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TO: Shane Spahr, PE
Burlington Project Office, NWR

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Geotechnical Office

SUBJECT: SR 005/Secret, Freedom, and Milltown Creeks x12, MP 213.62 to MP 218.56
XL5949 Site IDs: 992175, LP66, 996077, 930947, 996454, 996074, 996073, 996071, 996095, 930940, 995242, and 03.0183 1.20
Geotechnical Scoping Memorandum

INTRODUCTION

This memorandum presents a summary of geotechnical information collected to date and provides conceptual geotechnical recommendations for consideration in planning the replacement of the fish barriers at SR 005/Secret, Freedom, and Milltown Creeks x12, MP 213.62 to MP 218.56. The Project site described in this memorandum is composed of 12 culvert sites that convey Freedom Creek and unnamed tributaries (UNT) to Secret Creek, Fisher Creek and Milltown Creek below Interstate 5 (I-5), between I-5 Mileposts (MPs) 213.62 and 218.56. Note that Freedom Creek is sometimes referred to as "WF Church Creek", but for purposes of this memorandum, we use "Freedom Creek" for consistency with the Hydraulics Office. Similarly, UNT to Milltown Creek is sometimes referred to as "UNT to Fisher Creek", but "UNT to Milltown Creek" is used for the remainder of this memorandum.

The 12 existing fish barriers (culverts) are listed in Exhibit 1 along with the proposed action understood at the time of writing this memorandum. The Project includes the following:

1. removal of seven culverts and replacement with fish passable structures,
2. removal of three culverts and replacement with open channels,
3. plugging of one culvert and re-routing the stream, and
4. one culvert currently without an assigned action.

This memorandum focuses on assessment and recommendations for the seven culverts proposed for replacement (Item #1 above) and includes a brief mention of the remaining five culverts (Items #2 through #4) where geotechnical considerations may impact design and/or construction.

EXHIBIT 1: SUMMARY OF EXISTING FISH BARRIER (CULVERTS)

Site ID	MP	Tributary Name	Existing Culvert Diameter, Length and Type			Action Proposed
			D (feet)	L (feet)	Type ¹	
992175	213.62	UNT to Secret Creek	2.5	118	RCP	Replace
LP66	213.85	UNT to Secret Creek	1.5	37	CMP(st)	Remove
996077	214.36	Freedom Creek ²	2	378	Other	Replace
930947	214.36	Freedom Creek ²	2.6	17	Conc.dam	Remove
996454	214.52	Freedom Creek ²	1.5	148	RCP	Remove
			2	146	CMP(al)	Plug + Realign
996074	214.56	Freedom Creek ²				w/ 500-foot long cut to 996073
996073	214.64	UNT to Freedom Creek ²	2.5	157	CMP(st)	Replace
996071	214.7	UNT to Freedom Creek ²	2	245	CMP(al)	Replace
996095	214.7	UNT to Freedom Creek ²	2	66	CMP (st)	No Action³
930940	215.05	Freedom Creek ²	3.5	82	CMP(st)	Replace
995242	218.44	UNT to Milltown Creek	4	600	Steel	Replace
03.0183 1.20	218.56	UNT to Milltown Creek	5	279	CMP(st)	Replace

NOTES:

1. RCP = Reinforced Concrete Pipe; CMP(st) = Corrugated Metal Pipe (steel); CMP(al) = Corrugated Metal Pipe (aluminum); Steel = Steel Pipe
2. WF Church Creek is referred to as "Freedom Creek" in the PHD and for the remainder of this document.
3. Site 996095 was originally included in the scope of culvert replacement, but no longer appears in the scope provided by the Project Office. Site 996095 crosses Hall Road which is maintained by Snohomish County.

The Project site is located about three miles east of Stanwood, Washington (see Figure 1 for Project Vicinity). For the purposes of this memorandum, the Project site is the approximately 5-mile-long by 800-foot-wide area that includes all 12 culvert sites along I-5 between Site 992175 to the south and Site 03.0183 1.20 to the north. We refer to the sites between MP 213.62 and 215.05 as the Southern Project Sites and sites between 218.44 and 218.56 as the Northern Project Sites. Exhibits 2A and 2B show the stream alignments and water flow direction through the southern and northern existing culverts, respectively.

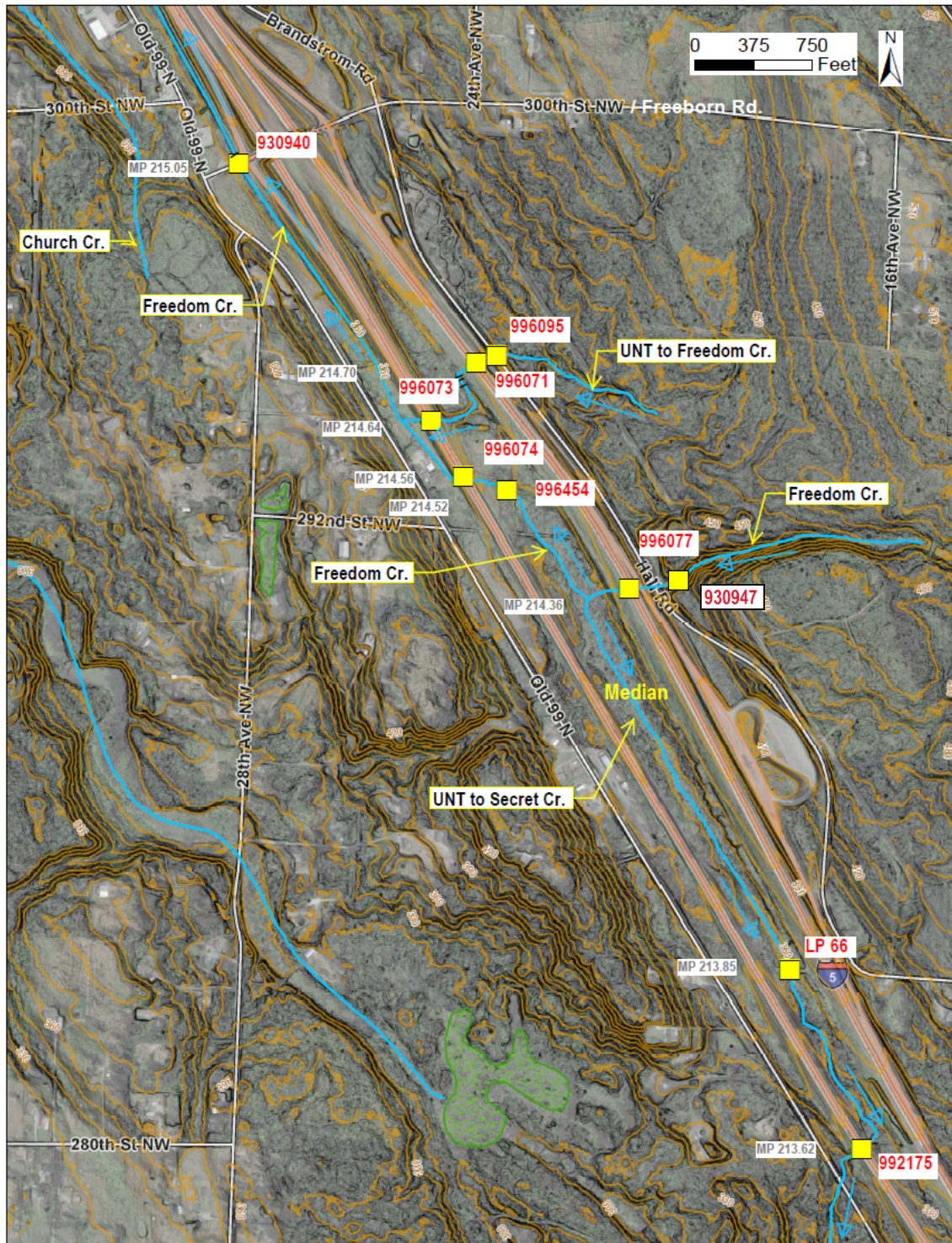


EXHIBIT 2A: SOUTHERN SITES (TRIBUTARIES OF FREEDOM CREEK AND SECRET CREEK)

Blue arrow shows water flow direction. Yellow boxes indicate the approximate location of existing culverts.

SR 005/Secret, Freedom, and Milltown Creeks x12, MP 213.62 to MP 218.56

XL5949 Site IDs: 992175, LP66, 996077, 930947, 996454, 996074, 996073, 996071, 996095, 930940, 995242, and 03.0183 1.20

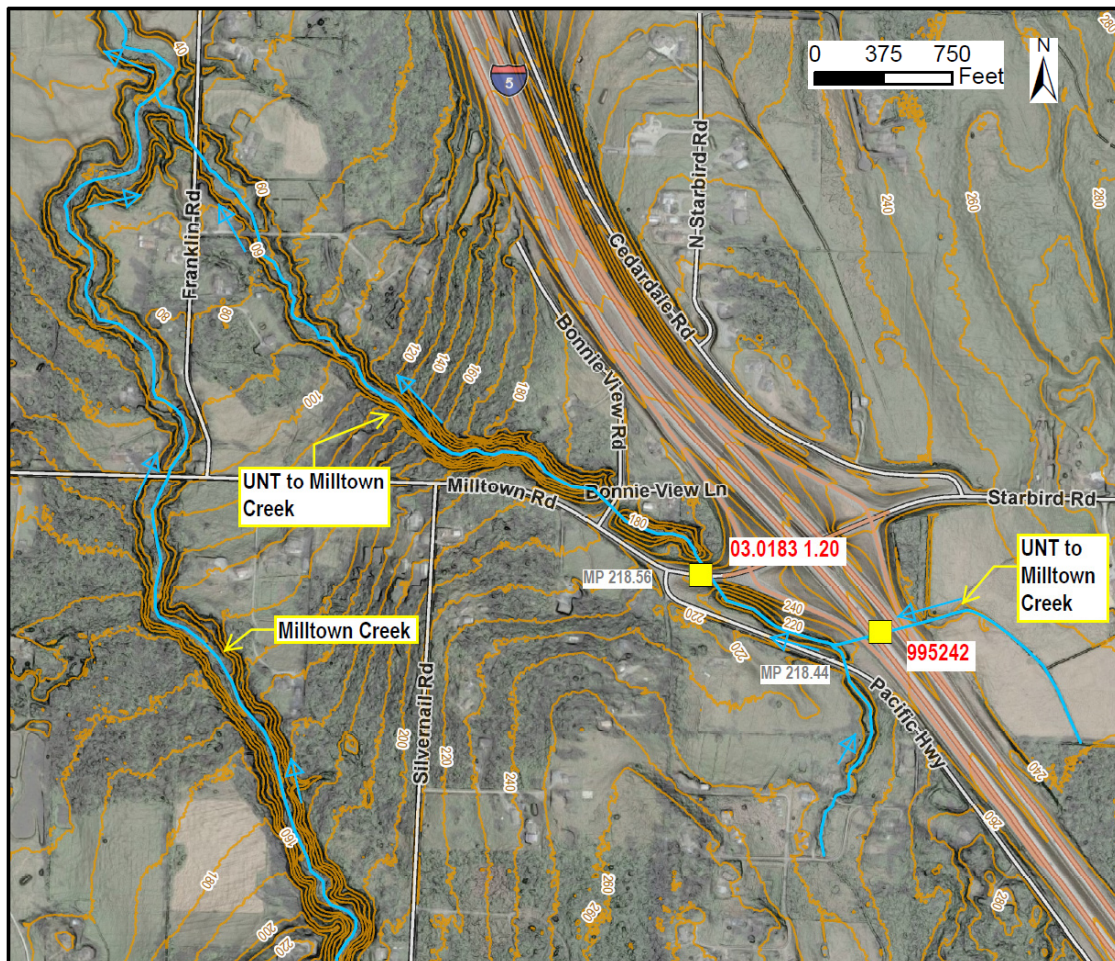


EXHIBIT 2B: NORTHERN SITES (TRIBUTARY TO MILLTOWN CREEK)

Blue arrow shows water flow direction. Yellow boxes indicate the approximate location of existing culverts.

GEOLOGIC AND GEOTECHNICAL RECORDS REVIEW

We reviewed the following available data to develop our understanding of the site:

- Geologic mapping: Geologic map of the Utsalady and Conway 7.5-minute Quadrangles, (Dragovich and others, 2002¹)
- Light detection and ranging (lidar) data: 2017 North Puget Sound (Quantum Spatial Company, 2017²)
- Aerial imagery between 1990 and 2020 available in Google Earth, the National Agriculture Imagery Program, and Washington Statewide Orthophoto Program

¹ Dragovich, J.D., Gilbertson, L.A., and Norman, D.K., 2002 (rev. 2004), Geologic Map of the Utsalady and Conway 7.5-Minute Quadrangles, Skagit, Snohomish, and Island Counties, Washington: Washington Division of Geology and Earth Resources, Open File Report 2002-5 (rev. 2004), plate 1 of 2, scale 1:24,000.

² Quantum Spatial Company, 2017, Western Washington 3DEP LiDAR, Technical Data Report. Portland, Oregon.

- Hazard maps available from the Washington State Department of Natural Resources

We searched available Washington State Department of Transportation (WSDOT) records for historic geotechnical information pertinent to the site. We obtained and reviewed the following information from WSDOT records:

- I-5 soils report with soil profile, covering sites 992175, 996077, 996071, and 930940 (WSDOT, 1955³).
- I-5 plan and profile showing proposed location of Freeborn Overcrossing, and geotechnical borings, near site 930940 (WSDOT, 1956a⁴).
- I-5 plan and profile, covering sites 992175, 996077, 996071, 996095, and 930940. The profile indicates where unsuitable soils were reportedly removed prior to constructing the highway embankment. Site 996454 is also shown bordering an area where unsuitable foundation material is present at the ground surface (WSDOT, 1956b⁵; 1958⁶). Numerous springs are indicated in the plan sheets along present-day NB I-5 between site 992175 and 996077. Based on the present-day length of the culvert at Site 996077, the present-day culvert extends about 80 feet west of the culvert extent shown in the 1956 plan. This suggests that the embankment was widened and/or over-built.
- I-5 soil profile and borings related to widening the East Bridge and constructing the West Bridge of Freeborn Overcrossing (WSDOT, 1968⁷).
- I-5 soil profile covering sites 996077, 996073, 996071, and Freeborn Road (WSDOT, 1969⁸).
- I-5 / Freeborn Road bridge plan and details related to widening the East Bridge and constructing the West Bridge of Freeborn Overcrossing (WSDOT, 1970a⁹; 1970b¹⁰).
- I-5 drainage plans and profiles showing location of sites 996074 and 996073 (WSDOT, 1972¹¹).
- I-5 Weigh Station plan profiles and borings near site 996077 (WSDOT, 1997a¹²).
- I-5 borings for sign structures near sites 996071 and 996095 (WSDOT, 1997b¹³).

³ WSDOT, 1955, PSH No. 1, Stillaguamish River Bridge to Conway, March 24, job number L-840.

⁴ WSDOT, 1956a, Primary State Highway No. 1, Pilchuck Hill to North Burn Road, Approved November 23, 1956, contract number 5423.

⁵ WSDOT, 1956b, PSH No. 1, Pilchuck Hill to Conway Junction, Approved November 1, 1956, contract number 5423.

⁶ WSDOT, 1958, PSH No. 1, Pilchuck Hill to Conway Junction, Approved May 22, 1958, contract number 5885.

⁷ WSDOT, 1968, PSH No. 1, Stillaguamish River to Conway Junction, Freeborn Rd O'Xing, May job number L-2849.

⁸ WSDOT, 1969, PSH No. 1, SSH 1-Y (SR532) to Conway Junction, job number L-2849.

⁹ WSDOT, 1970a, SR 5, SR 532 Interchange to Conway Hill O'Xings, Approved July 2, 1970, contract number 8874.

¹⁰ WSDOT, 1970b, SR 5, SR 532 Interchange to Conway Hill Overcrossing (As-Built), Freeborn Road Overcrossing, contract number 8879.

¹¹ WSDOT, 1972, SR 5, 284th Street NW to Conway Hill, Approved March 24, 1972, contract number 9403.

¹² WSDOT, 1997a, SR 5 Stanwood/Bryant Vicinity, Northbound Weigh Station, job number OL-1602.

¹³ WSDOT, 1997b, SR 5 Stanwood/Bryant Vicinity, Northbound Weigh Station, job number OL-1602.

Relevant plans, profiles, boring logs, and laboratory data are included in Appendix A. Our review of historic records did not include sufficient information to characterize the subsurface conditions for this conceptual geotechnical evaluation. Additional geotechnical data were obtained, as described in the following sections.

Four Preliminary Hydraulic Design Reports (PHD) were available at the time of writing this memorandum:

- I-5 MP 213.66 and 213.86 Unnamed Tributary to Secret Creek (992175 and LP66): Draft Preliminary Hydraulic Design Report¹⁴, dated September 2021 (referred to in text as PHD 992175 and LP66)
- I-5 MP 214.38 Freedom Creek (WDFW ID# 996077): Draft Preliminary Hydraulic Design Report¹⁵, dated July 2021 (referred to in text as PHD 996077)
- I-5 MP 214.65 Freedom Creek (WDFW IDs: 996074 and 996454) Draft Preliminary Hydraulic Design Report¹⁶, dated July 2021 (referred to in text as PHD 996074 and 996454).
- I-5 MP 214.74 Tributary to Freedom Creek (WDFW ID# 996073): Draft Preliminary Hydraulic Design Report ¹⁷, dated October 2021 (referred to in text as PHD 996073).

We used the PHDs to gain an understanding of the preliminary stream geometry and hydraulic requirements for the replacement structure.

GEOTECHNICAL SITE INVESTIGATION

Our scoping-level geotechnical investigation consisted of conducting a geologic site reconnaissance, drilling ten test borings, performing laboratory testing of selected samples retained from the test borings, and monitoring groundwater levels.

Geologic Site Reconnaissance

We conducted geologic site reconnaissance visits on January 7, March 30, March 31, and October 20, 2021, to observe surface site conditions, the extent and character of exposed soil units, and the condition of the roadway, culvert, channel banks, and embankment slopes. During our site reconnaissance, we looked for evidence of potential geologic hazards and challenging geotechnical conditions.

¹⁴ Heilman, J. and others., 2021, I-5 MP 213.66 and 213.86 Unnamed Tributary to Secret Creek (992175 and LP66): Draft Preliminary Hydraulic Design Report: Olympia, Wash., Washington State Department of Transportation, 145 p., December.

¹⁵ Heilman, J. and others., 2021, I-5 MP 214.38 Freedom Creek (WDFW ID# 996077): Draft Preliminary Hydraulic Design Report: Olympia, Wash., Washington State Department of Transportation, 145 p., December.

¹⁶ Heilman, J. and others., 2021, I-5 MP 214.65 Freedom Creek (WDFW IDs: 996074 and 996454) Draft Preliminary Hydraulic Design Report: Olympia, Wash., Washington State Department of Transportation, 121 p., July.

¹⁷ Heilman, J. and others., 2021 I-5 MP 214.74 Tributary to Freedom Creek (WDFW ID# 996073): Draft Preliminary Hydraulic Design Report: Olympia, Wash., Washington State Department of Transportation, 121 p., July.

Test Borings

The test borings were drilled by a WSDOT drill crew to characterize subsurface conditions at the site and to install piezometers for groundwater monitoring. The locations of the test borings are shown in Figures 2a to 2c. A summary of the test borings is presented in Exhibit 3. Boring locations were surveyed by the Region and the subsequent coordinates are presented on the boring logs included in Appendix B. The borings are also shown in subsurface profiles (Figures 3a to 3e).

EXHIBIT 3: SUMMARY OF TEST BORINGS

Site	Milepost	Boring Designation	Approximate Test Depth (feet)	Reference Profile
992175	213.62	A-445p-21	50	Figure 3a
		A-446p-21	50	
996077	214.36	A-423p-21	50	Figure 3b
		A-424p-21	60	
996073	214.64	A-425p-21	60	Figure 3c
996071	214.7	A-426p-21	60	Figure 3c
		A-427p-21	60	
930940	215.05	N/A ¹	N/A	Figure 3d
995242	218.44	A-432p-21	40	Figure 3e
		A-433p-21	40	
03.0183 1.20	218.56	A-449-21	80	Figure 3e

NOTE

1 Geotechnical scoping of site 930940 relied on nearby historic borings.

Borings were not drilled at Sites LP66, 930947, 996454, 996074, and 930940. Sites LP66, 930947, 996454, and 996074 will be removed or plugged without replacement. Site 930940 did not require geotechnical drilling for the scoping effort due to availability of nearby historic borings.

The test borings were advanced using mud rotary drilling methods and a casing advancer system. Sampling was performed as follows:

- Disturbed samples were obtained in conjunction with the Standard Penetration Test (SPT). Sampling was performed at 5-foot intervals or at 2- to 3-foot intervals for specific areas of interest.
- Collection of undisturbed tube samples was attempted where soft, fine-grained soils were encountered.
- Core samples were attempted when bedrock was encountered. Core sample recovery was not successful due to the tendency for drill fluid to wash out the highly weathered, extremely weak rock (sandstone).

A WSDOT drill inspector observed the drilling and sampling activities, collected soil and rock samples, and completed a visual description of the recovered samples. The samples were returned to the Shannon & Wilson Laboratory for further review by a

geologist and for selection of samples for laboratory testing. Logs of the test borings are provided in Appendix B.

Laboratory Testing

The samples were transported to either the WSDOT Materials Laboratory (A-449-21) or the Shannon & Wilson soils laboratory (all other borings) for testing. The WSDOT Materials Laboratory and Shannon & Wilson laboratory performed tests on selected soil samples for the purposes of classification and evaluation of soil properties. Laboratory testing included natural moisture content, Atterberg Limits (plasticity), grain size distribution, slake testing, organic content, and soil corrosivity (pH and resistivity). The laboratory testing was performed in general accordance with appropriate ASTM and American Association of State Highway and Transportation Officials (AASHTO) test methods. Laboratory test data are provided in Appendix C.

