, and will need to be accommodated by the drainage design.

I-84 generally sheds to the north; however, a few sections are crowned, directing some runoff to the south.

5.3 Drainage

Drainage design will be based on ODOT standards. Conveyance and spread design will be based on the 10-year event. The project is within ODOT Zone 5 for IDF curves. Minimum culvert size will be 18-inch diameter. Maximum storm sewer length will be 400 lineal feet.

The typical trail section will be cross-sloped toward the south and away from I-84. Flows will be carried in a vegetated ditch along the south side of the trail where cross culverts will carry the flow under the trail for eventual discharge. Table 9 lists the anticipated cross culverts and their size.

TABLE 9

Summary of anticipated Trail cross-culverts

Segment ID	Approximate Station	Culvert Diameter (in)	ESA Fish[1]	Native Fish[1]	Fish Passage Required [1]
A	18+40	18″	No	No	No
A	24+00	18″	No	No	No
A	33+25	18″	No	No	No
A	36+65	18″	No	No	No
A	39+00	18″	No	No	No
A	64+00	18″	No	No	No

TABLE 9

Summary of anticipated Trail cross-culverts

Segment ID	Approximate Station	Culvert Diameter (in)	ESA Fish[1]	Native Fish[1]	Fish Passage Required [1]
B	70+00	18”	No	No	No
B	80+00	18”	No	No	No
B	86+90	18”	No	No	No
B	91+85	18”	No	No	No
B	100+38	18”	No	No	No
B	106+10	Summit Creek exist 66” CMP to be extended	No	No	No
B	106+80	18”	No	No	No
C	136+90	18”	No	No	No
C	147+60	18”	No	No	No
C	152+00	Lindsey Creek exist 7’x12’ RCB	Yes	Yes	Yes
D	160+50	18”	No	No	No
D	173+15	18”	No	No	No
D	178+00	Proposed Warren Creek Bridge	Yes	Yes	Yes
D	185+00	18”	No	No	No
D	192+65	18”	No	No	No
D	201+25	18”	No	No	No
D	202+95	24”	No	No	No
D	216+50	18”	No	No	No

[1] Fish presence based on Biological Research and Impact Assessment Report

Sections of the trail are adjacent to I-84, with a barrier separating the trail from the shoulder of I-84. The segment from approximate station 50+00 to 60+00 is adjacent to I-84 where the cross slope of the east bound I-84 lane is cross sloped toward the trail barrier. The I-84 ditch flows are carried by an 18-inch pipe with four G-2 inlets placed along the barrier to limit the shoulder spread to 9-feet within the 12-foot shoulder. Additional impacts to the I-84 ditch will be at approximate stations 33+00 to 39+00 and 153+00 to 170+00. Both of these locations are on the high side of the I-84 super. Inlets are provided to maintain maximum pipe runs of under 400 feet.

6.0 BEST MANAGEMENT PRACTICES

Erosion and Sediment Control Plans (ESCPs) will be written well in advance of construction; best management practices (BMPs) employed by the plans will ensure that sediment does not reach either waterbody during construction. ESCPs and stormwater management plans (SWMP) will protect sensitive resources, including Lindsey and Warren Creeks.

Wherever possible construction BMPs will be sustainable. For example, straw wattles will be used in preference to silt fence where possible. The ODOT Erosion Control Manual and BMPs are based on the requirements of the National Pollutant Discharge Elimination System (NPDES) laws and permits.

The ESCP will prevent erosion to the extent possible through preservation of natural vegetation, mulching, matting, sheeting and dust control. Control of runoff will be accomplished through the use of construction entrances, tire washes, stabilization of temporary roads, and flow control with diversion dams and outlet protection.

The trail will increase the impervious surface area within the project boundaries, which has the potential to increase volume, velocity, and pollutant loading of stormwater runoff into the Columbia River. Additionally, the multi-use trail is intended for foot and bike traffic, which are not associated with stormwater pollutant concerns such as petroleum hydrocarbons and dissolved metals. Water quality treatment will be provided through overland, infiltration and ditch flow. The ultimate discharge is to the Columbia River where flow control is not required due the size of the receiving water.

Therefore, both quantity and quality impacts from stormwater runoff are expected to be nominal. The trail improvements are designed to fulfill project-wide federal Endangered Species Act (ESA) requirements.

7.0 MAINTENANCE PLAN

ODOT will be responsible for maintaining all the facilities that convey stormwater from the trail back to the natural drainage areas. ODOT will also be required to develop a detailed maintenance plan identifying specific maintenance actions and a schedule for each of those along with a contingency and repair plan. Maintenance will be aligned with their NPDES MS4 permit requirements.

