

Response to Public Works Comment 5:

5. *Provide downstream analysis for the stormwater discharging to the Pleasant Bay Road ditch and beyond to Pleasant Bay.*

Downstream analysis was provided, however not sufficiently addressed. Consultant to provide an exhibit for the area in question to accompany narrative. Address capacity and condition of the downstream culvert and ditch.

Figure 3: *Cross Culvert Basins*, provided in our October 23, 2019 response to the August 14, 2019 NOAR, shows the locations of the stormwater discharge points and roadside ditches along Pleasant Bay Road. Figure 1, *Downstream Ditch*, of this (January 9, 2020) response shows a more detailed plan view of the Pleasant Bay Road ditch.

The proposed project will not redirected any new runoff to the Pleasant Bay Road ditch. The only change in the runoff to this ditch will be for the conversion of the site's gravel road to a paved road for the section of Road A-South from Sta. 1+00 to Sta 12+00. As stated in our previous response, a WWHM analysis was performed for this 585 ft section of road and a flow rate of 0.20 cfs was estimated for the 100-year developed flow. While this is not new runoff, for the sake of this ditch analysis we will conservatively assume that this 0.2 cfs flow is added to any existing background flow.

Two areas were identified as representative for evaluating the ditch. The first location, identified as Section A in Figure 1, shows the narrowest section of the ditch. At this location the ditch is "V" shaped, approximately three feet wide, one foot deep, and has an approximate slope of 7%. The second location is at the ditch's trail crossing. The ditch has a four foot wide flat bottom, is approximately 3.5 feet deep to the top of the trail, and has an approximate slope of 5%. Figure 2, *Typical Ditch Cross Sections*, provides details of these two ditch sections.

A Manning's Analysis was performed at both ditch cross sections to evaluate the ditch performance. For this analysis a six-inch deep flow in each section was assumed as the existing background flow. A 0.20 cfs flow was added to the section (to represent the runoff from the proposed road) and the new flow depth was calculated. The change in flow depth provides a very conservative assessment of the project's impact on the ditch. A summary of the calculations and results is provided in the table below:

Ditch Flow - Ditch Along Pleasant Bay Road										
DITCH CHARACTERISTICS	Trapezoid section						Type n	Slope (ft/ft)	V (ft/sec)	Q (ft ³ /sec)
	side slope	b - width	flow depth	area	wp					
	X:1	(ft)	(ft)	(ft ²)	(ft)					
Section A - with 6" flow depth	1.5	0	0.50	0.38	1.80	0.035	0.069	3.9	1.47	
Section A - with additional 0.2 cfs	1.5	0	0.52	0.41	1.89	0.035	0.069	4.1	1.67	
Section B - with 6" flow depth	1.5	4	0.500	2.38	5.80	0.035	0.050	5.2	12.46	
Section B - with additional 0.2 cfs	1.5	4	0.505	2.40	5.82	0.035	0.050	5.3	12.66	

Section A – Narrowest Ditch Section

A visual inspection was performed and the ditch was observed covered with low profile vegetated ground cover. This vegetation did not appear to impact the flow of runoff in the ditch and no signs of erosion or exposed soils were observed. Assuming the one-foot deep ditch has six-inches of base flow, the estimated ditch flow rate is 1.47 cfs. With the additional 0.20 cfs flow (for a new total flow rate of 1.67 cfs), the estimated flow depth is 0.52 inches, or an increase in flow depth of about ¼-inch. This increase in flow is not a significant impact on the ditch and well within the existing ditch's capacity.