Groundwater Monitoring

Bail and recharge testing was performed in each of the test borings to obtain an estimate of soil permeability and groundwater elevation at the time of drilling. The test includes removing (bailing) water from the borehole and then measuring the time for the water in the borehole to recharge to a stable level. The depth of the drill casing during the test and the measured water depths versus time are noted on the test boring logs in Appendix B.

A standpipe piezometer was installed in each test boring (except for A-449-21) to obtain long-term groundwater measurements. A datalogger was installed in each piezometer to collect and store measurements at 6-hour intervals. The piezometers will be decommissioned by the WSDOT Geotechnical Office upon request. Piezometer installation details and minimum and maximum measured groundwater depths are shown on the test boring logs in Appendix B.

SITE CONDITIONS

Our evaluation of the site conditions is based on our site visits on January 7, 2021 and March 31, 2021 and on descriptions from four draft PHDs (PHD 992175 and LP6; PHD 996077; PHD 996074 and 996454; and PHD 996073). Conditions described in the following paragraphs should be expected to vary spatially across and below the site (e.g., subsurface soil conditions) and seasonally (e.g., groundwater levels and stream flow).

The 12 Project sites are situated along I-5 between MP 213.62 and MP 218.56. In the Project area, I-5 is aligned southeast to northwest across a broad glacial plateau that descends to the South Fork of the Skagit River to the northwest and the Stillaguamish River valley to the south. The plateau is a gently undulating, low-relief glacial upland with multiple northwest aligned flutes and troughs formed during glacial advance. Streamflow through the Project area is controlled by a combination of glacial topography and ditching and re-routing for agricultural needs and subsequent highway drainage systems.

In the vicinity of the Southern Project Sites, I-5 roughly follows a glacial trough (Exhibit 2A). For the purposes of this memorandum, we refer to this glacial trough as the 'Freedom Creek valley,' named after one of the primary streams conveyed by Project culverts. Freedom Creek is one of the many streams that drain the uplands to the northeast of I-5. These streams flow to the west through multiple short stream channels toward the valley bottom to the west.

Freedom Creek is conveyed west through Project culverts below the I-5 northbound (NB) lanes and enters the wooded median between the I-5 NB and southbound (SB) lanes. All Project culverts convey flow to, from, or through the 2.5-mile-long wooded median that reaches a maximum width of approximately 500 feet (Exhibit 2A). Before the construction of I-5, the median, as part of the larger Freedom Creek valley, had been farmland. The PHD for sites 996454 and 996074 includes site plans that show relict property boundaries and roads. Remnants of a few of the roadways still stand within the median as overgrown embankments and berms.

After reaching the I-5 median downstream of culvert site 996077, flow from Freedom Creek splits into northerly and southerly streams that follow poorly-defined channels and connect wetland areas within the median; northerly flow continues as Freedom Creek and southerly flow feeds into the Unnamed Tributary (UNT) of Secret Creek (Exhibit 2A). In subsequent sections, we describe the Project culvert systems relative to these stream main stems, from upstream to downstream.

In the vicinity of the Northern Project Sites, I-5 gradually descends from the glacial upland and is aligned roughly parallel to nearby streams that are flowing northwest toward the Skagit River valley (Exhibit 2B). One of these streams is Milltown Creek, located about 0.5 mile west of I-5. Ditched flow of the UNT to Milltown Creek crosses below I-5 and Starbird Rd / Milltown Rd through Project culverts, enters an open channel, and flows northwest along a gentle grade toward its confluence with Milltown Creek near the Skagit River valley bottom.

A summary of site conditions observed at each of the culvert locations (e.g., roadway elevations, observations of embankment and culvert conditions, utilities, etc.) are summarized and tabulated in Table 1. Site photos are compiled in Appendix D. The Project sites that are grouped by stream mainstem and described in this memorandum include:

- Southern Project Sites (MP 213.62 and 215.05) (Exhibit 2A):
 - Freedom Creek (sites 996077, 930947, 996074, 996095, 996071, 996073, and 930940, 996454),
 - Secret Creek (sites 992175 and LP 66),
- Northern Project Sites (MP 218.44 - 218.56) (Exhibit 2B):
 - Milltown Creek (sites 995242, 03.0183 1.20)

Freedom Creek (MP 214.36 to MP 215.05)

Culvert 996077

Freedom Creek drains the glacial upland east of I-5 and flows west through an undeveloped forest, around a small concrete dam (Site 930947), and through the 996077 inlet below Hall Road (Exhibit 4A). From the east shoulder of Hall Road, the stream is conveyed west to the I-5 median through three sections of 2.5-foot-diameter, reinforced concrete pipe below three roadways, from east to west: Hall Road, the I-5 NB on-ramp, and the I-5 NB lanes (Exhibit 4A and Photo D-1.1). Between the inlet (Photos D-1.2 and D-1.3) and outlet, flow ditched along roadway medians enters the culvert pipe system via a grated inlet between Hall Road and the on-ramp and a catch basin between the on-ramp and I-5 NB (Photos D-2.1 and D-2.2).

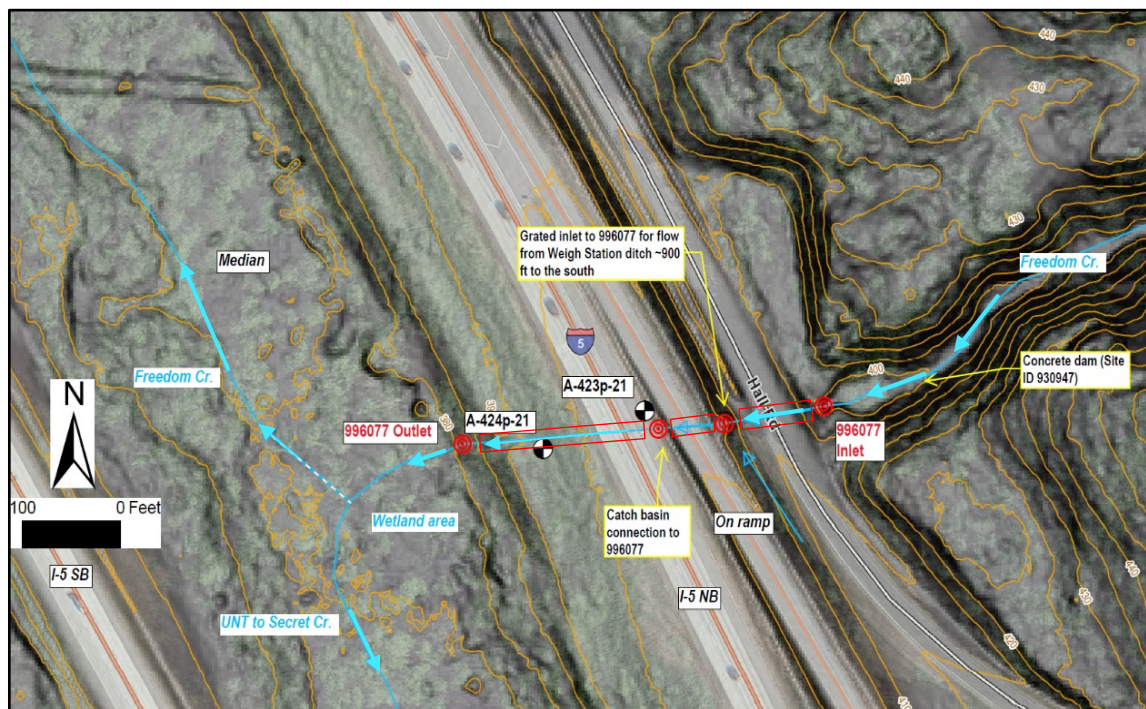


EXHIBIT 4A: LIDAR SLOPE MAP OF PROJECT SITE 996077 SHOWING STREAM FLOW OF FREEDOM CREEK THROUGH PROJECT CULVERTS.

Red circles are Project inlet and outlet culvert locations and related features, red boxes indicate locations of culvert pipes, light blue arrows indicate stream flow direction, orange lines are 5-ft contour intervals.

At the outlet, Freedom Creek flows down a 2-to-3-foot drop into a scour pool (Photo D-2.3). Downstream of the outlet, the creek flows west into a broad, flat and wooded wetland area within the center of the I-5 median (Photo D-2.4 and Exhibit 4A). During the January 2021 site visit, we observed areas of standing water downstream of the outlet, surrounded by saturated ground, but we did not observe a stream channel exiting the wetland area. The 996077 PHD indicates that, although the stream pathway is not well defined, the wetland area downstream of 996077 feeds into northerly stream flow of Freedom Creek, presumably augmented by high groundwater and inflow from ditched runoff. From the same wetland area, flow from the outlet also flows south as UNT to

Secret Creek. Both branches of Freedom Creek flow through diffuse channels that follow the low, wetland areas in the center of the median and string together areas of standing water and small ponds.

Culverts 996454 and 996074

From the wetland downstream of 996077, Freedom Creek flows north for about 650 feet, passes through an unnamed culvert beneath the abandoned roadway embankment of the former 292nd St NW (PHD 996454 and 996074), then continues north for another 300 feet to the inlet of 996454 (Exhibits 2A and 4B).

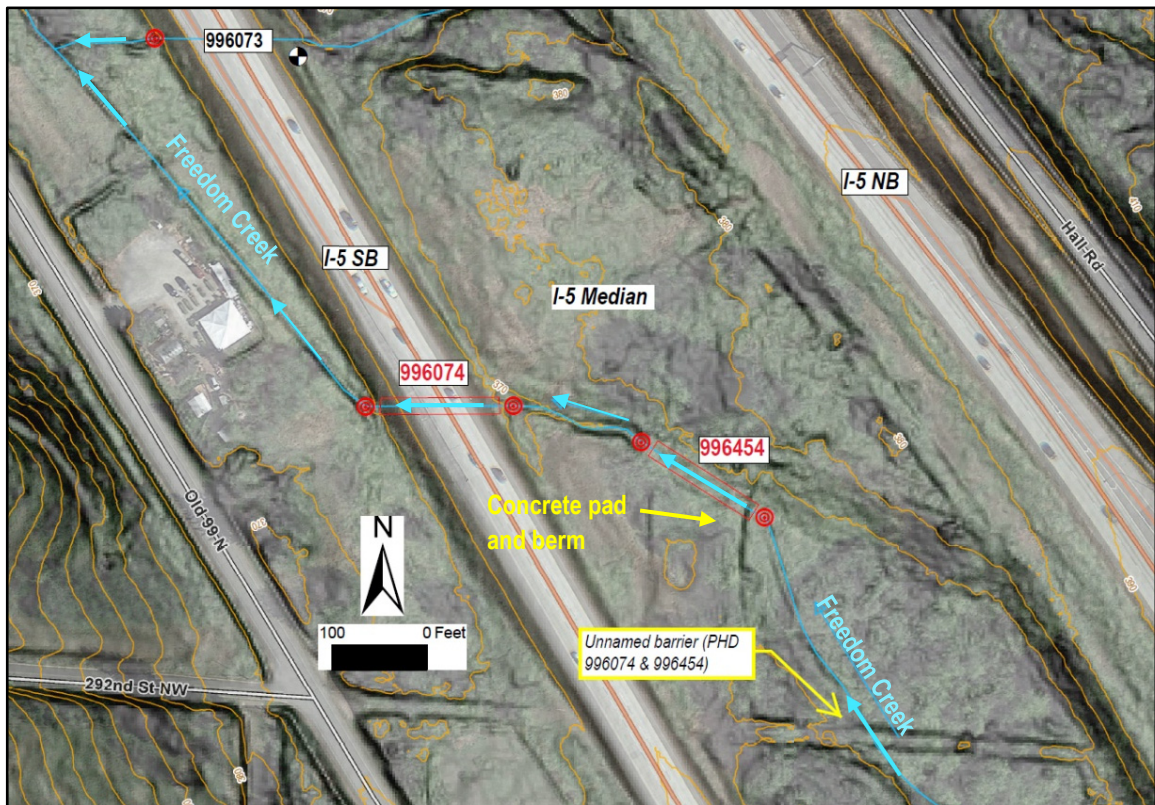


EXHIBIT 4B: LIDAR SLOPE MAP OF PROJECT SITE 966454 AND 996074 AND STREAM FLOW OF FREEDOM CREEK THROUGH PROJECT CULVERTS.

Red circles are Project inlet and outlet culvert locations and related features, red boxes indicate locations of culvert pipes, light blue arrows indicate stream flow direction, orange lines are 5-ft contour intervals...

Upstream of the culvert, the creek follows a discontinuous channel through thick grass and ponds behind the inlet that is fully submerged (Photos D-3.1 and D-3.2). Photos of the inlet and outlet during prior drier conditions are shown in Photo D-3.3. During the January 2021 site visit, we observed a concrete pad (or old driveway) and berm over the culvert between the inlet and outlet (Photo D-3.2). The pipe at the outlet was submerged in January 2021 (Photo D-3.4).

From the 996454 outlet, Freedom Creek flows about 150 feet to the northwest toward the inlet of culvert 996074 below the west shoulder of I-5 SB (Exhibit 4B, Photos D-4.1

and D-4.2). The creek flows west below I-5 SB and exits into the grassy median between I-5 SB and Pacific Hwy / Old 99N. After exiting the outlet, Freedom Creek turns north and becomes ditched flow through the ground between the two roads, collecting runoff from I-5 SB to the east and Pacific Hwy to the west.

Culverts 996095, 996071, and 996073

Approximately 500 feet downstream of the 996074 outlet, Freedom Creek is joined by an UNT that flows west under I-5 through a series of three culverts below three roadways and a connecting open channel that crosses the I-5 median (Exhibits 2A and 4C and Photo D-4.3).

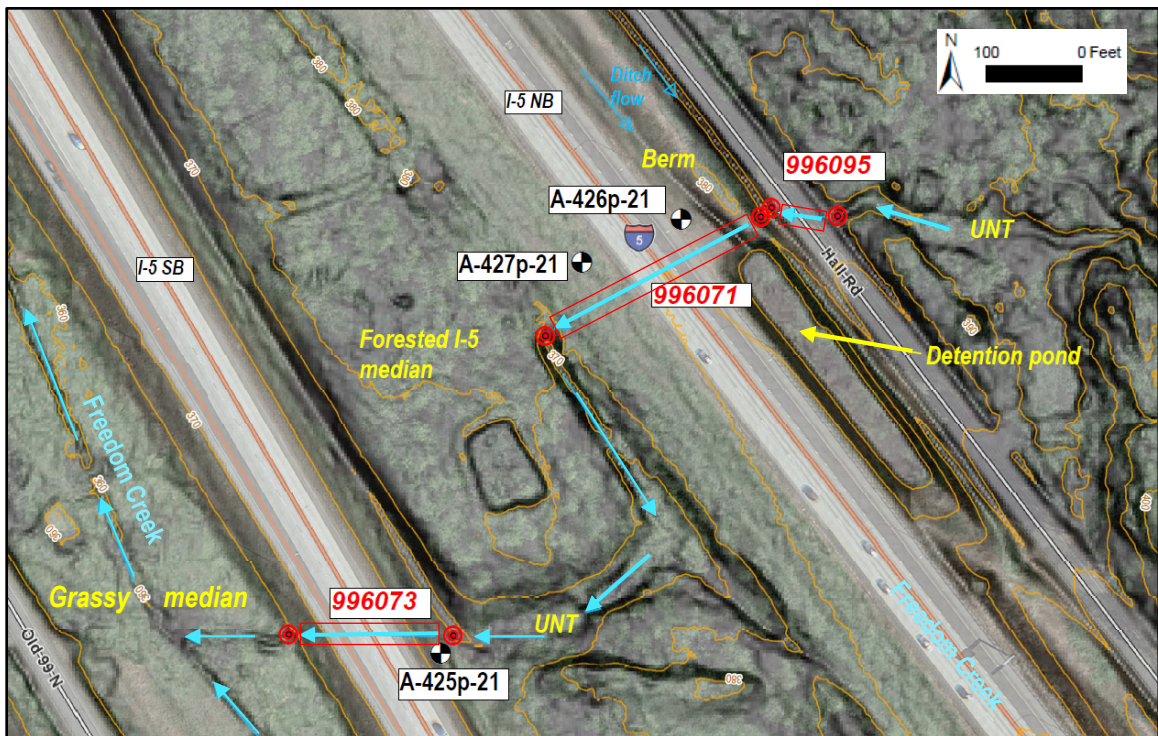


EXHIBIT 4C: LIDAR SLOPE MAP OF PROJECT SITES 996095, 996071, AND 996073, AND STREAM FLOW OF UNT TO FREEDOM CREEK THROUGH PROJECT CULVERTS.

Red circles are Project inlet and outlet culvert locations and related features, red boxes indicate locations of culvert pipes, light blue arrows indicate stream flow direction, orange lines are 5-ft contour intervals.

The UNT drains the forested slopes that border I-5 to the northeast and flows west into the 996095 inlet below the east shoulder of Hall Road (Photos D-5.1 and D-5.2). The UNT exits the outlet into a ditch along the west shoulder of Hall Road and directly enters the 996071 inlet, which is located in the same ditch (Photo D-5.3). From the ditch, culvert 996071 conveys the UNT southwest to the I-5 median below an inlet ditch to a detention pond and I-5 NB (Exhibit 4C). Downstream of the 996071 outlet, the UNT flows south along a wooded, steep-walled ditch within the median that follows the west shoulder of I-5 NB (Photo D-5.4). About 200 feet downstream of the outlet, the UNT turns west, its channel broadens, and the UNT flows across the I-5 median toward I-5 SB and culvert 996073 (Photo D-6.1).

The UNT enters the 996073 inlet below the east shoulder of I-5 SB and flows west to the grassy area between I-5 SB and Pacific Hwy (Exhibit 4C, Photos D-6.2, D-6.3). Downstream of the outlet, the tributary flows west to the center of the grassy median where it joins Freedom Creek (Photos D-7.1 and D-7.2). From the confluence, Freedom Creek flows north through the partially wooded and grassy median toward the Freeborn Road overpass and culvert 930940, located approximately 2000 feet to the north (Exhibit 4C and Photo D-7.2).

Culvert 930940

From the 996073 outlet, Freedom Creek flows about 2000 feet north to the I-5 / Freeborn Rd Overpass and the 930940 culvert through the grassy median between I-5 SB On-ramp /Off-ramp and Pacific Hwy (Exhibits 2A and 4D and Photo D-7.3).

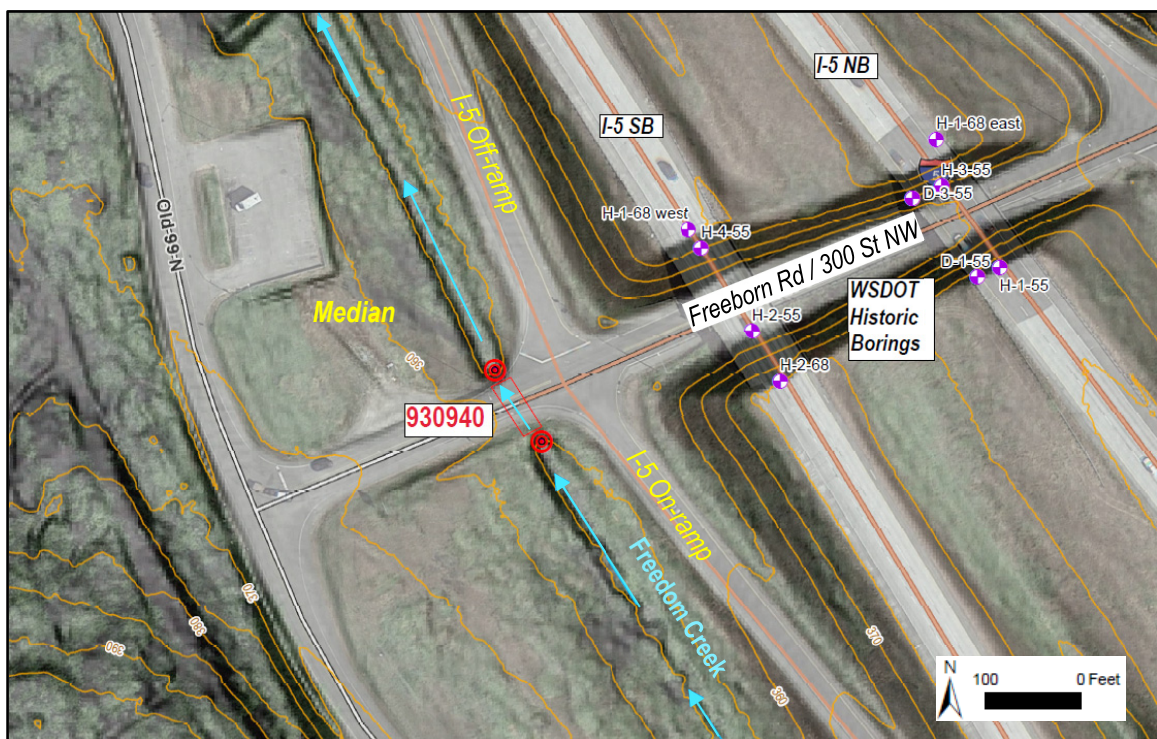


EXHIBIT 4D: LIDAR SLOPE MAP OF PROJECT SITE 930940, LOCATIONS OF HISTORIC BORINGS, AND STREAM FLOW OF FREEDOM CREEK THROUGH PROJECT CULVERT.

Red circles are Project inlet and outlet culvert locations and related features, red boxes indicate locations of culvert pipes, light blue arrows indicate stream flow direction, orange lines are 5-ft contour intervals.

Freedom Creek enters the 930940 inlet below the south shoulder of Freeborn Rd / 300th St NW (Photo D-8.1 and D-8.2 and Table 1). Downstream of the 930940 outlet, Freedom Creek flows north through the median along a grassy ditch that parallels I-5 SB (Photos D-8.3 and D-8.4). No geotechnical borings were performed at this site. Our scoping-level interpretation of subsurface conditions relies on nearby historic geotechnical borings shown in Exhibit 4D. Logs of these borings are included in Appendix A.