8.0 CONCLUSIONS

The trail will increase the impervious surface area within the project boundaries, which has the potential to increase volume, velocity, and pollutant loading of stormwater runoff into the Columbia River. Additionally, the multi-use trail is intended for foot and bike traffic, which are not associated with stormwater pollutant concerns such as petroleum hydrocarbons and dissolved metals. Additionally, it is anticipated that runoff will sheet flow to adjacent vegetation where it will be filtered and infiltrate into the upper soil layer. Therefore, both quantity and quality impacts from stormwater runoff are expected to be minimal.

9.0 REFERENCES

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PRELIMINARY CALCULATIONS

STORMWATER DRAINAGE DESIGN
INLET/SPREAD CALCULATIONS

Project: HCRHT I-84 Inlets
Project Number: 465275

Location	Side	Inlet No.	From STA (Note Stationing has changed)	To STA	Section Width (ft)	Section Length (ft)	Area (ft^2)	Area (ac)	C	CA	Tc to CO (min)	Intensity I (in/hr)	Flow Q (cfs)	Slope: Pavement Long. SL (ft/ft)	Slope: Pavement Cross Sx (ft/ft)	Slope: Equiv. Cross Se	Pavement Manning's n 0.016	Prev. Bypass Qb (cfs)	Total Gutter Qg (cfs)	Depth D (ft)	Opening Length L (ft)	L_T (ft)	Spread: Calc'd T (ft)	Spread: Max T_{MAX} (ft)	Spread: Check	W/	Inlet Type	Gutter Width W (ft)	Gutter Velocity Vg (ft/sec)	Eo	Efficiency E	Rf	Rs	Intercept Flow Qi (cfs)	Bypass Flow (cfs)	Bypass %	Remarks
I-84 East Bound																																					
STA 51+40 to 61+45																																					
		1	50+00.00	52+50.00	68.0	250	17000	0.39	0.90	0.35	5.00	2.50	**0.88**	0.0065	0.0200	0.1300	0.016	**0.00**	**0.88**	0.15	1.95	5.09	**7.49**	**6.50**	**OK**	#	**G-2**	1.53	1.56	0.46	**0.57**	1.00	0.22	**0.50**	**0.37**	**43%**	
		2	52+50.00	55+00.00	68.0	250	17000	0.39	0.90	0.35	5.00	2.50	**0.88**	0.0065	0.0200	0.1300	0.016	**0.37**	**1.25**	0.17	1.95	5.91	**8.55**	**6.50**	**OK**	#	**G-2**	1.53	1.71	0.41	**0.52**	1.00	0.19	**0.65**	**0.60**	**48%**	
		3	55+00.00	57+50.00	68.0	250	17000	0.39	0.90	0.35	5.00	2.50	**0.88**	0.0065	0.0200	0.1300	0.016	**0.60**	**1.48**	0.18	1.95	6.33	**9.10**	**6.50**	**OK**	#	**G-2**	1.53	1.78	0.39	**0.50**	1.00	0.18	**0.74**	**0.74**	**50%**	
		4	57+50.00	60+00.00	68.0	250	17000	0.39	0.90	0.35	5.00	2.50	**0.88**	0.0065	0.0200	0.1300	0.016	**0.74**	**1.62**	0.19	0.00	6.58	**9.42**	**6.50**	**OK**	#	**None**	0.00	1.82	0.00	**0.00**	1.00	0.00	**0.00**	**1.62**	**100%**	

Max Flow in I-84 Pipe

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00646	ft/ft
Diameter	1.50	ft
Discharge	1.89	ft^3/s

Results

Normal Depth	0.48	ft
Flow Area	0.49	ft^2
Wetted Perimeter	1.81	ft
Hydraulic Radius	0.27	ft
Top Width	1.40	ft
Critical Depth	0.52	ft
Percent Full	32.2	%
Critical Slope	0.00492	ft/ft
Velocity	3.85	ft/s
Velocity Head	0.23	ft
Specific Energy	0.71	ft
Froude Number	1.15	
Maximum Discharge	9.08	ft^3/s
Discharge Full	8.44	ft^3/s
Slope Full	0.00032	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	32.16	%
Downstream Velocity	Infinity	ft/s

Max Flow in I-84 Pipe

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.48	ft
Critical Depth	0.52	ft
Channel Slope	0.00646	ft/ft
Critical Slope	0.00492	ft/ft

PRELIMINARY PLANS