Section B – Ditch Section at Trail Crossing

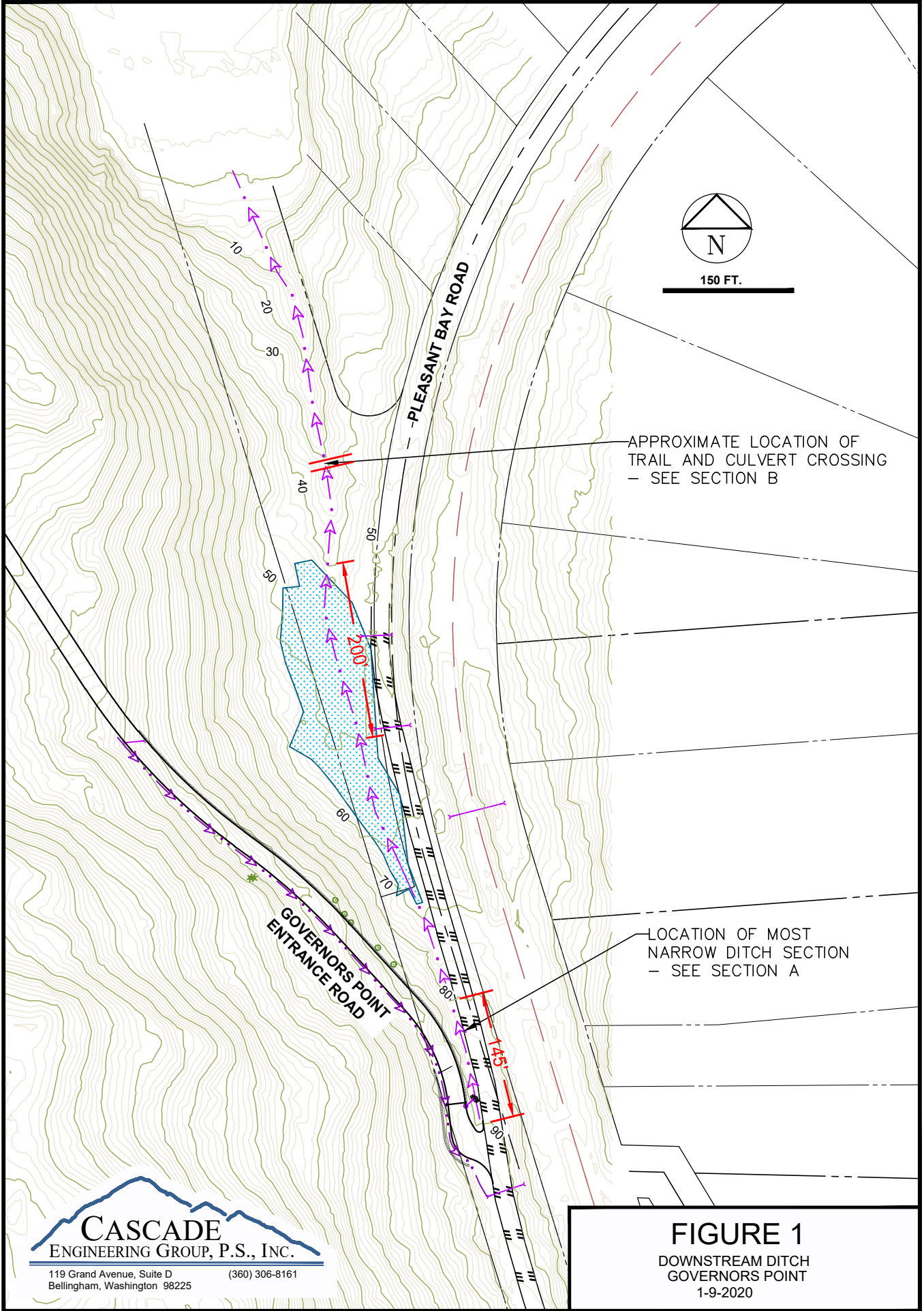
As the ditch extends north of the project entrance road, it moves west away from Pleasant Bay Road and becomes wider, both at its base and at its top, as it drops lower the adjacent terrain. A significant amount of water is added to the ditch from two crossing culverts conveying runoff from the east side of Pleasant Bay Road into this ditch. A visual inspection was performed and the ditch has areas of an exposed aggregate base, especially in the center of the channel. Evidence of soil transport was observed in the 12-inch diameter corrugated metal pipe below the trail. Only the top two to three inches were clear of sediment and flow was conveyed through this area downstream. No signs of distress (excessive erosion or loss of vegetation) were observed in the ditch at this crossing, both upstream and downstream of the culvert. The ditch either was able to self-scour the pipe clean under high flow conditions and/or the culvert is maintained by the property owner, Chuckanut Beaches, Inc.