UNT to Secret Creek (MP 213.62 to MP 214.36)

Downstream of the 996077 outlet, Freedom Creek feeds into southerly flow that follows the low areas of saturated ground that have formed along the axis of the I-5 median (Exhibit 2A). Known as UNT to Secret Creek, this stream flows south through the wooded median along a series of discontinuous stream channels that connect areas of standing water and wetlands (PHD 996077).

Culvert LP 66

Downstream of the 996077 outlet, the UNT flows about 2700 feet through forested wetland and dense brambles before reaching the inlet of culvert LP 66 (Exhibits 2A and 4E). This culvert conveys stream flow below the road embankment for 284th St NW that was abandoned after construction of I-5 (see PHD 992175 and LP66 for historic site plans) (Exhibit 4E).

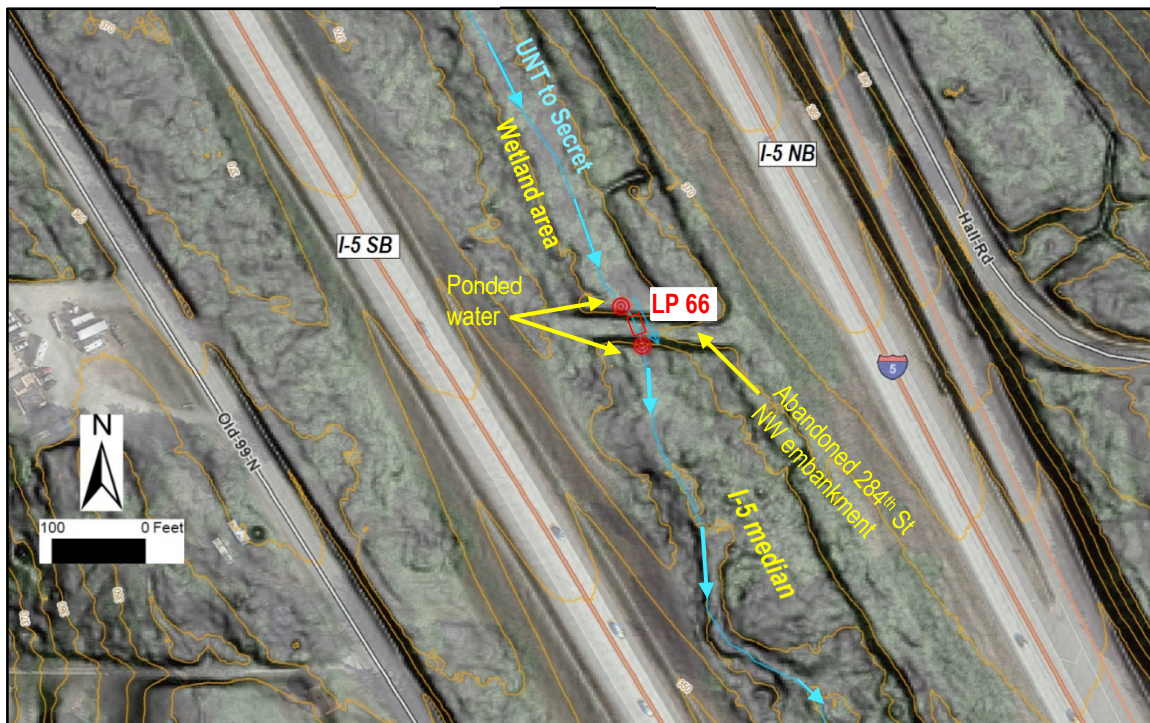


EXHIBIT 4E: LIDAR SLOPE MAP OF PROJECT SITE LP 66 AND STREAM FLOW OF UNT TO SECRET CREEK THROUGH PROJECT CULVERT.

Red circles are Project inlet and outlet culvert locations and related features, red box indicates location of culvert pipe, light blue arrows indicate stream flow direction, orange lines are 5-ft contour intervals.

The embankment is oriented east-west and crosses through the center of the median. Upstream of the inlet, the embankment is overgrown with vegetation and water has ponded along the north side of the embankment (Photo D-9.1). The inlet is completely submerged and although we were not able to observe the pipe in place during the March 2021 site visit, we were able to obtain thoroughly rusted pieces of the inlet from the submerged base of the embankment. The outlet also is densely vegetated and stream

flow has ponded at the outlet behind what appears to be a small animal dam (Photos D-9.2 and D-9.3). Downstream of the outlet, the UNT flows south for about 1200 feet through dense vegetation and an undefined channel before turning west toward the 992175 inlet.

Culvert 992175

The UNT enters the inlet for 992175 below the east shoulder of I-5 SB and flows west to the median between I-5 SB and Old 99N (Exhibits 2A and 4F, Photos D-10.1 and D-10.2).

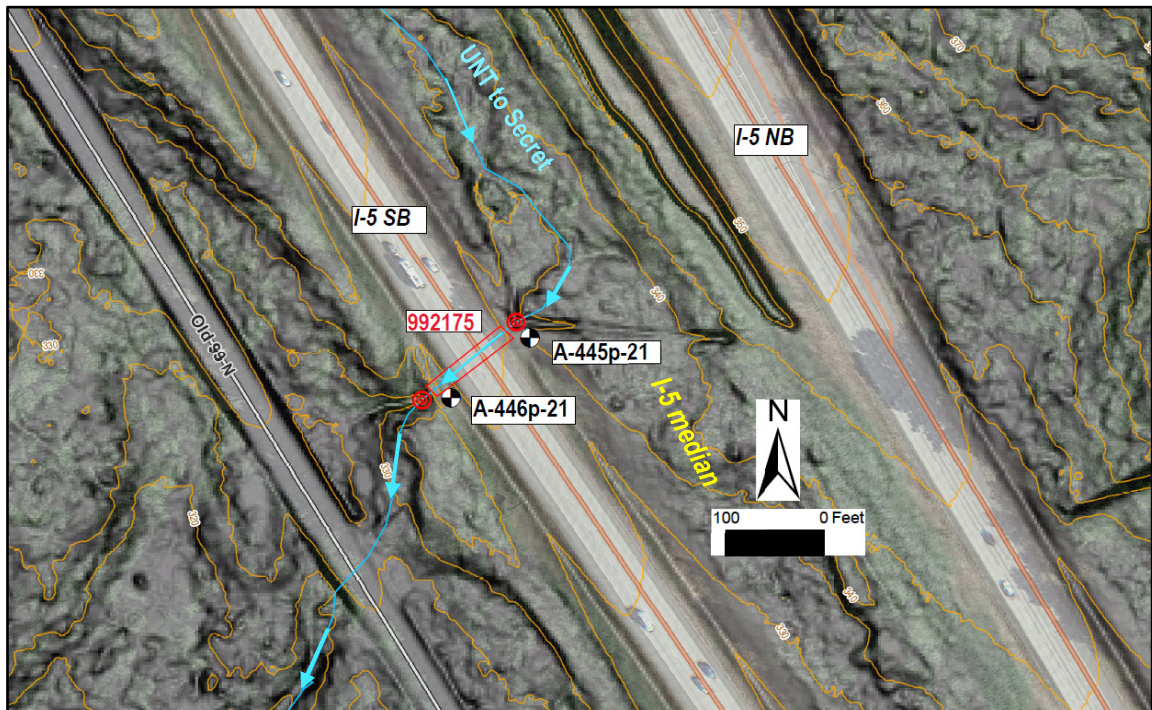


EXHIBIT 4F: LIDAR SLOPE MAP OF PROJECT 992175 AND STREAM FLOW OF UNT TO SECRET CREEK THROUGH PROJECT CULVERT.

Red circles are Project inlet and outlet culvert locations and related features, red box indicates location of culvert pipe, light blue arrows indicate stream flow direction, orange lines are 5-ft contour intervals.

The stream exits the outlet and flows down a ~1-foot drop into a small scour pool, then flows west through a brushy and forested channel (Photo D-10.3). Downstream of the outlet, the tributary flows southwest for about 200 feet through the forested median before passing below the Old 99N roadway on its way to Secret Creek (Photo D-11.1).

Milltown Creek (MP 218.44 to MP 218.56)

Approximately 600 feet southeast of the I-5 / Starbird Road overpass, the Northern Project Site culverts convey the UNT of Milltown Creek below I-5 and, downstream, below Starbird Road (called Milltown Road west of I-5) 995242 (MP 218.44) and 03.0183 1.20 (MP 218.44), respectively (Exhibits 2B and 4G).

Culvert 995242

Ditched flow of the UNT to Milltown Creek flows north across relatively flat agricultural fields on the east side of I-5 before turning west and entering the 995242 inlet below the east shoulder of the I-5 NB off-ramp (Exhibits 2B and 4G and Photos D-12.1 and D-12.2). The UNT exits the 995242 outlet below the west shoulder of the I-5 SB on-ramp into a scour pool (Photos D-12.3 and D-12.4 and). At the outlet, the UNT is joined by another UNT of Milltown Creek that enters the UNT that flows below Pacific Hwy through culvert CR60 (not part of this study) (Exhibit 4G).

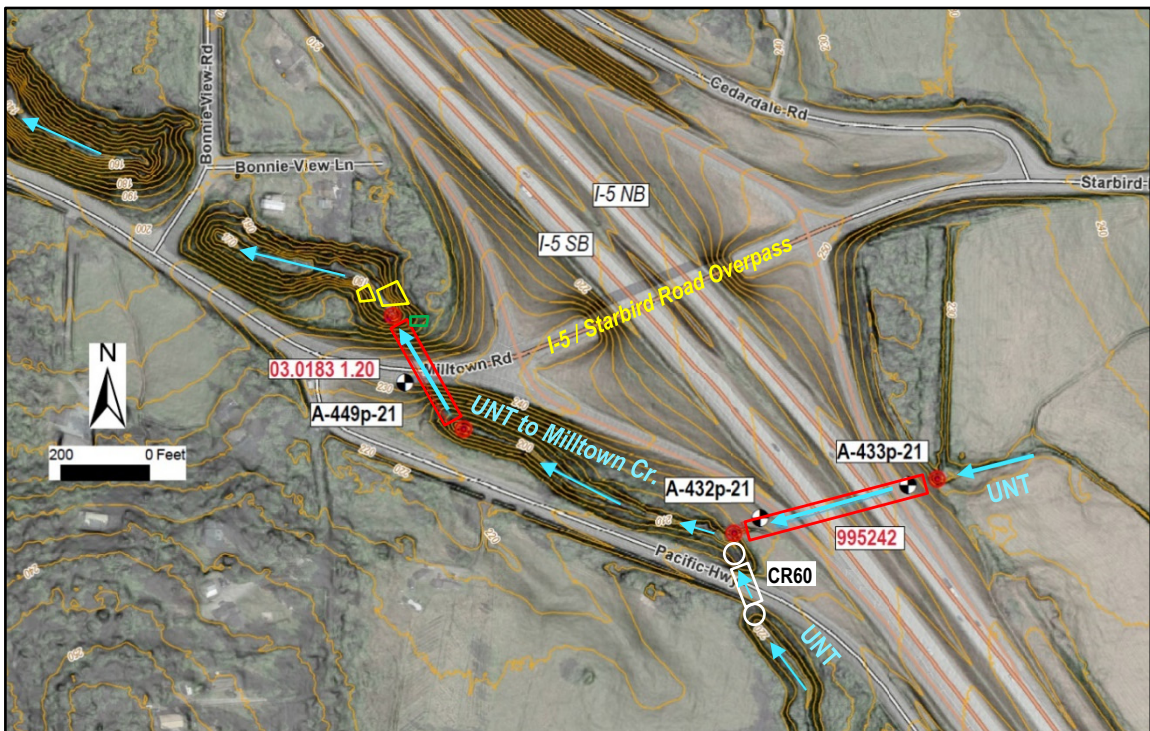


EXHIBIT 4G: LIDAR SLOPE MAP OF PROJECTS 992175 AND 03.0183 1.20 AND STREAM FLOW OF UNT TO MILLTOWN CREEK THROUGH PROJECT CULVERTS.

Red circles are Project inlet and outlet culvert locations and related features, red box indicates location of culvert pipe, white box and circles show location of non-project culvert, light blue arrows indicate stream flow direction, yellow boxes indicate approximate location of pistol-butted trees, green box indicates approximate location of suspected erosion gully, orange lines are 5-ft contour intervals.

The combined UNT flow follows a partially wooded channel that is enclosed by I-5 SB to the southeast, the on-ramp to the northeast, Milltown Road to the north, and Pacific Hwy to the south and west. The stream flows northwest for about 750 feet before reaching the 03.0183 1.20 inlet below Milltown Road (Photos D-13.1 through D-13.3).

Culvert 03.0183 1.20

The embankment for Milltown Road is about 45 feet thick over the 03.0183 1.20 culvert and about 20 feet thick over buried channel slopes. Glacial till is exposed in the streambed and in a 5-foot high near-vertical exposure on the eastern ravine slope

downstream of the outlet (Photo D-14.1), exposure (Photo D-14.2). Cobbles and boulders lie over the till exposed in the streambed (Photos D-15.1 and D-15-2).

The metal apron and wingwalls at the culvert outlet are completely rusted through, presumably by a combination of corrosion and abrasive action from alluvial sands and gravels. The site is likely subject to high-energy flows and scouring events. Refer to the Scour section of this memorandum for additional discussion.

Downstream of the outlet, there are multiple signs of potential surficial slope instability (Exhibit 4G).

- A few pistol-butted trees (Photo D-15.3) line the crest of steep channel slopes downstream of the outlet, such as the eastern channel slope which is inclined at 1H:1V and about 30 feet tall. The slopes appear to be composed of a few feet of colluvium overlying very dense sands and till.
- Toward the southeast of the outlet, we observed a 2-foot wide by 2-foot deep by several feet long opening in the ground, with length direction oriented down slope. The opening is located about mid-way up the slope, and we suspect it is a partially-exposed erosion gully.

Refer to the Unstable Slopes section of this memorandum for more information.

Site Geology

The Project site is situated on a broad glacial upland that descends to the South Fork of the Skagit River to the northwest and the Stillaguamish River valley to the south. Geologic maps of the Southern and Northern Project sites are presented in Exhibit 5. Published geologic mapping (Dragovich and others, 2002¹⁸) indicates that the upland area is underlain by Pleistocene glacial and nonglacial deposits. These deposits represent multiple glaciations spanning Pre-Fraser time, the Vashon Stade, and the subsequent Everson Interstade. Bedrock was encountered at about 25 feet below original ground in six Southern Project site borings.

¹⁸ Dragovich, J. D.; Gilbertson, L. A.; Norman, D. K.; Anderson, Garth; Petro, G. T., 2002, Geologic map of the Utsalady and Conway 7.5-minute quadrangles, Skagit, Snohomish, and Island Counties, Washington: Washington Division of Geology and Earth Resources Open File Report 2002-5, 34 p., 2 plates, scale 1:24,000.

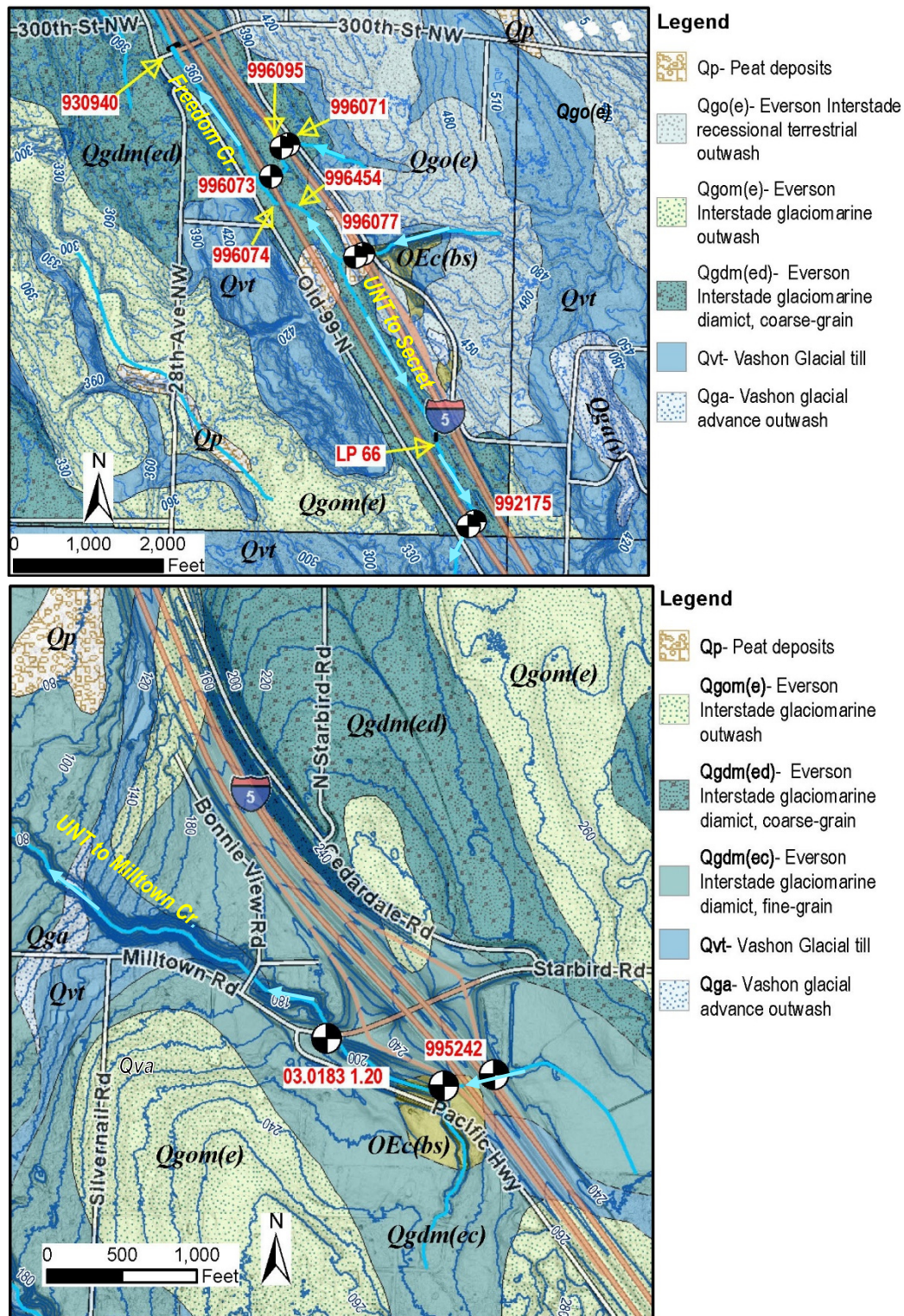


EXHIBIT 5: GEOLOGIC MAP OF SOUTHERN (TOP) AND NORTHERN (BOTTOM) PROJECT SITES, MODIFIED FROM DRAGOVICH AND OTHERS (2002)

Light blue arrows indicate flow direction; dark Blue lines are 10-foot contour intervals.

SR 005/Secret, Freedom, and Milltown Creeks x12, MP 213.62 to MP 218.56

XL5949 Site IDs: 992175, LP66, 996077, 930947, 996454, 996074, 996073, 996071, 996095, 930940, 995242, and 03.0183 1.20

The nonglacial, glacial, and recessional deposits in the Project vicinity represent complex and fluctuating environments that include glacial advance, occupation, retreat, and a marine incursion into the Skagit Valley. The oldest surficial deposits mapped in the Project vicinity consist of pre-Vashon, nonglacial deposits (Qpnl) and glacial deposits (Qpgt). Although not shown in Exhibit 5, these deposits are typically visible at the base of steep gully walls. Vashon-age lodgment till (Qvt), which was directly emplaced by advancing glacial ice, mantles portions of the upland area and is exposed at the surface along the scoured and undulating top and flanks of the upland. Beds of Vashon glacial advance outwash (Qva) are exposed below the Qvt in some drainages (Exhibit 5).

The more recent Everson Interstade deposits blanket much of the upland area and fill in former outwash stream channels and depressions between Qvt-cored glacial flute ridges. The Everson deposits represent the inundation of marine water into the Puget Lowland during ice retreat and before isostatic rebound raised the glacially depressed land masses to current elevations. The dynamic environment at this time created a complex interplay between glaciomarine and terrestrial environments that produced coeval and interfingering glaciomarine deposits and terrestrial fluvial deposits. These deposits, listed from onshore (ice-distal) to offshore (ice-proximal), include the following:

- terrestrial fluvial deposits (Qgo(e));
- nearshore, fluvial-influenced and clast-rich, glaciomarine diamict (Qgmd(ed)); and
- offshore, deep-water, fine-grain, glaciomarine diamict (Qgdm(ec)).

These deposits are typically interlayered and contacts between units can be gradational.

Since the Everson Interstade occurred while the Vashon ice was receding, we consider the Everson-age deposits to be normally consolidated, recessional deposits. Dragovich and others (2002) describe these units as being typically lower-density deposits, based on outcrop observations. However, within the Project vicinity, the Qgdm(ec) and Qgdm(ed) were locally observed to be dense to very dense, more common in over-consolidated soils. Therefore, a relatively wide range of soil densities can be anticipated for the Everson deposits in the Project vicinity.

The youngest surficial deposits in the Project vicinity include alluvium (Qyal) that was deposited along stream channels and lacustrine and/or wetland deposits (Hl / Qw).

In the Project vicinity, bedrock is exposed in stream channels and along steep slopes. The rock consists of Oligocene to Eocene sandstone and siltstone Rocks of Bulson Creek (OEcb). The OEcb was encountered in six Southern Project site borings.

Engineering Stratigraphic Units

We grouped the subsurface materials into ten Engineering Stratigraphic Units (ESUs) based on subsurface data from the Project borings listed in Exhibit 3. Collectively, Project borings encountered normally consolidated, post-glacial and recessional deposits, including fill, Qyal, Hl/Qw, Qgo(e), Qgdm(ed), and Qgdm(ec) over glacially overridden soil, Qvt, Qva, Qpgt, and Qpnl, and bedrock (OEcb) at depth. Generalized descriptions of the ESUs and associated geological units are tabulated in Exhibit 6.

EXHIBIT 6: SUMMARY OF ENGINEERING STRATIGRAPHIC UNIT (ESU) DESCRIPTIONS

ESU ¹	Geologic Unit ²	Description	Density	USCS	Other Notes
1	Fill	Fill	Loose - Dense	SM with gravel	
2a	HI / Qw	Lacustrine / wetland deposits	Medium Stiff	CH	with peat, sand
2b	Qyal	Fluvial deposits and slope colluvium	Loose - Dense	SM with gravel, GC to GM with sand	
3	Qgo(e)	Everson Interstade terrestrial outwash	Medium Dense - Dense	GM with sand	
4a	Qgdm(ed) - gravel	Everson Interstade glaciomarine drift-- clast-rich	Dense to Very Dense	Silty Clayey gravel to GM	with sand, sand and gravel interbeds
4b	Qgdm(ed)- sand	Everson Interstade glaciomarine drift-- clast-rich	Medium Dense - Very Dense	SC to SM with gravel	
5	Qgdm(ec)	Everson Interstade glaciomarine drift - fine grain	Medium Dense, Stiff - Hard	Sandy ML and Sandy CL	with varying amounts of gravel
6	Qvt	Vashon glacial till	Very Dense	Sandy ML with gravel to SM with gravel	Occasional cobbles and boulders
7	Qva	Vashon Advance Outwash	Very Dense	Sand	
8	Qpgt	Pre-Fraser glacial till	Very Dense	SM with gravel	with fragments of ESU10b
9	Qpnl	Pre-Fraser nonglacial deposits	Hard	CL with sand	with carbonized wood and organics
10a	OEc(bs)- Weathered Rocks of Bulson Creek	Completely Weathered Sandstone / Claystone	Very Dense	SM and sandy CL	fragments of ESU10b, trace organics
10b	OEc(bs)- Rocks of Bulson Creek	Highly weathered, fine to medium grain sandstone	Extremely Weak	Sandstone / Claystone	with claystone interbeds

NOTES:

1 Color shading shown is used in Exhibit 7 to depict each ESU.

2 Based on Dragovich and others (2002), cobbles and boulders can typically be encountered in ESU4a, ESU4b, and ESU6.

Simplified profiles (not to scale) of the Southern Project Sites and the Northern Project Sites are shown in Exhibit 7 to provide an overview and comparison of the geology, and associated ESUs, along the entire project alignment.

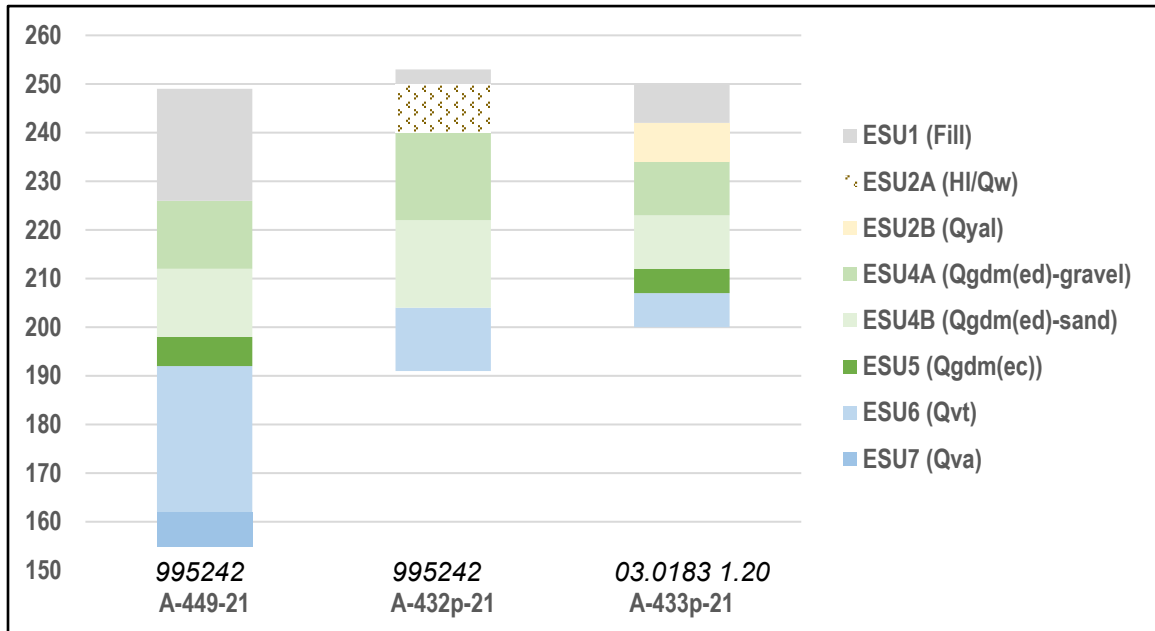
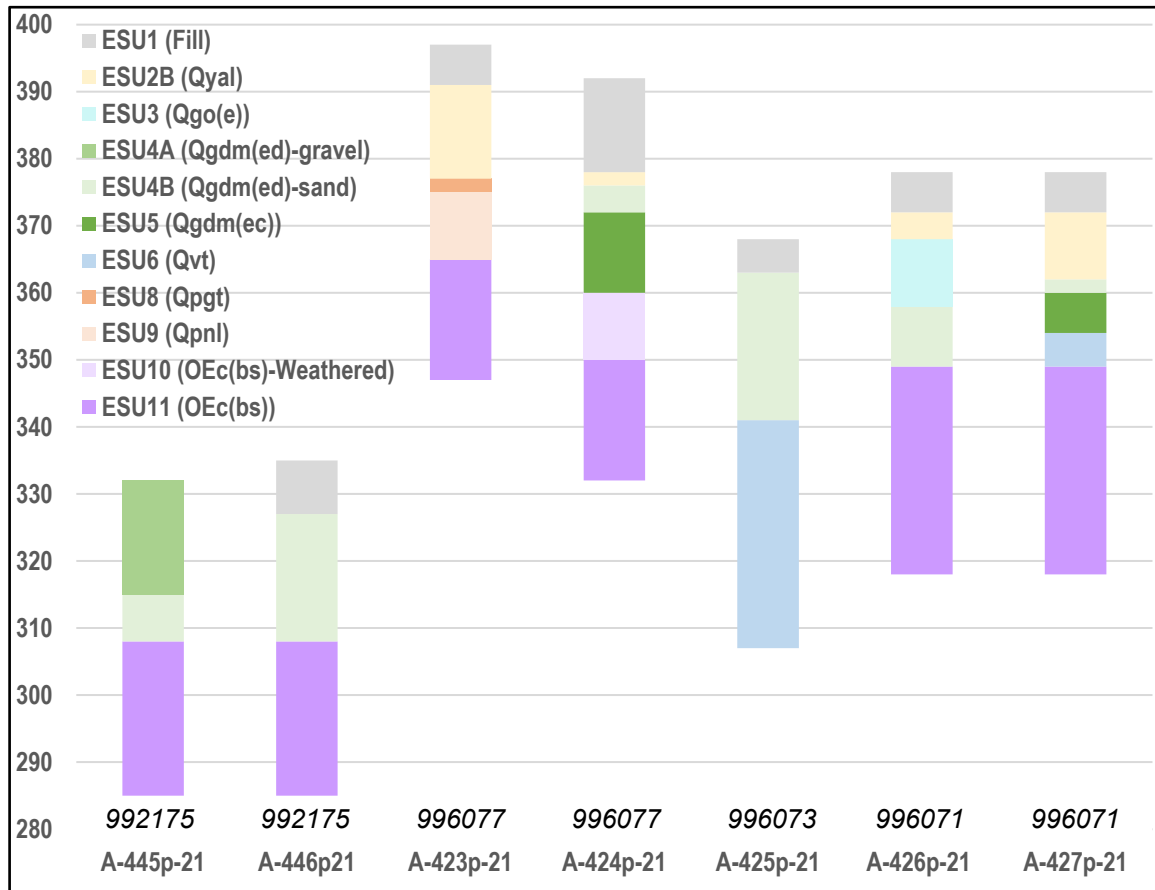


EXHIBIT 7: SIMPLIFIED PROFILES OF SOUTHERN PROJECT SITES (TOP) AND NORTHERN PROJECT SITES (BOTTOM).

Borings listed from south (left) to north (right), elevation in feet vertical axis, not to scale

SR 005/Secret, Freedom, and Milltown Creeks x12, MP 213.62 to MP 218.56

XL5949 Site IDs: 992175, LP66, 996077, 930947, 996454, 996074, 996073, 996071, 996095, 930940, 995242, and 03.0183 1.20

Subsurface profiles along the existing culvert alignment showing available subsurface data are included in the following figures:

- Figure 3a: Profile for I-5 / UNT to Secret Creek (992175)
- Figure 3b: Profile for I-5 / Freedom Creek (996077)
- Figure 3c: Profile for I-5 / UNT to Freedom Creek (996071 and 996073)
- Figure 3d: Profile for I-5 / Freedom Creek (930940)
- Figure 3e: Profile for I-5/ UNT to Milltown Creek (995242 and 03.0183 1.20)

Groundwater

Groundwater data from piezometers installed as part of the current explorations are summarized in Exhibit 8. A graphical representation of groundwater data obtained from the piezometers is presented in Exhibit 9.

EXHIBIT 8: SUMMARY OF GROUNDWATER DATA

Site ID	Boring	Date(s) of Groundwater Measurement	Depth to Groundwater ¹ (feet)			Groundwater Elevation ¹ , NAVD88 (feet)		
			Min	Avg	Max	Max	Avg	Min
992175	A-445p-21	4/21/21 – 9/15/21	2	4	7	333	331	328
	A-446p-21	4/21/21 – 9/15/21	1	5	7	333	329	327
LP66	N/A	Multiple	Submerged			Submerged		
996077	A-423p-21	4/21/21 – 9/15/21	7	12	13	387	386	385
	A-424p-21	3/31/21, 4/21/21 – 9/15/21	7	12	14	385	380	378
996454	N/A	Multiple	Submerged			Submerged		
996074	--	March 1967	3 ²			360 ^{2,4}		
996073	A-425p-21	4/21/21 – 9/15/21	2	4	7	365	363	361
996071	A-426p-21	4/21/21 – 9/15/21	4	5	7	374	373	371
	A-427p-21	4/21/21 – 9/15/21	3	5	7	375	373	371
996095	A-426p-21	4/21/21 – 9/15/21	4	5	7	374	373	371
930940	H-2-68	1/12/1968	4 ²			356 ^{2,3}		
995242	A-432p-21	4/21/21 – 9/15/21	10	12	14	221	219	217
	A-433p-21	4/21/21 – 9/15/21	7	9	10	232	231	230
03.0183 1.20	A-449-21	N/A	51 ²			184 ²		

NOTES:

- 1 Taken from where boring was drilled, typically at top of road embankment for current explorations, or from original ground for historic explorations. Rounded to nearest foot.
- 2 Groundwater measured at time of drilling.
- 3 Adjusted for assumed vertical datum shift from old City of Seattle to NAVD88 (about +10 feet).
- 4 Adjusted for assumed vertical datum shift from NGVD29 to NAVD88 (about + 3.5 feet)

SR 005/Secret, Freedom, and Milltown Creeks x12, MP 213.62 to MP 218.56

XL5949 Site IDs: 992175, LP66, 996077, 930947, 996454, 996074, 996073, 996071, 996095, 930940, 995242, and 03.0183 1.20

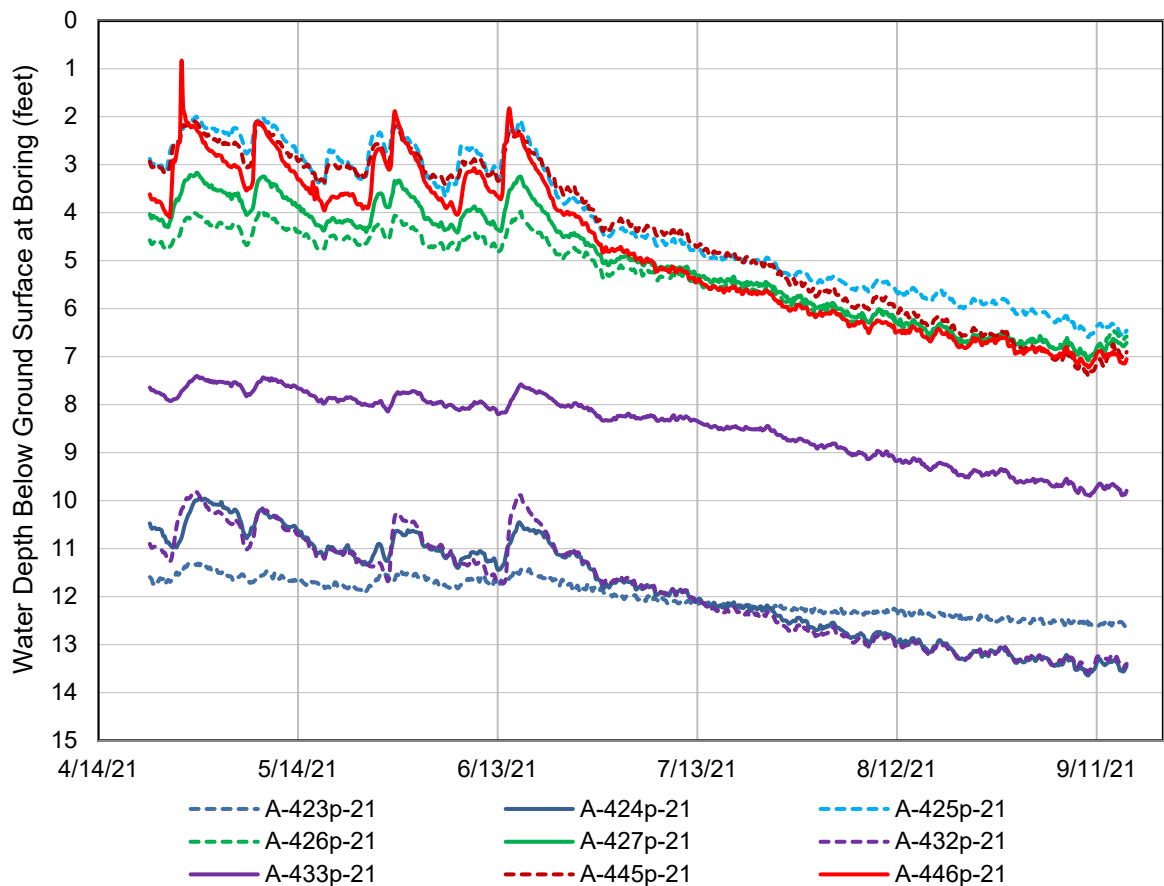


EXHIBIT 9: GROUNDWATER MONITORING RESULTS IN PIEZOMETER BETWEEN APRIL 15 AND SEPTEMBER 15, 2021

Groundwater levels recorded in historic borings (typically at time of drilling) are included in Appendix A. Refer to Figures 3a to 3e for interpretations of groundwater level across the culvert sites. Note that the groundwater measurements from the piezometers are ongoing and updated groundwater information may be provided upon request. The dates of groundwater measurement include time that was considered a drought, and for analyses that are sensitive to the average groundwater level (e.g., liquefaction analysis) we conservatively selected the minimum depth (highest elevation) to groundwater. We recommend that groundwater is monitored through at least one full calendar year to evaluate seasonal variations.

UNSTABLE SLOPES

The Unstable Slope Management System (USMS) indicates two unstable slopes within the Project limits (slope designation 579 and 1801). Both of these slopes are located at the I-5 / Freeborn Road intersection and are listed as unstable for erosion. Slopes 579 and 1801 are unrelated to the Project sites and are not anticipated to affect the Project. Slope stability for temporary slopes and permanent slopes is discussed later in this memorandum.

Based on our evaluation of the lidar data, we did not identify slopes in the Project site with geomorphic characteristics typical of unstable slopes. However, during our site reconnaissance we observed existing slopes that could be susceptible to future slope instability:

- Soft soils identified as “Unsuitable Foundation Material” in 1956 I-5 plans are present at the toe of the existing embankment slope downstream of Site 996077.
- Downstream of the outlet of culvert 03.0183 1.20, we observed multiple pistol-butted trees located near the crest of near-vertical channel slopes and a small, suspected erosion gully uphill of the outlet (Exhibit 4G). The soils encountered at this site are generally dense to very dense granular soils and are unlikely to be prone to deep-seated instability, however the possibility of instability could be assessed with an additional geotechnical boring. We anticipate that the observations of instability are surficial, potentially coinciding with a few feet of weathered or colluvial cover soil over predominantly dense subsurface soils.

ACTIVE FAULTS

We reviewed online maps hosted by the U.S. Geological Survey (USGS) and the DNR for faults close to the Project site. Based on our review, we identified three Quaternary-active fault zones in the vicinity of the Project site (Exhibit 10). The Darrington-Devils Mountain Fault Zone (DDMFZ) is located about 3.5 to 6 miles north of the Project area and consists of an approximately 75-mile-long group of sub-parallel, oblique-left lateral faults. Although age control of fault movement is unknown for the entire fault zone, late Quaternary activity is inferred for at least the western end of the zone (roughly including the Project area), based on marine seismic studies, and a paleoseismic trench study across one of the fault strands near Mt Vernon where Holocene surface rupture was documented^{19,20}.

The mapped extents of active strands of the Strawberry Point Fault Zone (SPFZ) and the Utsalady Point Fault Zone (UPFZ) are located about 6 miles to the west of the Project. These left-lateral oblique-strike-slip faults project roughly toward the Project area but terminate about 6 miles to the west of the Project. Paleoseismic studies on Whidbey Island documented late Pleistocene (<130,000 years) fault rupture along the SPFZ and latest Pleistocene (<15,000 years) fault rupture along the UPFZ, each consistent with marine seismic studies that inferred Quaternary activity along these faults¹⁹.

¹⁹ Johnson, S.Y., Dadisman, S.V., Mosher, D.C., Blakely, R.J., and Childs, J.R., 2001, Active tectonics of the Devils Mountain fault and related structures, northern Puget Lowland and eastern Strait of Juan de Fuca region, Pacific Northwest: U.S. Geological Survey Professional Paper 1643, 46 p., 2 pls.

²⁰ Personius, S.F., Briggs, R.W., Nelson, A.R., Schermer, E.R., Maharrey, J.Z., Sherrod, B., Spaulding, S.A., Bradley, L-A., 2014, Holocene earthquakes and right-lateral slip on the left-lateral Darrington-Devils Mountain fault zone, northern Puget Sound, Washington: Geosphere, v. 10, p. 1482 – 1500, doi: 10.1130/GES01067.1

In our opinion, based on the location of currently-mapped active faults in the Project vicinity, the risk of near-fault effects and surface fault rupture affecting the short-span structures proposed for the Project is low.

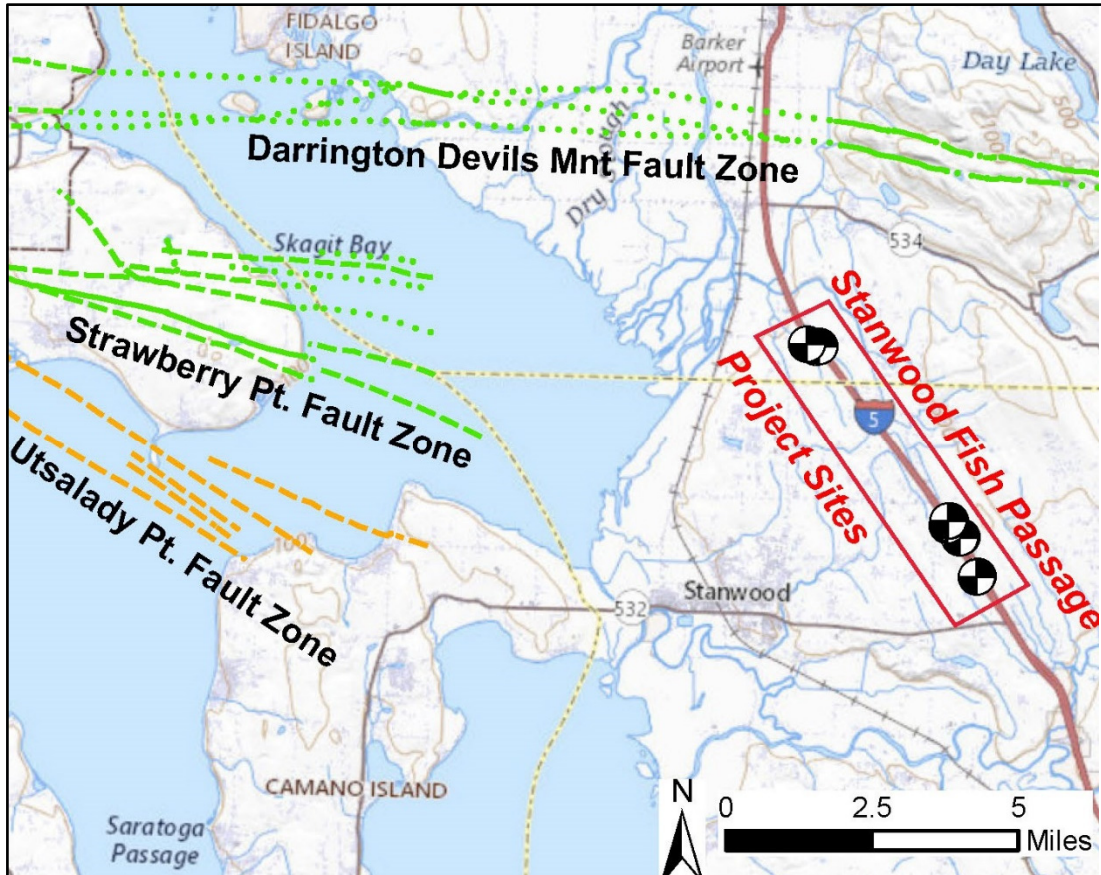


EXHIBIT 10: MAP OF PROJECT SITE RELATIVE TO REGIONAL FAULTS

Gold lines show locations of faults active since the last 15,000 years (latest Quaternary); green lines show locations of faults active since the last 130,000 years (late Quaternary). Fault data from the USGS.