Assuming the 3.5 ft deep ditch has six-inches of base flow, the estimated ditch flow rate is 12.46 cfs. With the additional 0.20 cfs flow (for a new total flow rate of 12.66 cfs), the estimated flow depth is 0.505 inches, or an increase in flow depth of about 1/16-inch. This increase in flow is not a significant impact on the ditch and well within the existing ditch's capacity. This change in flow rate is not anticipate to impact the operation and maintenance of the trail culvert.

Attachments:

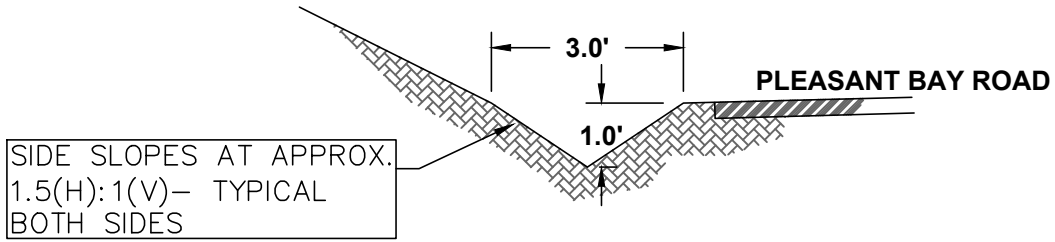
1. Figure 1: *Governors Point, Downstream Ditch*
2. Figure 2: *Governors Point, Typical Ditch Cross Sections*

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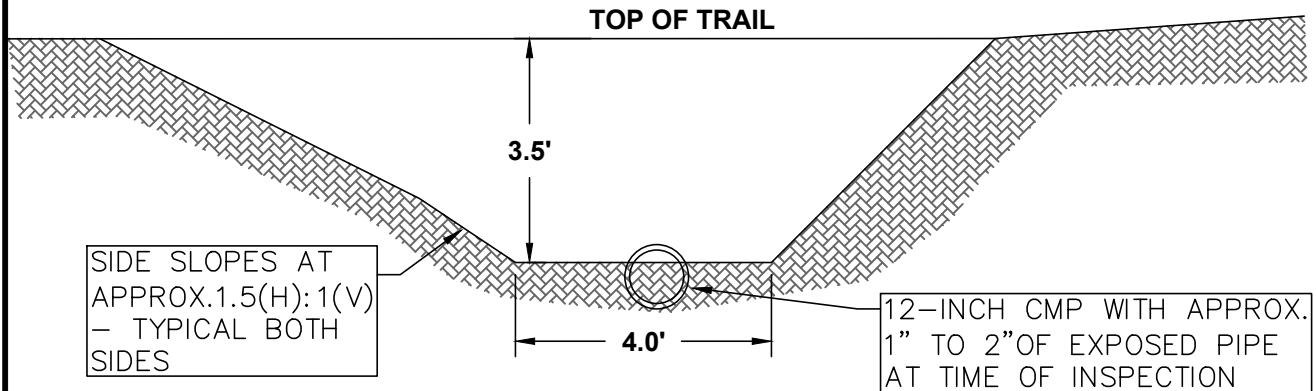
CASCADE
 ENGINEERING GROUP, P.S., INC.
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 Bellingham, Washington 98225

FIGURE 1
 DOWNSTREAM DITCH
 GOVERNORS POINT
 1-9-2020



SIDE SLOPES AT APPROX.
1.5(H):1(V) – TYPICAL
BOTH SIDES

SECTION A - LOOKING NORTH
TYPICAL DITCH CROSS SECTION AT NARROWEST POINT
(DIMENSIONS ARE APPROXIMATE)



SIDE SLOPES AT
APPROX. 1.5(H):1(V)
– TYPICAL BOTH
SIDES

12-INCH CMP WITH APPROX.
1" TO 2" OF EXPOSED PIPE
AT TIME OF INSPECTION

SECTION B - LOOKING NORTH
TYPICAL DITCH CROSS SECTION AT TRAIL CROSSING
(DIMENSIONS ARE APPROXIMATE)

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