CONCEPTUAL GEOTECHNICAL DESIGN RECOMMENDATIONS

Recommendations in this section are provided for the seven sites where replacement structures are proposed. The Northwest Region provided conceptual-level plans for five out of seven sites. Type, size, and location of replacement structures are typically selected after hydraulic analysis and meetings with stakeholders are completed. Common fish-passable structures include box culverts, structural plate culverts, three-sided or arch structures, or single-span bridges. We anticipate that the structure type for each site will be governed predominantly by:

- the presence of potentially liquefiable soils,
- the depth of excavation below groundwater required to construct the structure and perform subgrade improvement,
- the need to limit the buried structure Length-to-Span (L:S) ratio to 10:1 (or less),
- potential for scour, and
- the presence of potentially corrosive soils.

We have provided conceptual recommendations for buried structures to replace the culverts. We also address considerations for bridge alternatives, associated walls, and embankment slopes.

We have provided the following considerations for selection of the potential structure type for each site:

- We anticipate that most of the fish passage structures can be accommodated with buried structures. In areas where unfavorable soils are present, four-sided structures are strongly preferred over three-sided structures. Site-specific discussion of structure feasibility is provided in the Foundation Recommendations section of this memorandum.
- Bridges, if used, may need to be supported on deep foundations for non-geotechnical constraints such as scour, depth of excavation below groundwater, or construction staging. If deep foundations are necessary, drilled shafts would be best suited due to the presence of very dense soils and sandstone bedrock near the surface. Shallow foundations are potentially feasible if the above constraints are satisfied.
- Near-surface groundwater has been observed. The depth of excavation required below groundwater plays a large role for anticipating dewatering effort, shoring effort, and structure type selection at these sites. Further discussion is provided in the Temporary Slopes and Shoring, and Dewatering sections of this memorandum.
- Depending on the slope configuration and proximity to replacement structures, existing fill slopes may need mitigation (e.g., flattening or subgrade improvement) to reduce the effects of seismic slope instability.
- Seismic design is required for nearly all replacement structures and walls (due to spans typically greater than 20 feet and walls typically greater than 10 feet high)

Exhibit 11 provides our estimate of the anticipated (A) structure type or alternative structure type (B) that may be appropriate for each site. We also indicate which structure types unlikely (U). The minimum hydraulic opening is also presented for sites where a PHD or conceptual stream plans are available.

EXHIBIT 11: ANTICIPATED STRUCTURE TYPE

Site ID	Minimum Hydraulic Opening, (feet) from PHD	Buried Structure Span < 20 feet*	Bridge Foundation Or Buried Structure Span > 20 feet
992175	30	--	A
996077	22	--	A (2 structures)
996073	24	--	A
996071	30	--	A
930940	Unavailable ¹	A	B
995242	14	A (2 structures)	B (2 structures)
03.0183 1.20	Unavailable ¹	U	A

NOTES:

- 1 PHD, stream plans, and minimum hydraulic opening are not yet available at the time of writing.
- 2 A = Anticipated; B = Alternative; U = Unlikely to be feasible due to L:S Ratio > 10.

Seismic Design Considerations

The Project will be designed in accordance with the current versions of the WSDOT Geotechnical Design Manual (GDM), the WSDOT Bridge Design Manual, and American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design Bridge Design Specifications (BDS). Based on these documents, the following seismic design considerations from GDM Section 6-1.2.1 apply.

- Seismic design is required for:
 - Bridges
 - Buried structures with clear spans greater than 20 feet, as measured along the roadway (WSDOT Hydraulics Manual Section 3-3.1.2).
 - Walls that are greater than 10 feet high or that pose a life safety risk to the roadway if the wall were to collapse during an extreme seismic event.
- Seismic design is not required for:
 - Buried structures with clear span lengths less than 20 feet, as measured along the roadway.
 - Walls that are less than 10 feet high and do not pose a life safety risk to the roadway should the wall collapse.
- Structures shall be designed for no-collapse for the extreme seismic event.

We evaluated the seismic site classification for the Project based on AASHTO BDS Table 3.10.3.1-1 and the subsurface conditions previously described. We used the

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seismic design maps provided in the GDM and adjusted for the soil response factors provided in the GDM. Exhibit 12 shows the Site Class corresponding to each of the sites where new structures are proposed. Site Class C is anticipated for sites where very dense soils and/or weathered sandstone is present in the subsurface. Site Class D is anticipated for sites where loose to medium dense surficial alluvium, wetland deposits, and/or stiff fine-grained soils overlie denser strata.

EXHIBIT 12: SUMMARY OF SEISMIC SITE CLASSIFICATIONS

Site ¹	MP	Seismic Design Anticipated? ²	Site Class
992175	213.62	Yes	C
996077	214.36	Yes	D
996073	214.64	Yes	C
996071	214.7	Yes	D
930940	215.05	Yes	D ³
995242	218.44	Yes	D
03.0183 1.20	218.56	Yes	C

NOTES:

- 1 Culverts that will be plugged or removed without replacement are not listed.
- 2 PHDs and stream plans are pending for some of the sites in this memorandum. The need for seismic design depends on wall height and hydraulic opening of the proposed structure, which is unknown for sites without PHDs made available at the time of writing.
- 3 Site Class assumption based on nearby historic borings.

Seismic parameters for both Site Class C and Site Class D are indicated in Exhibit 13. Seismic design among the sites could be simplified by using an upper-bound envelope of the seismic response spectrum of Site Class C and Site Class D. If this hybrid approach is used, the upper-bound envelope spectrum should be based on the highest recommended values from Exhibit 13 (i.e., A_s , S_{DS} , S_{D1}) between Site Class C and Site Class D. This approach would have minimal effect on seismic design loads for short-period structures such as the small bridges and buried structures anticipated for the Project.

The Project is located within 3.5 to 6 miles of the DDMFZ and near-fault effects may need to be considered depending on the structure configuration. In our opinion, near-fault effects will not be significant for short-period structures such as the small bridges and buried structures anticipated for the Project.

EXHIBIT 13: PRELIMINARY CODE-BASED SEISMIC PARAMETERS

Description	Recommended Value		
Site class based on soil conditions	Site Class =	C	D
Mean magnitude ¹	M =	7.0	7.0
Peak horizontal ground acceleration coefficient on Class B/C (soft rock) ²	PGA =	0.346 g	0.346 g
0.2-second period spectral acceleration coefficient on Class B/C (soft rock) ²	S _s =	0.78 g	0.78 g
1.0-second period spectral acceleration coefficient on Class B/C (soft rock) ²	S ₁ =	0.23 g	0.23 g
Site coefficient for the peak ground acceleration coefficient	F _{pga} =	1.20	1.25
Site coefficient for 0.2-second period spectral acceleration	F _a =	1.20	1.19
Site coefficient for 1.0-second period spectral acceleration	F _v =	1.50	2.13
Design peak ground acceleration coefficient (g)	A _s = (PGA)F _{pga} =	0.41 g	0.43 g
Design earthquake response spectral acceleration coefficient at 0.2-second period	S _{DS} = F _a S _s =	0.94 g	0.93 g
Design earthquake response spectral acceleration coefficient at 1.0-second period	S _{D1} = F _v S ₁ =	0.35 g	0.50 g
Seismic Design Category based on S _{D1}	SDC =	C	D

NOTES:

- 1 Mean magnitude is less than 7.0 for major contributing sources. GDM Section 6-A.2 recommends magnitude 7.0 for geotechnical design.
- 2 Based on the U.S. Geological Survey Uniform Hazard Tool (<https://earthquake.usgs.gov/hazards/interactive/>) using the U.S. Dynamic Conterminous edition for 2014 (v.4.1.4).

Liquefaction

We assessed the liquefaction susceptibility based on the geotechnical borings and seismic parameters provided in Exhibit 13. The results of the liquefaction assessment are summarized in Exhibit 14. In general, the soils that are potentially liquefiable include saturated, loose to medium dense zones of: ESU 1, ESU 2b, ESU 4b, and ESU 5. Potentially liquefiable soils are indicated on the subsurface profiles (Figures 3a to 3e) and on annotated copies of the Stream Plans from the PHD reports (Figures 4a to 4g). Some potential consequences of liquefaction are included in Exhibit 14 and are further described in subsequent sections of this memorandum.

EXHIBIT 14: LIQUEFACTION ASSESSMENT

Site	Borings	Assumed Ground-water Depth (feet) ¹	Potentially liquefiable soils	Potential Consequences of Liquefaction		
				Post-Liquefaction Settlement ² (inch)	Slope Instability ³	Liq. Soils behind walls ⁴
992175	A-445p-21 A-446p-21	1 to 2	None	N/A	N/A	N/A
996077	A-423p-21 A-424p-21	7	ESU 1(Hf), ESU 2b (Qyal), ESU 5 Qgdm(ec)	<1 to 4	Yes	Yes
996073	A-425p-21	2	None	N/A	N/A	N/A
996071	A-426p-21 A-427p-21	3 to 4	ESU 1(Hf), ESU 2b (Qyal)	1 to 3	Yes	Yes
930940	N/A	4	None ⁵	N/A ⁵	N/A ⁵	N/A ⁵
995242	A-432p-21 A-433p-21	7 to 10	ESU 2b (Qyal), ESU 4b sand Qgdm(ed)	0 to 4	Yes	Yes
03.0183 1.20	A-449-21	45	None	N/A	N/A	N/A

NOTES:

- 1 Depth to groundwater based on piezometer data and interpretation of the groundwater surface across the site. Additional groundwater measurements are in progress.
- 2 Refer to the Settlement section of this memorandum.
- 3 Refer to the Permanent Slopes section of this memorandum.
- 4 Refer to the Wing Walls and Retaining Walls section of this memorandum.
- 5 To be confirmed based on additional geotechnical borings.

Scour

The Project sites are generally underlain by sands and silts which are susceptible to scour. The findings from our geotechnical explorations, laboratory results, and site reconnaissance should be considered by the Hydraulics Office in their evaluation of scour. Boring logs are included in Appendix B and the results of laboratory tests such as sieve analyses, hydrometer tests, and Atterberg Limits are included in Appendix C. Table 1 includes observed scour at the time of the site reconnaissance visits.

We recommend that scour analysis be conducted early in the design process as this will be a key geotechnical design consideration for the replacement structures. The following considerations may apply to scour analysis.

- Completely weathered bedrock (ESU 10a) should be treated as a soil for purposes of scour analysis.
- The sandstone bedrock (ESU 10b), where encountered across the Project, is extremely weak and highly weathered. ESU 10b may be somewhat susceptible to scour. However, ESU 10b is encountered 15 to 20 feet below anticipated structure invert and is not anticipated to affect the scour analysis.
- Based on our site reconnaissance, Site 03.0183 1.20 shows evidence of past scour (e.g., incised channel wall, damaged culvert apron, and cobbles and boulders present in the streambed). The channel wall and streambed are composed of glacial till (ESU 6). Embedded clasts within the till have been polished smooth, presumably by scouring action. These observations suggest that ESU 6 is relatively scour resistant compared to alluvial sands and gravels. The scour-resistant properties of ESU 6 should not be expected to be consistent across the Project.

Foundation Recommendations

In our opinion, either bridges or buried structures are geotechnically feasible to accommodate the structure requirements indicated in the PHDs. Based on the PHDs we anticipate the basic structure configurations listed in Exhibit 11. The following information is provided for planning purposes and is based on the limited subsurface information available at each site:

- Sites 992175, 996073, and 930940 appear to have favorable soils that would accommodate most buried structure types (three- or four-sided box structures, structural plate culverts, bridges on shallow foundations, or bridges on drilled shafts).
- Sites 996077, 996071, and 995242 likely have unfavorable soils that may require subgrade improvement. Four-sided or other closed-section culverts are strongly preferred over three-sided culverts due to the potential for static and/or seismic differential settlement. Subgrade improvement using overexcavation and replacement is anticipated. If deep overexcavation is not desired, bridge options would be feasible and would likely require deep foundations. If deep foundations are considered:
 - Driven piles are likely not feasible due to the risk of early refusal on very dense soils and obstructions.

- Drilled shafts embedded in very dense soils is likely necessary. Wet methods of construction and methods to reduce soil caving and slaking of the bedrock (e.g., temporary casing) is required.
- Site 03.0183 1.20 is a unique site that has favorable soils but shows evidence of high scour events that are partially resisted by the indurated glacial till. For planning purposes, we anticipate that a 30-foot wide, three- or four-sided box buried structure would be feasible. Alternatively, a bridge that spans the ravine, supported on drilled shafts could be feasible. Due to undulating ravine width and skew to the roadway, a bridge may require multiple spans to cross the ravine.
- Corrosivity of soil and groundwater should be considered, especially for structural plate culverts. Several sites showed evidence of corrosion (Table 1). Refer to the Corrosion section of this memorandum.
- Seismic design is required for buried structures with clear span greater than 20 feet as measured along the roadway.
- The configuration of the buried structure may affect wall design and construction. Skew of the buried structure should be minimized where possible.
- We observed cobbles and boulders in exposures of ESU 6, which may act as obstructions for excavations, drilled shafts, and piles. Based on our experience, cobbles and boulders may also be encountered in ESU 1, and to a lesser extent ESU 4a, ESU 4b, and ESU 5.

Exhibit 15 provides a summary of the anticipated foundation bearing conditions (ESUs and potential liquefaction) at each site. Refer to Figures 3a to 3e for elevations at which the ESUs occur.

Nearby bridges, as listed below, are supported on shallow foundations bearing on very dense ESU 4b or supported on short piles founded on very dense ESU 4b and hard ESU 5.

- Bridge 5/674E and 5/674W are supported on shallow foundations bearing on very dense ESU 4b.
- Bridge 5/701 Bonnieville Interchange (i.e., I-5 / Milltown Road) is supported on short concrete piles, driven to refusal in very dense ESU 4b and ESU 5. The abutments are supported on two rows of driven 12 BP 53 piles, spaced about 9 feet apart, with the front row battered. The internal piers are supported on 3 to 4 rows of short, 13-inch diameter concrete piles, driven to refusal in ESU 4b and spaced about 3.5 feet apart.

EXHIBIT 15: SUMMARY OF FOUNDATION BEARING CONDITIONS

Site ID	MP	ESUs Present	Soil & Rock Conditions ^{1,2}	Suitable for Bearing? ³	Reason
992175	213.62	ESU 1	MD sands	Yes ⁴	
		ESU 4a	VD gravels	Yes	
		ESU 4b	VD sands	Yes	
		ESU 10b	Sandstone	Yes	
996077	214.36	ESU 1	L to MD sands	No ⁴	Locally Liquefiable
		ESU 2b	L to MD gravels	No ⁴	Locally Liquefiable
		ESU 5	Stiff silts / clays	Maybe	Locally Liquefiable
		ESU 4b	D sands	Yes	
		ESU 8	VD sands	Yes	
		ESU 9	H clay	Yes	
996073	214.64	ESUs 10a/b	Sandstone	Yes	
		ESU 1	MD sands	Yes ⁴	
		ESU 2b	MD sands	Yes ⁴	
		ESU 4b	D to VD sands	Yes	
996071	214.7	ESU 6	VD silt/sand (till)	Yes	
		ESU 1	L to MD sands	No ⁴	Locally Liquefiable
		ESU 2b	L to MD sands	No	
		ESU 3	MD to D gravels	Yes	
		ESU 4b	MD to D sands	Yes	
		ESU 5	H silts / clays	Yes	
		ESU 6	VD silts (till)	Yes	
930940	215.05	ESU 10b	Sandstone	Yes	
		ESU 1	Likely MD sands	Yes ⁴	
		ESU 4b	D to VD silts	Yes	
995242	218.44	ESU 6	VD sands (till)	Yes	
		ESU 1	MD sands	No ⁴	Above unsuitable ESUs
		ESU 2a	MS clay / peat	No ⁴	Wetland / organics
		ESU 2b	VL to L sands	No ⁴	Liquefiable
		ESU 4b	MD to VD sands	No	Locally Liquefiable
		ESU 4a	D gravels	Yes	
		ESU 5	H clays	Yes	
03.0183 1.20	218.56	ESU 6	VD sands	Yes	
		ESU 1	MD to D sands	Maybe ⁴	Verify long-term slope stability of ESU 4b and ESU 5.
		ESU 4b	MD to VD sands	Maybe ⁴	
		ESU 5	H clays	Maybe	
		ESU 6	VD silts (till)	Yes	
		ESU 7	VD sands	Yes	

NOTES:

- 1 VL = Very Loose; L = Loose; MD = Medium Dense; D = Dense; VD = Very Dense.
- 2 VS = Very Soft; S = Soft; MS = Medium Stiff; Stiff = Stiff; V Stiff = Very Stiff; H = Hard
- 3 "No" = removal or stabilization may be required to place foundations in this zone; "Maybe" = suitability of bearing layer depends on structure and potentially additional subsurface data.
- 4 ESU is located above anticipated invert / footing and may not be relevant for bearing considerations.

SR 005/Secret, Freedom, and Milltown Creeks x12, MP 213.62 to MP 218.56

XL5949 Site IDs: 992175, LP66, 996077, 930947, 996454, 996074, 996073, 996071, 996095, 930940, 995242, and 03.0183 1.20

Wing Walls and Retaining Walls

Where buried structures are selected as the preferred option, we expect that wing walls used to retain the adjacent embankment fill would exceed 10 feet in most cases (unless the culvert is proportioned to reduce the wall height). Where walls exceed a height of 10 feet (above the base of the wall footing), seismic design is required (GDM Section 6-1.2.1).

Where dense to very dense subgrade soils are present, we anticipate that the global stability of the wing walls will meet the seismic stability requirements of GDM Section 7.4. For sites with locally soft soils or potentially liquefiable soils, subgrade improvement may be necessary to meet stability requirements. We anticipate that overexcavation and replacement with compacted structural fill or quarry spalls may be the most cost effective approach to improve the subgrade. Additional mitigation of problematic soils may be necessary on a case-by-case basis. For planning purposes:

- Sites with soft saturated fine-grained soils or loose to medium dense, saturated silts and sands may be marginally stable under static conditions and may not be stable during a seismic event due to the presence of potentially liquefiable soils. Subgrade improvement considerations follow:
 - Sites 996077, 996071, and 995242 require overexcavation and replacement of about 3 feet of soil below wall footings and structures to remove potentially liquefiable soils and mitigate seismically unstable slopes within influence of the walls and structures.
 - Liquefiable soils should also be removed from the retained zone behind walls, or special design may be needed to account for liquefiable retained soil (GDM Section 15-4.11).
 - If overexcavation cannot be performed due to elevated groundwater or other site constraints, then ground improvement below the buried structure and wing walls may be necessary. This option should consider that a “hard spot” may be created in the roadway between the unimproved and improved soil resulting in differential settlement. Additional ground improvement will likely be needed to transition between the unimproved and improved soils to mitigate this condition.
- Where possible, wing walls should preferably be configured to be less than 10 feet tall and/or oriented such that potential failure under a seismic event would not influence travel lanes.
- Walls may require special design and detailing if the buried structure or bridge is skewed (due to effects of corners where the wing wall meets the structure).

We recommend early engagement with the Geotechnical Office during the design process to discuss wing wall options.

For bridges, retaining walls will likely be constructed at the bridge abutments and extend along the roadway from the abutment (curtain walls) to support the bridge approaches. The abutment walls are typically supported by the bridge abutment foundation and consist of concrete walls. Typically, the curtain walls are also concrete walls. If a retained approach embankment is constructed beyond the curtain walls, wall options could include concrete cantilever walls, geosynthetic walls, or structural earth (SE) walls.

Based on the design peak ground acceleration coefficient of 0.43 g (Exhibit 13), standard plan reinforced concrete retaining walls Types 1 and 2, and standard plan geosynthetic walls Types 1 to 4 are potentially applicable. Considerations for walls at each site are included in Exhibit 16. Note that the presence of liquefiable soils within influence of the walls generally precludes use of Standard Plan walls. Use of Standard Plan walls at sites where liquefiable soils are present likely requires overexcavation of about 3 feet below the retaining wall footing and lateral overexcavation behind the walls by tens of feet.

EXHIBIT 16: SUMMARY OF ANTICIPATED WINGWALLS / RETAINING WALLS

Site ID	Anticipated Subgrade Soils ¹	Anticipated Maximum Wall Height (feet)	Seismic Design Required?	Global Stability Ok?	Notes
992175	ESU 4a (VD gravel)	~10	Potentially	Yes	Could be configured to have walls < 10 feet high (no seismic design)
996077	ESU 2b (L to MD gravel)	15 - 20	Yes	No – Requires mitigation	Liquefiable soils behind and below wall.
996073	ESU 4b (D to VD sand)	10 - 12	Potentially	Yes	Could be configured to have walls < 10 feet high (no seismic design)
996071	ESU 2b (L to MD sand)	15	Yes	No – Requires mitigation	Liquefiable soils in wall backfill zone and potentially at subgrade level.
930940	ESU 4b (D to VD silt)	~10	Potentially	Yes	Could be configured to have walls < 10 feet high (no seismic design)
995242	ESU 4b/4a (D gravel / MD to VD sand)	22	Yes	No – Requires mitigation	Liquefiable soils in wall backfill zone and potentially at subgrade level.
03.0183 1.20	ESU 6 VD silt (till)	33	Yes	Yes	Maximum wall height assumed based on tallest Standard Plan. Due to favorable subgrade, taller walls are likely possible with special design.

NOTE:

1 L = loose, MD = medium dense; D = dense; VD = very dense

Contractor Design

Based on the geotechnically favorable subsurface conditions anticipated at this site, most of the sites appear to be appropriate candidates for a contractor-designed structure per Section 6-20 of the WSDOT Standard Specifications. The following sites may have sufficient complexity where contractor-design delivery is not preferred:

- If the liquefaction risk at Site 996077 and 995242 cannot be adequately be mitigated by overexcavation, ground improvement or other options may need to be considered.
- If a bridge is selected at Site 03.0183 1.20, we anticipate there will be challenges to developing bridge configuration options (e.g., single span vs. multi-span, foundation options, approaches).

Temporary Slopes and Shoring

Construction will require excavating through fill and native soils. Temporary slopes (above the groundwater table) and/or shoring will be required when constructing the proposed structures. Temporary slopes and shoring are typically the responsibility of the Contractor. The Contractor shall determine the appropriate measures to ensure that all excavation work is in compliance with local, state, and federal safety codes. Shoring should be anticipated for excavations made below groundwater or where soft soils are exposed. The WSDOT Standard Specifications, which also refer to the GDM, provide requirements for shoring adjacent to roadways. The Contractor must follow these specifications in addition to the applicable safety codes.

Exhibit 17 lists anticipated temporary slopes and shoring considerations for each site. The anticipated depths shown in Exhibit 17 are based on invert elevations shown in the stream plans included in the PHDs. Where PHDs are not yet available, we assumed that the invert of the new buried structures will be about 3 feet below the existing culverts. In addition, we anticipate that overexcavation below buried structures and wing walls may be needed where soft or loose soils exist.

EXHIBIT 17: CONSIDERATIONS FOR TEMPORARY SLOPES AND SHORING

Site	Anticipated Maximum Excavation Depth (feet)	Anticipated Soils Exposed in Excavation	Depth Below Ground-water (feet)	Shoring Anticipated?	Planning-level Maximum Temp. Slope Inclination ³
992175	10	ESU 1, ESU 4a ESU 4b	6 to 9	Yes ^{1,2}	+GW: 1.5H:1V -GW: Shoring
996077	16	ESU 1 ESU 2b	5 to 11	Yes ¹	+GW: 1.5H:1V -GW: Shoring
996073	13	ESU 1 ESU 2b ESU 4b	5 to 8	Yes ^{1,2}	+GW: 1.5H:1V -GW: Shoring
996071	14	ESU 1 ESU 2b	7 to 9	Yes ¹	+GW: 1.5H:1V -GW: Shoring

Site	Anticipated Maximum Excavation Depth (feet)	Anticipated Soils Exposed in Excavation	Depth Below Ground-water (feet)	Shoring Anticipated?	Planning-level Maximum Temp. Slope Inclination ³
930940	10	ESU 1 ESU 4b ESU 6	6	Yes ^{1,2}	+GW: 1.5H:1V -GW: Shoring
995242	22	ESU 1 ESU 2a ESU 2b ESU 4b ESU 4a	8 to 15	Yes ^{1,2}	+GW: 1.5H:1V -GW: Shoring
03.0183 1.20	50	ESU 1 ESU 4a ESU 5 ESU 6	3	Yes ² (for staging)	1.5H:1V likely adequate for planning purposes until additional boring is drilled. Mid-slope bench recommended.

NOTES:

- 1 Shoring needed due to excavation in sands below groundwater.
- 2 Subsurface conditions indicate dense to very dense soils which could preclude some shoring installation methods (e.g., driving or vibrating into place).
- 3 N/A = not applicable; H:V = horizontal to vertical slope ratio; +GW = excavation entirely above groundwater; -GW = excavation extends below groundwater

We anticipate that temporary shoring is likely necessary at the majority of sites due to excavations that will be several feet below groundwater (Exhibit 17). Shoring may also be needed as part of staged construction. Shoring, excavation, and subgrade preparation considerations are as follows:

- Vertical elements for shoring may need to be drilled into place, rather than vibrated or driven, where dense to very dense soils exist near the surface (refer to cross-section Figures 3a to 3e). Cobbles and boulders may occasionally be encountered in ESU 1, ESU 6, and rarely in ESU 4a, ESU 4b, and ESU 5.
- Weak layers consisting of topsoil or organics may be present below ESU 1, particularly at sites LP66, near the outlet of 996077, at 996454, near the inlet of 996071, near the outlet of 996095, at 930940, and near the outlet of 995242. Organics and peat may also be found within ESU 2a and ESU 2b. Refer to the I-5 1956 plans in Appendix A and Figures 4a to 4g for approximate locations of soft soils.

Dewatering

We anticipate relatively high effort will be needed to dewater the excavations at these sites. We estimate that excavations required to construct the Project will generally extend to about 5 to 10 feet below groundwater, and potentially deeper at Site 995242 (Exhibit 17). Under these conditions, we anticipate that a combination of vacuum well points or pumped wells would be feasible to dewater the excavation. Note that

dewatering effort at these sites could be reduced by using water-tight shoring and basing the excavation in relatively impermeable soils. Alternatively, a base seal could be constructed in the base of excavation to achieve a dry excavation. Check dams and sump pumps may be suitable for dewatering Sites 930940 and 03.0183 1.20 due to relatively lower anticipated dewatering effort.

Exhibit 18 summarizes the anticipated soil behavior with respect to dewatering at each of the sites. Use this information in conjunction with the groundwater levels shown in Exhibit 17 and the subsurface profiles in Figures 3a to 3e.

EXHIBIT 18: ANTICIPATED DEWATERING BEHAVIOR OF SITE SOILS

Site	Anticipated Maximum Excavation Depth (feet)	Site Soils	Anticipated Dewatering Behavior	Subsurface Profile
992175	10	ESU 1	N/A	Figure 3a
		ESU 4a	High-flow	
		ESU 4b	Potential sealing layer	
		ESU 10b	Potential sealing layer	
996077	16	ESU 1	High-flow	Figure 3b
		ESU 2b	High-flow	
		ESU 5	Potential sealing layer	
		ESU 4b	Variable flow	
		ESU 8	Variable flow	
		ESU 9	Potential sealing layer	
		ESU 10a	Variable flow	
996073	13	ESU 10b	Variable flow	Figure 3c
		ESU 1	High-flow	
		ESU 2b	High-flow	
		ESU 4b-young	Variable flow	
		ESU 4b-old	Potential sealing layer	
996071	14	ESU 6	Potential sealing layer	Figure 3c
		ESU 1	High-flow	
		ESU 2b	High-flow	
		ESU 3	High-flow	
		ESU 4b-young	Variable flow	
		ESU 5	Potential sealing layer	
		ESU 6	Potential sealing layer	
930940	10	ESU 10b	Variable flow	Figure 3d
		ESU 1	N/A	
		ESU 4b	Variable flow	
995242	22	ESU 6	Potential sealing layer	Figure 3e
		ESU 1	High-flow	
		ESU 2a	High-flow	
		ESU 2b	Variable flow	
		ESU 4b	High-flow	

Site	Anticipated Maximum Excavation Depth (feet)	Site Soils	Anticipated Dewatering Behavior	Subsurface Profile
03.0183 1.20	50	ESU 4a	High-flow	Figure 3e
		ESU 5	Potential sealing layer	
		ESU 6	Potential sealing layer	
		ESU 1	N/A	
		ESU 4a	Variable flow	
		ESU 5	Potential sealing layer	
		ESU 6	Potential sealing layer	
		ESU 7	Potential high-flow	

Permanent Slopes

Embankment slopes within about 100 feet of bridge abutments are required to be stable for static and seismic scenarios. Based on existing slopes and performance, anticipated slope geometry, and seismicity, we anticipate:

- Slope stability is likely adequate across most of the Project sites where the depth to competent soils is shallow. Static and seismic stability is likely adequate if the existing embankment geometry and footprint is maintained (or flatter) and the embankment is founded directly on competent soils. Proposed cut slopes made in existing soils would be generally adequate except where made in/overlying liquefiable soils (described below).
- At Site 996077, soft soils may be present under the embankment slope of NB I-5 along the I-5 median. The soft soils at this location were identified in 1956 plans as "Unsuitable Foundation Material", and the present-day slope extends about 80 feet west of the work boundary indicated on the plans. A shallow boring could be drilled through the slope to verify the soil conditions.
- At Sites 996077, 996071, and 995242 slopes that will contain walls or will be within influence of other structures may be unstable due to the presence of loose, potentially liquefiable soils. Refer to the Wing Wall and Retaining Wall section of this memorandum regarding potential mitigation required to satisfy global stability requirements.
- At sites 996077 and 996071, new channel cut slopes proposed downstream of the outlets would likely be seismically unstable due to liquefiable soils and associated lateral spreading. These slopes should be assessed to determine if seismic deformation would impact the I-5 travel lanes or adjacent wing walls. Seismic instability of these cut slopes may be acceptable if there is no impact to structures or lanes. Refer to Figures 4b.1 and 4e.1.

Settlement

Settlement may occur as a result of virgin compression or recompression loose or soft soils, or as a result of seismic loading of soils that are susceptible to liquefaction.

- At Sites 992175, 996073, and 03.0183 1.20, the soils are generally dense to very dense sands or hard silts and clays and settlement of buried structures should be tolerable.
- At Site 996071, loose sands extend to about the elevation of the proposed replacement structure. We anticipate that the loose sands will be mostly removed during the excavation to remove the existing culvert and construct the replacement structure. Post-construction settlement and seismic settlement should be tolerable for the buried structure and walls with about 1 to 3 feet of overexcavation below the footings.
- At Sites 996077 and 995242 loose sands or medium stiff silts and clays associated with ESU 2a and ESU 2b are potentially susceptible to static and seismic settlement. These sites would require about 3 feet of overexcavation below the structure footings to reduce seismic settlement to tolerable levels for the buried structure and walls. Seismic settlement is discussed in the Seismic Design Considerations section of this memorandum.
- We anticipate that settlement of shoofly embankments could be problematic if placed over soft fine-grained soils which are present in the I-5 median areas. Refer to the Maintenance of Traffic section of this memorandum.

Maintenance of Traffic (MOT)

Exhibit 19 presents a summary of anticipated measures to maintain traffic and geotechnical considerations related to maintenance of traffic.

If traffic can be re-routed, then the lowest-cost MOT approach would be to implement a full closure of these areas. For sites that cross I-5, we anticipate that full closure is not feasible. If full closure is not feasible, staged construction (partial closure) with or without shoofly embankments may be considered. The following geotechnical considerations apply:

- Where possible, shoofly embankments should avoid the median area between NB I-5 and SB I-5 due to anticipated soft soils. Soft soil areas to avoid are identified on I-5 as-built plans from 1956 as "Unsuitable Foundation Material" (Appendix A). These areas are reproduced on the annotated stream plans in Figures 4a to 4g where relevant to the replacement structures. If shoofly embankments must be constructed over the soft areas, probe surveys of nearby soft soil areas from 1955 (Appendix A) suggest that overexcavation of at least 3 to 5 feet and use of geosynthetic reinforcement in the shoofly embankments should be anticipated.
- Shoofly embankments should generally avoid existing utilities or existing foundations due to the risk of damaging settlement.
- Temporary culverts or rerouting of the streams may be required where shoofly embankments cross over existing channels.

EXHIBIT 19: SUMMARY OF TRAFFIC CONSIDERATIONS

Site	Full Closure?	Staged Construction? (Partial Closure)	Geotechnical Constraints / Considerations
992175	Unlikely	Potentially	N/A
996077	Unlikely	Potentially (with shoofly to west)	Disturbed and wet clay at embankment surface will likely require conditioning or shallow removal to reduce rutting at temporary shoofly. Avoid extending shoofly into wetland west of existing embankment toe, if possible. Traffic outflow from the weigh station will likely be restricted due to grading and shoring work, unless traffic can be diverted (e.g., lane shift or shoofly)
996073	Unlikely	Potentially (with shoofly to west or east)	Potentially some soft surficial soils toward the west
996071	Unlikely	Potentially (with shoofly to west)	Disturbed and wet clay at embankment surface will likely require conditioning or shallow removal to reduce rutting at temporary shoofly. Avoid extending shoofly into wetland west of existing embankment toe, if possible.
930940	Potentially with shoofly (Freeborn Rd)	Potentially (with shoofly to north or south)	Potentially some soft surficial soils within channel
995242	Potentially (ramps)	Potentially (shoofly to median)	None anticipated
03.0183 1.20	Potentially (Milltown Rd)	Potentially (with shoofly to north or south)	None anticipated

NOTE:

1 N/A = No significant adverse conditions anticipated; however, geotechnical constraints will depend on final MOT plans.

Nearby Structures

During our site reconnaissance we observed the following existing structures and utilities which may be affected by the Project construction. Our observations do not constitute a comprehensive assessment of utility conflicts, which should be performed by others.

- A detention pond is located southeast of the inlet of Site 996071. The preliminary stream plan from the PHD (Figure 4e.1) indicates that cut slopes will be made to create a ditch that matches the invert elevation of the detention pond, and that the

- slopes will be protected from erosion. If the final plan invert elevation of the stream is lower than the invert of the pond, incision of anticipated soft soils and pond features could occur, and/or changes to the detention capacity of the pond could occur.
- Grading and shoring activity at Site 996077 may restrict outflow traffic from the weigh station to the south of the site, unless traffic can be diverted (see Maintenance of Traffic section of this memorandum).
 - One gas line crosses I-5 several feet south of the inlet of Site 996074 and crosses under the area proposed for the stream re-route (Figure 4c.1).
 - Utilities were observed at several sites, as noted in Table 1.

Corrosion

Structures embedded below ground are potentially subject to corrosion from soil and/or groundwater. Structures exposed to corrosive environments may experience a loss of structural thickness for steel components and/or degradation of concrete integrity. Identification of a potentially corrosive environment involves performing a suite of tests on soil or groundwater that will be in contact with Project elements. These tests typically include minimum resistivity and pH for screening purposes and sometimes chloride concentration and sulfate concentration as follow-up testing. In general, corrosivity of undisturbed, natural soil increases with increasing fines content (i.e., typically more severe for silts, clays, and organic soil). Corrosion tests were performed on samples obtained from the geotechnical borings for preliminary assessment of soil corrosivity. The corrosion test results are presented in Exhibit 20.

EXHIBIT 20: SUMMARY OF CORROSION TEST RESULTS AND OBSERVATIONS

Site	Boring Designation	Sample / Depth	pH	Resistivity (ohm-cm)	Field Observations of Existing Culvert and Site
992175	A-445p-21 A-446p-21	D-2 / 7 ft --	8.3 --	4000 --	
LP66	N/A	N/A	N/A	N/A	Wetland environment. Pipe is severely rusted
996077	A-423p-21 A-424p-21	-- D-6 / 17 ft	-- 8.3	-- 1800	
996454	N/A	N/A	N/A	N/A	Wetland environment
996074	N/A	N/A	N/A	N/A	Wetland environment Some corrosion
996095	See A-426p-21	N/A	N/A	N/A	Some corrosion
996073	A-425p-21	D-3 / 9 ft	8.0	6300	Wetland environment Some corrosion
996071	A-426p-21 A-427p-21	D-3 / 9 ft D-3 / 9 ft	5.8 6.1	5950 4250	
930940	N/A	N/A	N/A	N/A	Wetland environment. Culvert and wingwalls

Site	Boring Designation	Sample / Depth	pH	Resistivity (ohm-cm)	Field Observations of Existing Culvert and Site
					are moderately to severely rusted
995242	A-432p-21 A-433p-21	P-3 / 5.5 ft D-6 / 14 ft	7.3 6.5	1700 6750	Metal apron is rusted through
03.0183 1.20	A-449-21	D-1 / 4 ft D-8 / 39 ft	8.17 8.38	6000 5000	Metal apron and wingwalls are completely rusted through

Due to multiple observations of corrosion damage, wetland conditions, and occasionally low pH or low resistivity results across the sites, we recommend that preliminary design assume a corrosive environment.

GEOTECHNICAL SERVICES FOR FINAL DESIGN

We have developed the attached preliminary budget and schedule estimate (Table 2) for geotechnical services required for final design of the Project. This estimate is provided to assist with project planning and assumes a level of effort appropriate for design-bid-build (DBB) delivery. The basis of our estimate is shown in Exhibit 21, considering the anticipated structures summarized in Exhibit 11.

EXHIBIT 21: PARAMETERS ASSUMED FOR PRELIMINARY BUDGET ESTIMATE

Site ID	Minimum Hydraulic Opening, (ft)	Anticipated Structure Type	Anticipated Complexity	Reason
992175	30	Buried Structure	Complex	Span > 26 ft
996077	22	Two Buried Structures	Moderate	Span > 18 ft Liquefaction
996073	24	Buried Structure	Moderate	Span > 18 ft
996071	30	Buried Structure	Complex	Span > 26 ft Liquefaction
930940	Likely < 20 ²	Buried Structure	Simple	Span < 18 ft
995242	14	Two Buried Structures	Moderate	Span < 18 ft Liquefaction
03.0183 1.20	Likely 30 ²	Buried Structure	Complex	Span > 26 ft Detour Structure

NOTES:

- Simple = span < 18 feet and no liquefaction; Moderate = span < 26 feet with some liquefaction; Complex = span > 26 feet with limited liquefaction. Definitions taken from Geotechnical Planning Level Estimate decision matrix used to calculate the budget estimate (Table 2)
- PHD, stream plans, and minimum hydraulic opening are not yet available at the time of writing.

Our preliminary estimate of budget and schedule is based on our understanding of the site and Project at the time of this memorandum. We may need to revise this budget and schedule estimate when final design begins, and additional site configuration and planning information is available.

Additional geotechnical data is required for final design of the Project. Based on our assessment of anticipated structure types for the seven sites indicated for replacement (Exhibit 11), nine structures are anticipated. In accordance with recommendations in GDM Chapter 17 and considering the currently available borings, we anticipate the following additional borings would be required for final design:

- One 30-foot boring near the outlet of Site 996073 with piezometer.
- One 30-foot boring at Site 930940 to confirm subsurface conditions relative to historic borings from the I-5 / Freeborn Road bridges with piezometer.
- Two to three 40-foot borings at Site 995242 with piezometers. One of the borings should be in the I-5 median and the additional borings would be drilled along the location of the proposed re-route alignment.
- One 80-foot boring to the northeast of A-449-21 at Site 03.0183 1.20 to confirm very dense soils present at both sides of the buried channel with piezometer if seepage is encountered.
- One 20-foot boring near the outlet of Site 996077 to assess if the existing slopes are founded directly over soft soils at the margin of the I-5 median. This would allow better estimation of stability conditions for proposed cut slopes into the existing embankment.
- Additional shallow borings may be needed for shoofly embankments (perhaps two 20- to 30-foot borings per shoofly embankment, for an estimated total of 14 borings). Probe surveys should also be performed if shoofly embankments will cross soft soil areas.
- The above explorations could be augmented with geophysical transects, which would allow for interpretation of subsurface conditions between borings.

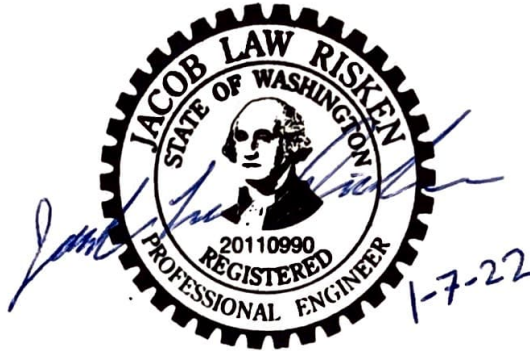
The above anticipated explorations are considered in the estimated budget shown in Table 2. After the Project configuration has been determined and the Preliminary Bridge Plan developed, we recommend contacting the Geotechnical Office as early as possible in the Project schedule to plan and complete the field explorations.

CLOSURE

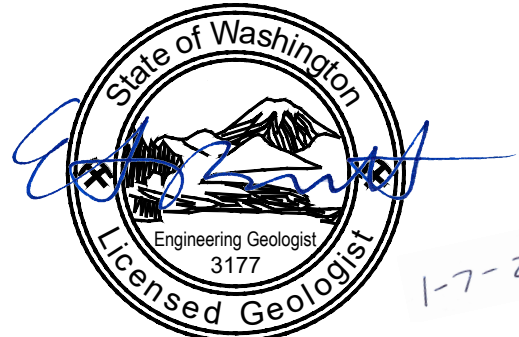
This memorandum has been prepared to assist in the scoping and conceptual engineering design of the Project. It should not be used, in part or in whole, for other purposes without contacting the Geotechnical Office for a review of the applicability of such reuse. If the Project is delivered using Design-Bid-Build, the contents of this memorandum, as applicable, should be incorporated into the final geotechnical report prepared for the Project. If the Project proceeds under Design-Build delivery, this memorandum should be provided as a reference document in the Request for Proposals.

The conclusions and recommendations contained in this memorandum are based on the Geotechnical Office's understanding of the Project at the time that the memorandum was written and site conditions that existed at the time of the field exploration. If significant changes to the nature, configuration, or scope of the project occur during the design process, the Geotechnical Office should be consulted to determine the impact of such changes on the recommendations and conclusions presented in this memorandum.

If you have questions or require further information, please contact Jacob Risken at (206) 482-0557 or Gabriel Taylor at (360) 709-5586.



Prepared By: Jacob Risken, PE
Geotechnical Engineer



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Assistant Chief Engineering Geologist

Reviewed By: Elizabeth Barnett, LEG
Engineering Geologist

c: Julie Heilman, State Hydraulic Engineer
Kim Mueller, Fish Passage Barrier Correction Program Manager

Attachments:

Table 1 – Summary of Site Conditions
Table 2 – Geotechnical Project Planning Level Estimate
Figure 1 – Site Vicinity Map
Figures 2a to 2c – Exploration Location Plans
Figure 3a – Subsurface Profile (Site 992175)
Figure 3b – Subsurface Profile (Site 996077)
Figure 3c – Subsurface Profile (Sites 996073 and 996071)
Figure 3d – Subsurface Profile (Site 930940)
Figure 3e – Subsurface Profile (Sites 995242 and 03.0183 1.20)
Figures 4a – Stream Plan and Profile Site 992175
Figures 4b – Stream Plan and Profile Site 996077
Figures 4c – Stream Re-Route Plan and Profile Sites 996454, 995074
Figures 4d – Stream Plan and Profile Site 996073
Figures 4e – Stream Plan and Profile Site 996071
Figure 4f – Site 930940 (placeholder - no plans available)
Figure 4g – Stream Plan Alternatives Sites 995242 and 03.0183 1.20
Appendix A – Historic Geotechnical Records
Appendix B – Test Boring Logs
Appendix C – Laboratory Test Results
Appendix D – Site Photographs

Table 1: Summary of Site Conditions

Site	Reference Photos ¹	Roadway Elev. at Site (ft) / Road name	Culvert Skew Relative to Roadway	Approximate Fill Height (ft) Over Culvert ²	Max Existing Slope Inclination (Horiz:Vert) of Embankment	Scour, Submerbence, Flow, or other Observations of Existing Conditions Observed Upstream (US) / Downstream (DS) of Inlet / Outlet	Culvert / Road Distress Observations	Major Utilities Observed at Site	Summary of Existing Conditions Observed Upstream (US) / Downstream (DS) of Culvert
996077	D-1.1 to D-2.4	409 / Hall Rd; 399 / I-5 On ramp; 397 / I-5 NB	20° to 30°	11.5	2H:1V	Inlet: US dam(930947), sandstone boulder 3 to 4 ft diameter in channel US inlet; Outlet: 2- to 3-ft drop and scour pool, DS stream flows through wetland in I-5 median (saturated, soft soils).	Road patch	None	US: wooded, gravelly channel approx 15-25 ft wide with banks approx. 5 ft tall at inlet; 930947 dam 75 ft US of inlet; DS: stream empties into a shallow scour pool and ponded wetland area with saturated and soft soil, flows south through median as UNT to Secret Creek.
996454	D-3.1 to D-3.4	NA	NA	2	Gently sloped	Inlet and Outlet: Pipes submerged and backwatered; Outlet: culvert may be partially under a concrete pad/abandoned drive.	Inlet and Outlet: Culvert submerged and could not observe	None	US: Channel is undefined and flows to inlet through the wooded and grassy median via a series of ponds separated by saturated ground. DS: Grassy channel underlain by split CMP.
996074	D-4.1 to D-4.2	373 / I-5 SB	0	6.5	4H:1V	Outlet: Potential scour	Inlet and Outlet: Crowns of pipes damaged and rusted; road patch	Gas pipeline crosses SB I-5 and median, several feet S of inlet.	US: Grassy channel underlain by split CMP. DS: Stream flows north through ditch along west shoulder of I-5 SB.
996095	D-4.3 to D-5.3	379 / Hall Rd	40° to 50°	2	1.5H:1V to 5H:1V	Inlet: Potential scour	Inlet and Outlet: Some rusting of inlet and outlet pipes	None	US: UNT flows through a wooded 5- to 10-ft-wide channel with 3- to 5-ft tall banks that steepen and narrow upstream. DS: stream empties into a ditch where it immediately enters 996071 inlet
996071	D-4.3 to D-6.1	380 / I-5 NB	10° to 20°	5	2H:1V to gentle, Locally 1.2H:1V near outlet	Outlet: Scour and undercutting of stream bank	Road patch	Few utility covers in grassy shoulder	US: 996095 outlet flows immediately into 996071 inlet at west shoulder of Hall Rd.; DS: UNT flows south through wooded median along a 8- to 12-ft-wide channel with 5- to 10-ft-tall banks, channel is ditched for ~250 ft before it turns west and widens to ~40 ft
996073	D-6.1 to D-7.2	371 / I-5 SB	30°	6.5	5H:1V	Inlet: Cobbles and boulders 2 to 3 ft diameter US of inlet; Outlet: Pipe is partially silted in and backwatered	Inlet: culvert rusted and damaged, road patched above culvert	None	US: UNT flows west through I-5 median along wooded and grassy channel that is ~5 ft wide with 2- to 3-ft-tall banks . DS: UNT flows west through the median between I-5 SB and Old 99 N along a 3-5 ft wide grassy ditch. About 100 ft east of outlet, UNT turns north to join ditched flow of Freedom Cr that follows the west shoulder of I-5 SB.
930940	D-7.3 to D-8.4	359 / Freeborn Rd - 300th St NW	10°	6.5	2H:1V	Inlet: Partially submerged, weed-choked. Outlet: mostly submerged	Outlet: Metal wingwalls are moderately to severely rusted.	None	US and DS: Grassy open channel lined with a few trees. The channel parallels SB I-5 and ramps.
LP66	D-9.1 to D-9.3	364 / Abandoned road in median	20°	6.5	1.5H:1V	Inlet and Outlet: Pipes are completely submerged and backwatered, pond at inlet, animal dam and minor ponding at outlet	Inlet: Pipe rusted and completely decayed. Outlet: Pipe rusted and warped	None	US: channel has undefined banks and flows south through a wetland in median; DS: stream continues through wetland and grassy areas toward I-5 SB
992175	D-10.1 to D-11.1	336 / I-5 SB	30° to 40°	1 (inlet) / 6.5 (outlet)	3H:1V	Inlet and Outlet: Minor flow, weed-choked, slight scour at base of outlet and small drop (<1 ft)	None	None	US: flows south through median along grassy ditch with shallow banks; DS: follows wooded 4-6 ft tall channel with 1- 2-ft tall banks, channel bed and banks consist of compact and gravelly soil.
995242	D-11.2 to D-12.4	241 / I-5 off-ramp 239 / I-5 NB 234 / I-5 SB on-ramp (SKAGIT COUNTY)	10° to 20°	23	4H:1V, Locally 2H:1V	Outlet: Approx 8-ft-wide scour pond between outlet and confluence with UNT from south	Inlet: Pipe and apron are rusted and corroded	Telecomm lines cross directly US of inlet from the W	US: UNT flows west across grassy famrland through a ~3-ft-wide ditch with 2- to 3-ft-tall banks. DS: UNT flows west for approx. 40 ft before merging with another UNT flowing from the south. UNT then flows north along a 10-ft-wide partially wooded ditch through the median between the I-5 SB on-ramp and Pacific Hwy/Old 99 N. About 650 ft DS, UNT enters the 03.0183 1.20 inlet.
03.0183 1.20	D-13.1 to D-15.3	Milltown Rd (SKAGIT COUNTY)	20° to 30°	50	Generally 2H:1V, Locally 1.5H:1V, One incised channel bank near-vertical	Outlet: Observed scour (channel drops about 1 foot into 2 to 3 feet deep by 12 foot wide scour pool. Till is incised about 5 feet high on right channel, and till is exposed at channel bed, similar to bedrock-stream. Cobbles and boulders in stream.	Inlet: Bitumen lining chipping off, otherwise ok. Outlet: Metal apron and wingwalls are completely rusted through.	Utility vault behind guard rail of EB Milltown Rd	US: Vegetated with mid-size trees. Stream pours over about 3 feet thick of sandy debris behind a mid-stream tree about 50 feet upstream. DS: Pistol-butted trees at crest of steep channel slopes, each side of stream indicate potential historic surficial instability. 2-ft wide erosion gulley is partially exposed (for about 2 feet) located about mid-slope to the southeast of the outlet.

Notes:

¹ See Appendix D.

² According to Combined Report for each site.

Table 2 - Geotechnical Project Planning Level Estimate

Print Date: 1/4/2022

Work Order #: XL5949 WIN #: SR: 005 MP: 213.6-218.6
Project Title: I-5 MP213.62 to 218.56 Secret_Freedom_Milltown Cr (x12 sites) WDFW #: varies
Scoping Engineer: Jacob Risken Email: Riskenj@wsdot.wa.gov

Engineering Rate: \$ 145.00 Support Rate: \$ 130.00 Lab Testing Rate: \$ 135.00
Scoping Date: 12/13/2021 AD Date: Drilling Rate (LF): \$ 135.00

PROJECT SCOPE & ASSUMPTIONS

Project / Structure Type:	Replace seven Fish Barriers with Fish Passable Structures			
Borings Qty:	4 to 18	Max Depth:	80 ft	Total Footage: 830 ft
Piezometers:	4 to 10	Slope inclinometers:	0	
Subsurface Conditions:	Complex			
Foundation Type:	Shallow			
Seismic Design:	Yes			
Engineering LRA:	30%			

Assumptions: PHDs available for 4 of 7 barrier sites scheduled for replacement. Proposed structure types are not yet selected, but we anticipate total structures (likely 9 buried structures). The scope of this estimate includes Site IDs # 992175, 996077, 996073, 996071, 930940, 995242, and 03.0183 1.20. Five additional barriers are scheduled for removal/plugging without replacement (LP66, 930947, 996454, 996074) or no action (996095). Shallow groundwater and dewatering needed to remove existing culverts and overexcavate potentially liquefiable soils may complicate design and construction. Seismic design is required for most of the structures and most of the wingwalls.

PROJECT ESTIMATE & DURATION

PROJECT SCOPING ESTIMATE & WORKFORCE PLANNING				Task Duration (Days)	Task Duration (Months)
	Hours	Budget	FTE's		
Drilling - (LF)	830 LF	\$ 112,100	0.30	18	0.9
Instrumentation	430	\$ 64,500	0.25	LOE	LOE
Lab Testing	800	\$ 108,000	0.45	133	6.3
Engineering	1440	\$ 218,880	0.81	600	28.6
Support	505	\$ 65,650	0.29	LOE	LOE
Consultant Agreements		\$ -		LOE	LOE
PE Risk	801	\$ 113,826	0.44	196	9.3
Construction Support	165	\$ 25,080	0.10	LOE	LOE
PE Budget	4005	\$ 569,130	2.1	751	35.8
PE Risk Budget	801	\$ 113,826	0.4	196	9.3
CN Budget	165	\$ 25,080	0.1	LOE	LOE
Total Budget	4971	\$ 708,036	2.6	947	45.1

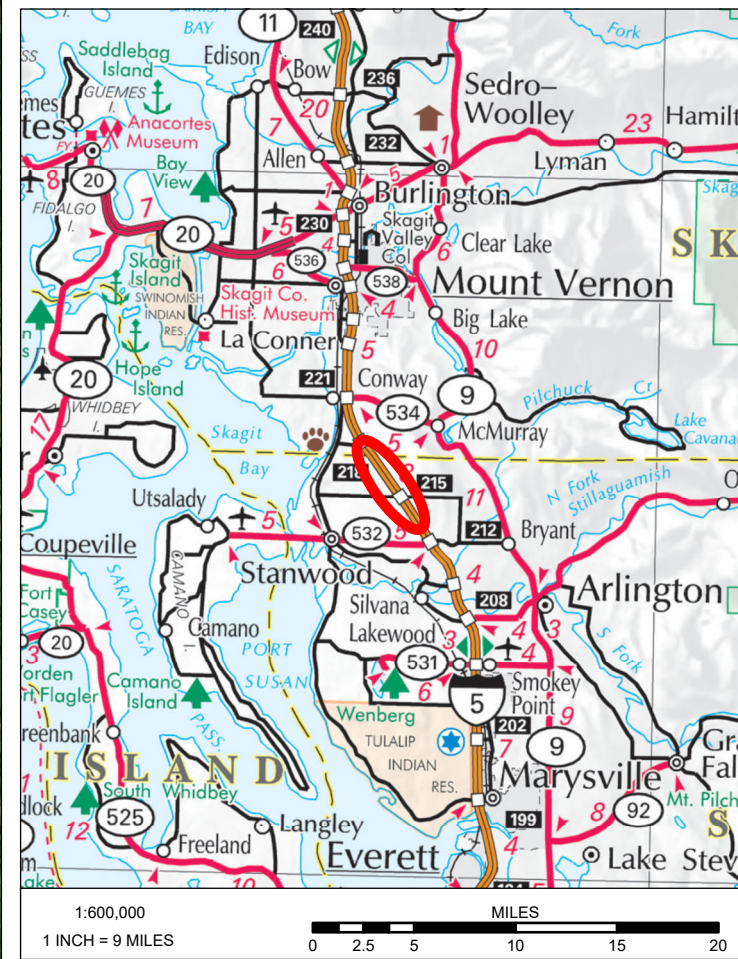
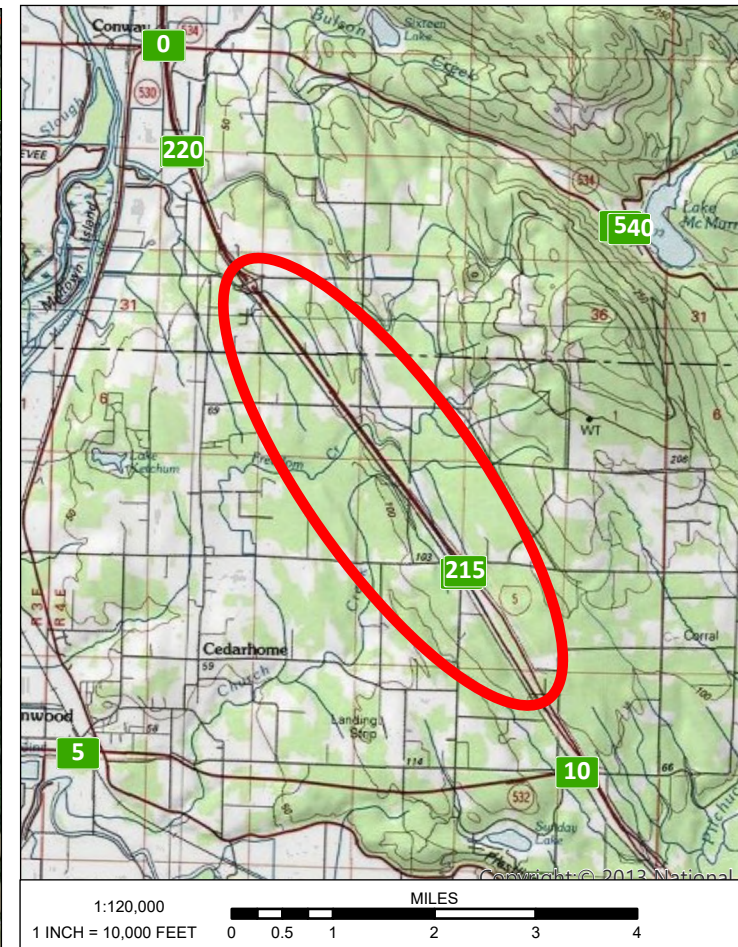
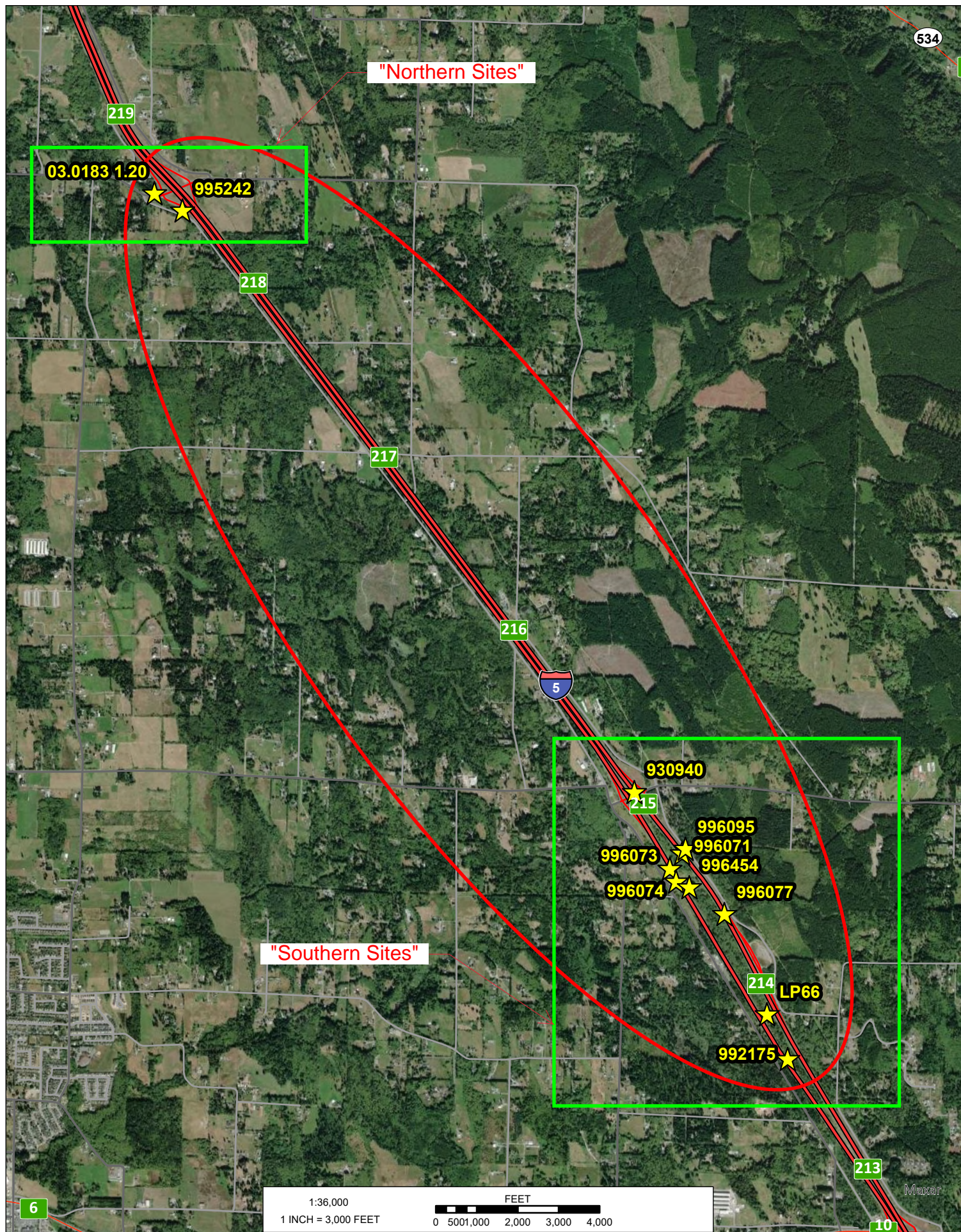
CONSTRUCTION CONSIDERATIONS

Staged construction and/or shoofly embankments are anticipated for many of these sites. Shoring and dewatering may be significant due to excavations made in sands well below groundwater.

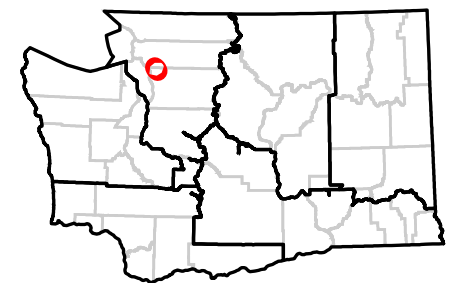
RISK

Geotechnical risk is moderate for these sites (Risk budget 20% to account for potential complications with dewatering and the possibility that one or two crossings may be better suited as bridges on piles due to other Project constraints such as scour):

- Seismic design of buried structures and wingwalls, and some risk of liquefaction may require additional consideration which may affect structure selection.
- Corrosion due to wetland environments and some fine-grained soils is potentially an issue.



- Legend**
- ★ Site
 - Milepost - 1 Mile
 - U.S. Interstate
 - State Route
 - Site Limits
 - WSDOT Regions
 - County Boundaries (1:500K)



JOB # XL5949 STATE ROUTE 005 MILEPOST(S) 213.62 to 218.56

FIGURE 1: SITE VICINITY MAP

Advanced PHD Fish Passage
Stanwood Cluster



PREPARED BY TropleT

Date: October 19, 2021



Legend

- ★ Site
- ⊕ Test Boring Locations
- Milepost - 1/10th Mile
- Milepost - 1 Mile
- U.S. Interstate
- Ramps (1:24K)
- Collectors
- Local Access

0 50 100 200 300 400

FEET

1:2,400

1 INCH = 200 FEET

JOB # XL5949 STATE ROUTE 005 MILEPOST(S) 213.62 to 213.85

FIGURE 2a: SITE EXPLORATION MAP

Advanced PHD Fish Passage
Stanwood Cluster



PREPARED BY TropleT

Date: October 19, 2021



Legend

- Test Boring Locations
- Site
- Milepost - 1/10th Mile
- Milepost - 1 Mile
- U.S. Interstate
- Ramps (1:24K)
- Collectors
- Local Access
- NHD Rivers & Streams

0 50 100 200 300 400

FEET


1:2,400

1 INCH = 200 FEET

JOB # XL5949 STATE ROUTE 005 MILEPOST(S) 214.36 to 215.05

FIGURE 2b: SITE EXPLORATION MAP

Advanced PHD Fish Passage
Stanwood Cluster



WSDOT GEOTECHNICAL OFFICE

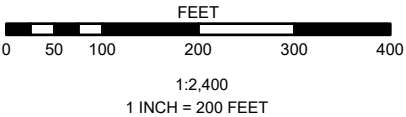
PREPARED BY TropleT

Date: October 19, 2021



Legend

- Test Boring Locations
- Site
- Milepost - 1 Mile
- Milepost - 1/10th Mile
- U.S. Interstate
- LXs and Frontage Roads - (1:24K)
- Ramps (1:24K)
- Collectors
- Local Access
- NHD Rivers & Streams



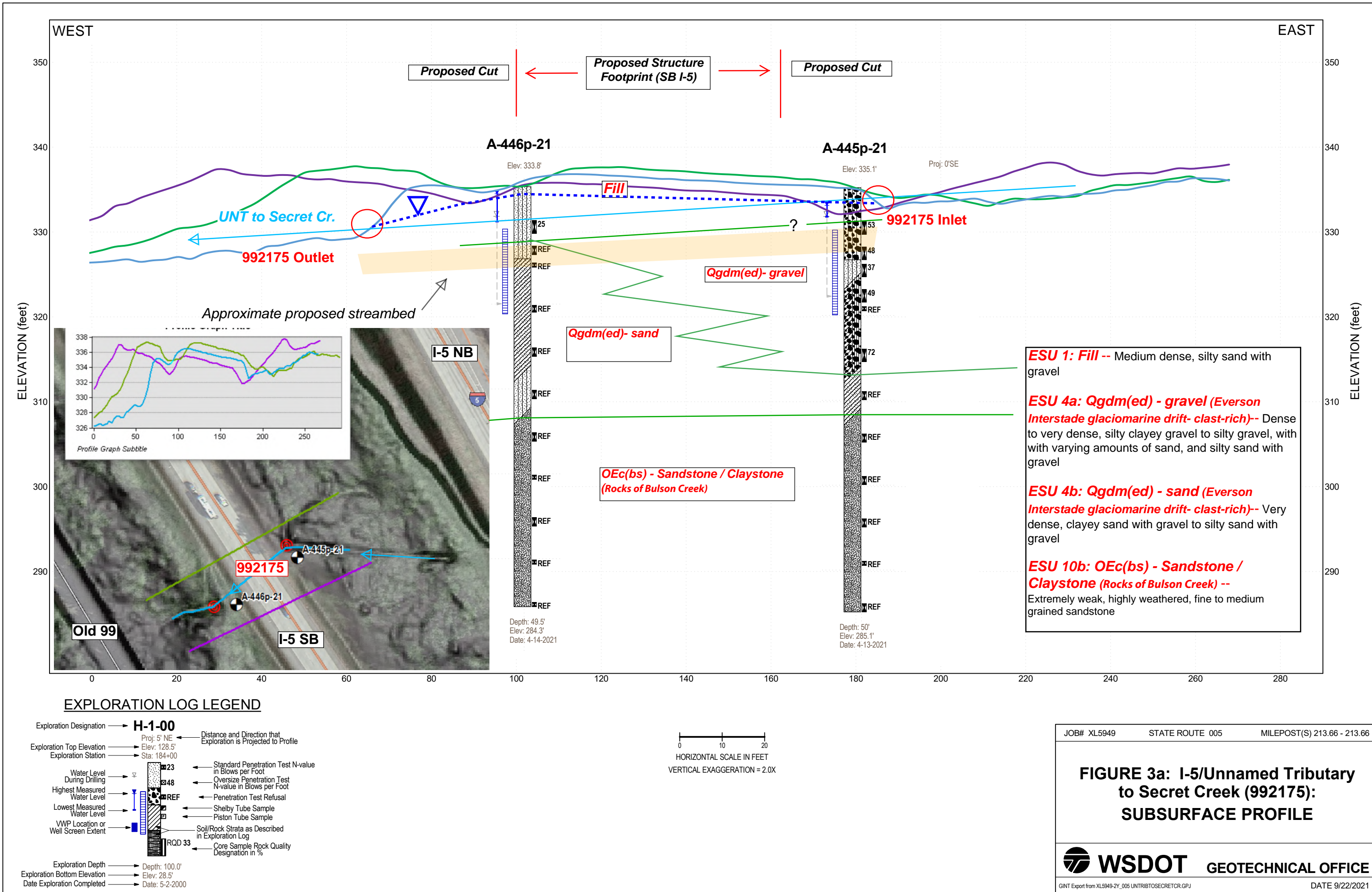
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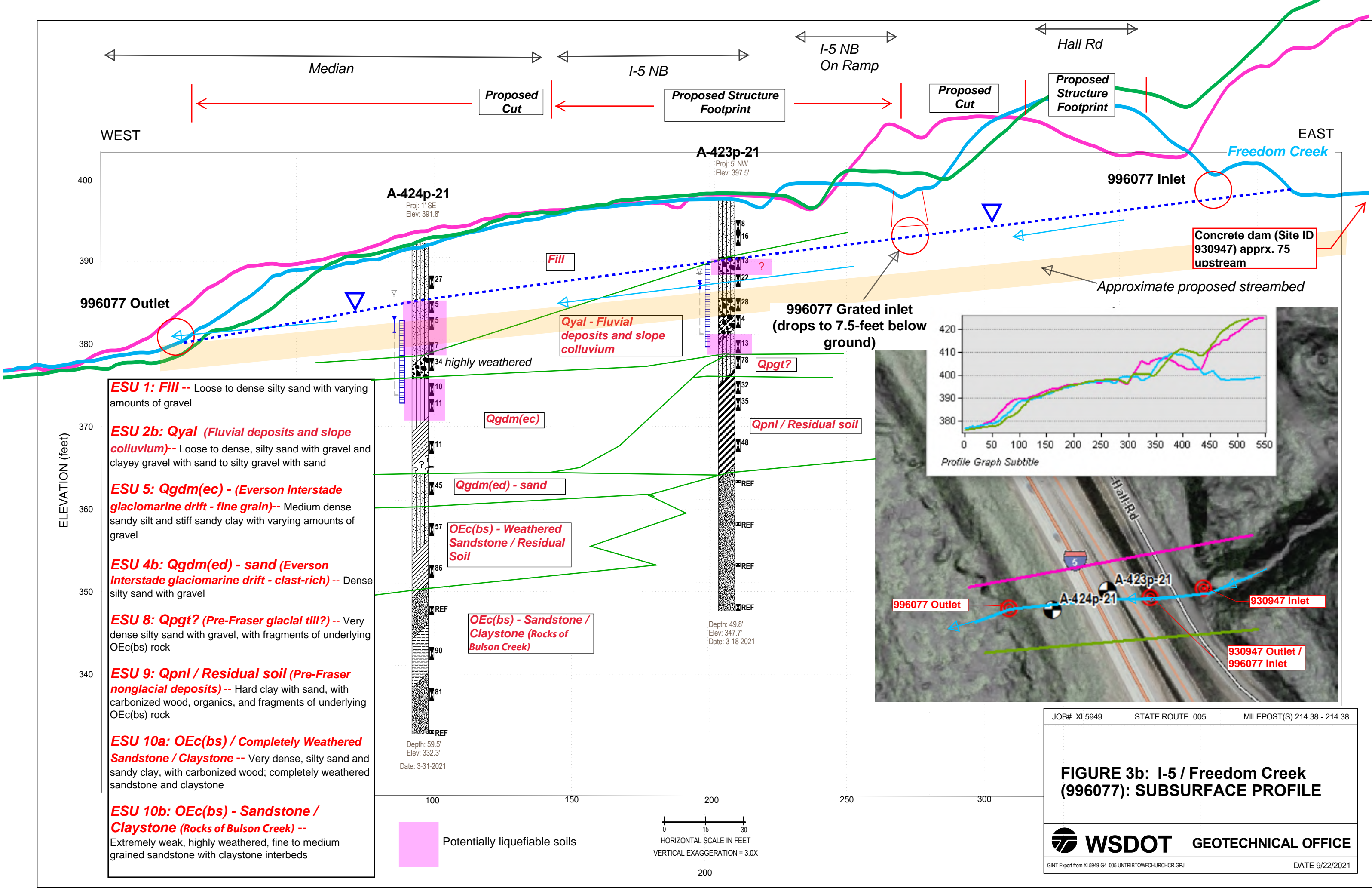
FIGURE 2c: SITE EXPLORATION MAP

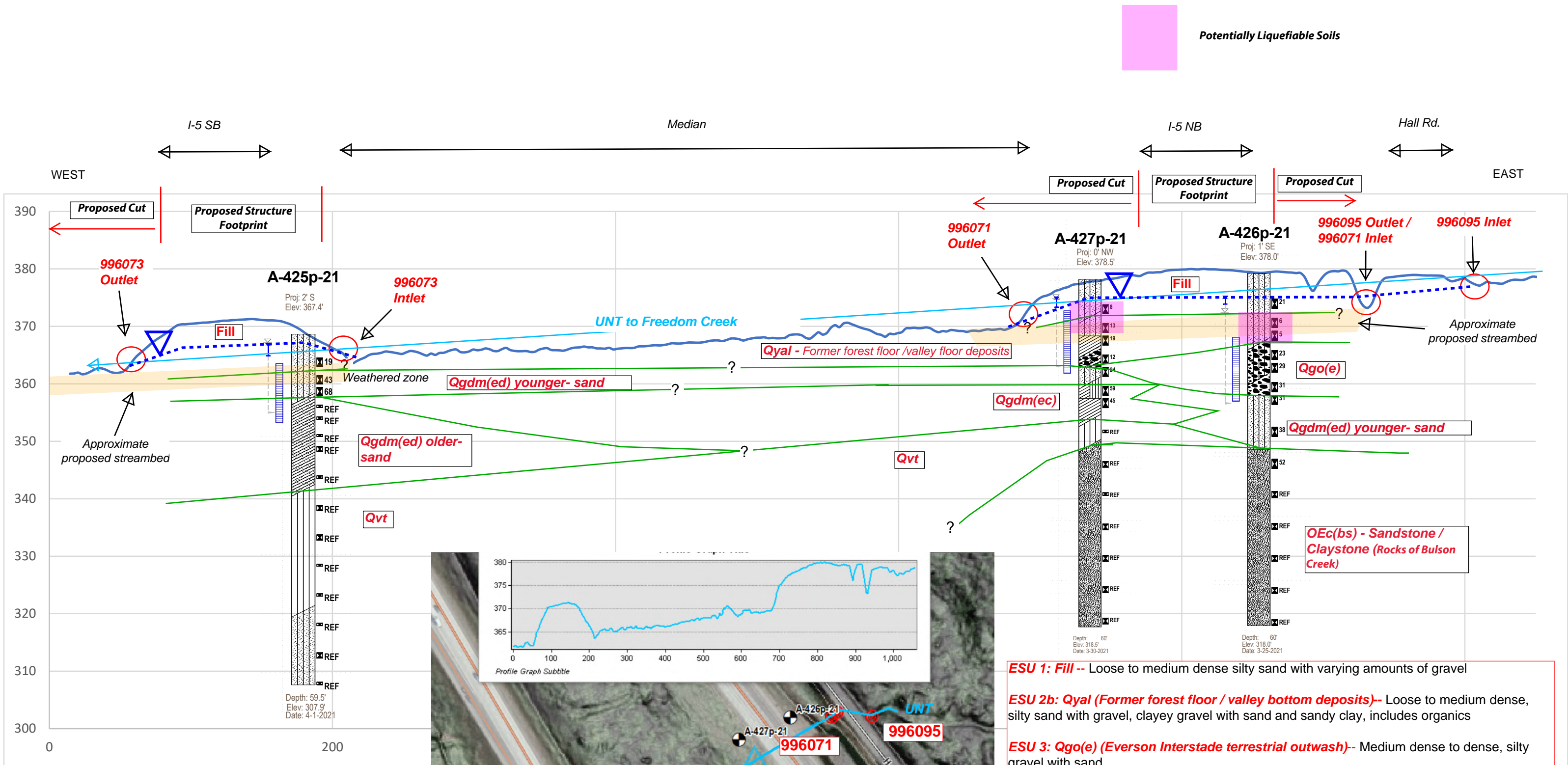
Advanced PHD Fish Passage
Stanwood Cluster



PREPARED BY TropleT Date: October 19, 2021





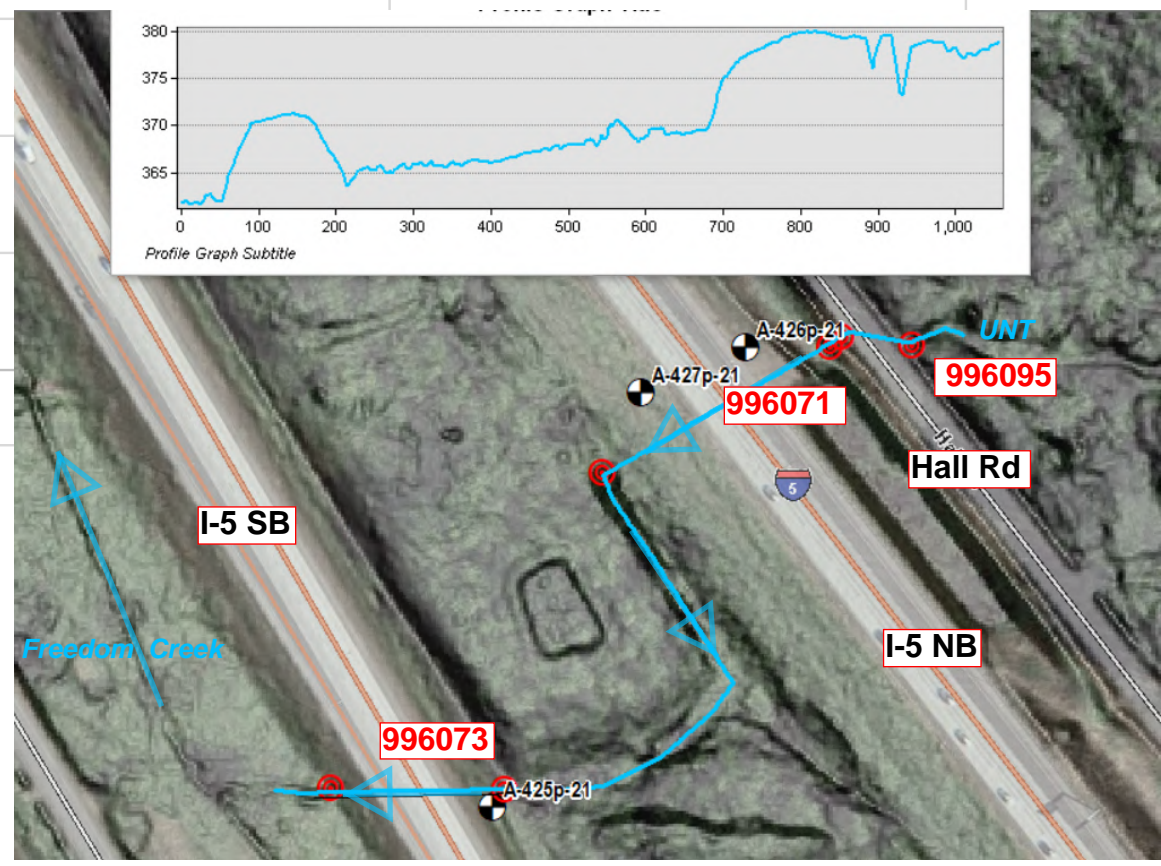


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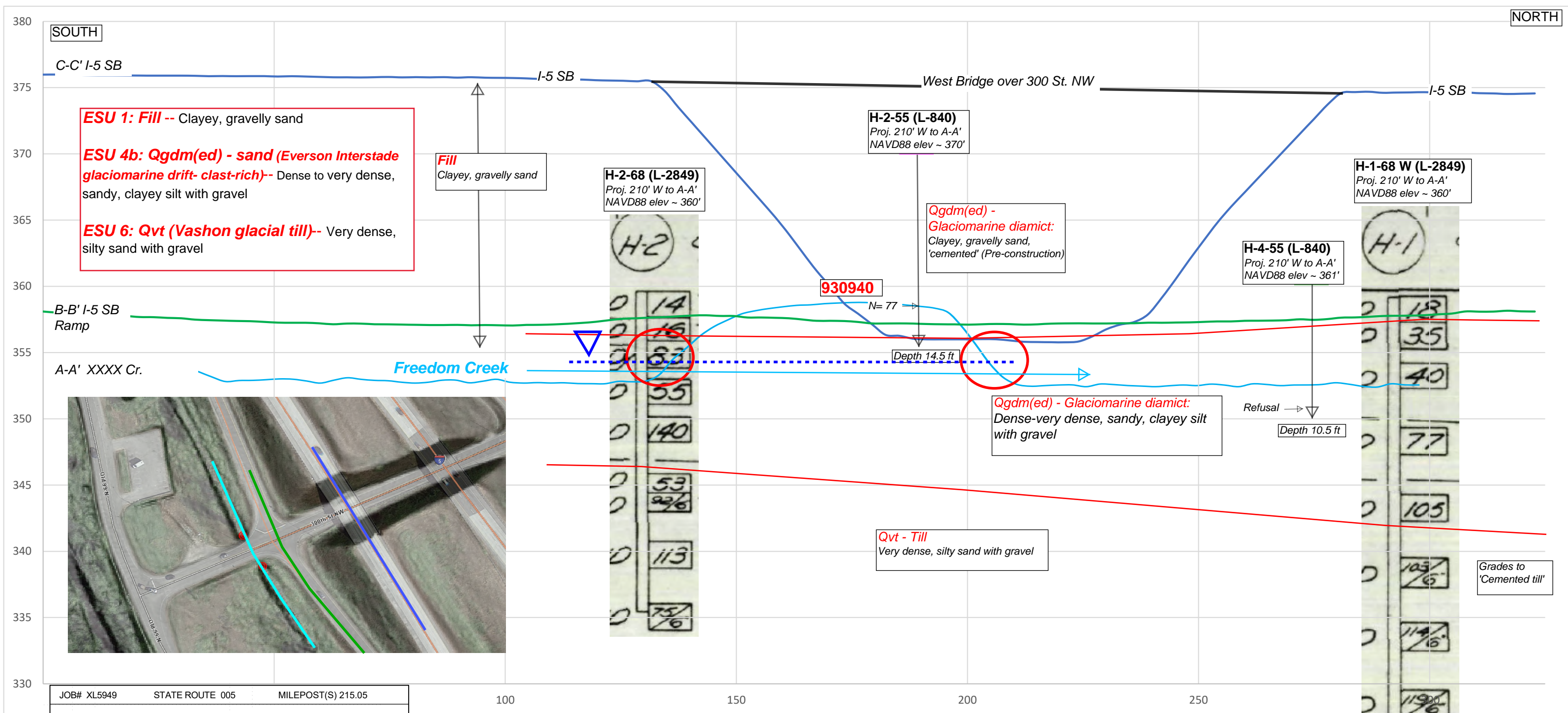
FIGURE 3c: I-5/Unnamed Tributary to Freedom Creek (996071/996073): SUBSURFACE PROFILE

WSDOT GEOTECHNICAL OFFICE

GINT Export from XL5949-G4_005 UNTRIBUTOWFCHURCHCR.GPJ DATE 9/22/2021



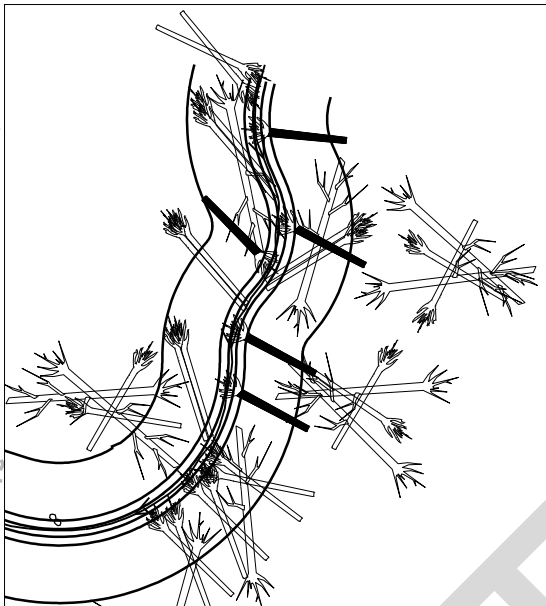
- ESU 1: Fill** -- Loose to medium dense silty sand with varying amounts of gravel
- ESU 2b: Qyal (Former forest floor / valley bottom deposits)** -- Loose to medium dense, silty sand with gravel, clayey gravel with sand and sandy clay, includes organics
- ESU 3: Qgo(e) (Everson Interstade terrestrial outwash)** -- Medium dense to dense, silty gravel with sand
- ESU 4b: Qgdm (ed) younger - sand (Later generation Everson Interstade glaciomarine drift - clast-rich)** -- Dense to very dense, silty sand with gravel
- ESU 5: Qgdm (ec) (Everson Interstade glaciomarine drift - fine grain)** -- Hard clay
- ESU 4b: Qgdm (ed) older - sand (Earlier generation Everson Interstade glaciomarine drift - clast-rich)** -- Very dense clayey sand with gravel
- ESU 6: Qvt (Vashon glacial till)** -- Very dense, sandy silt with gravel to silty sand with gravel
- ESU 10b: OEc(bs) - Sandstone / Claystone (Rocks of Bulson Creek)** -- Extremely weak, highly weathered, fine to medium grained sandstone with claystone interbeds



Historic subsurface (included in Appendix A):

- I-5 / Freeborn Road O'Xing Soil Profile, Borings, As-builts S.R. 5 Stillaguamish River to Conway Junction Job No. L-2849, Contract No. WSDOT (1968)
- I-5 / Freeborn Overcrossing Pilchuck Hill to North Burn Road Contract No. 5423 WSDOT (1956)

NOTES:
1. EXACT STRUCTURE TYPE, SIZE, LOCATION, AND WALLS TO BE DETERMINED.
2. GRADING LIMITS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY. FINAL LIMITS TO BE DETERMINED BASED ON FINAL STRUCTURE, TYPE, SIZE, AND LOCATION.



MEANDERING LOW-FLOW CHANNEL DETAIL

NTS

PROPOSED FISH PASSABLE STRUCTURE
30-FOOT MINIMUM HYDRAULIC OPENING

END CHANNEL GRADING 7+23.2

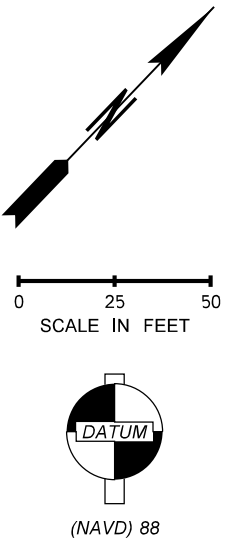
BEGIN CHANNEL GRADING 4+28.2

OLD 99 N

I-5 SOUTHBOUND

UNNAMED TRIBUTARY TO SECRET CREEK

I-5 NORTHBOUND



LEGEND	
	EXISTING CHANNEL FLOW
	CHAIN LINK FENCE
	MAJOR CONTOUR
	MINOR CONTOUR
	EDGE OF EX PAVEMENT
	EDGE OF EX GRAVEL
	EXISTING DITCH
	EXISTING CULVERT
	EXISTING PIPE
	RD MRK WHITE LINE
	RD MRK DBL YELLOW CENTER LINE
	EXISTING CATCH BASIN
	EXISTING GRATED INLET
	EXISTING TREE
	PROPOSED STRUCTURE
	PROPOSED WINGWALL
	PROPOSED LWM
	PROPOSED BOULDER CLUSTER
	PROPOSED MAJOR CONTOUR
	PROPOSED MINOR CONTOUR
	PROPOSED STREAM ALIGNMENT
	PROPOSED LOW-FLOW CHANNEL
	PROPOSED CUT LINE
	SLOPES TO BE DETERMINED BY OTHERS

PRELIMINARY

NOT FOR CONSTRUCTION

Figure 4a.1 Stream Plan and Profile Site 992175

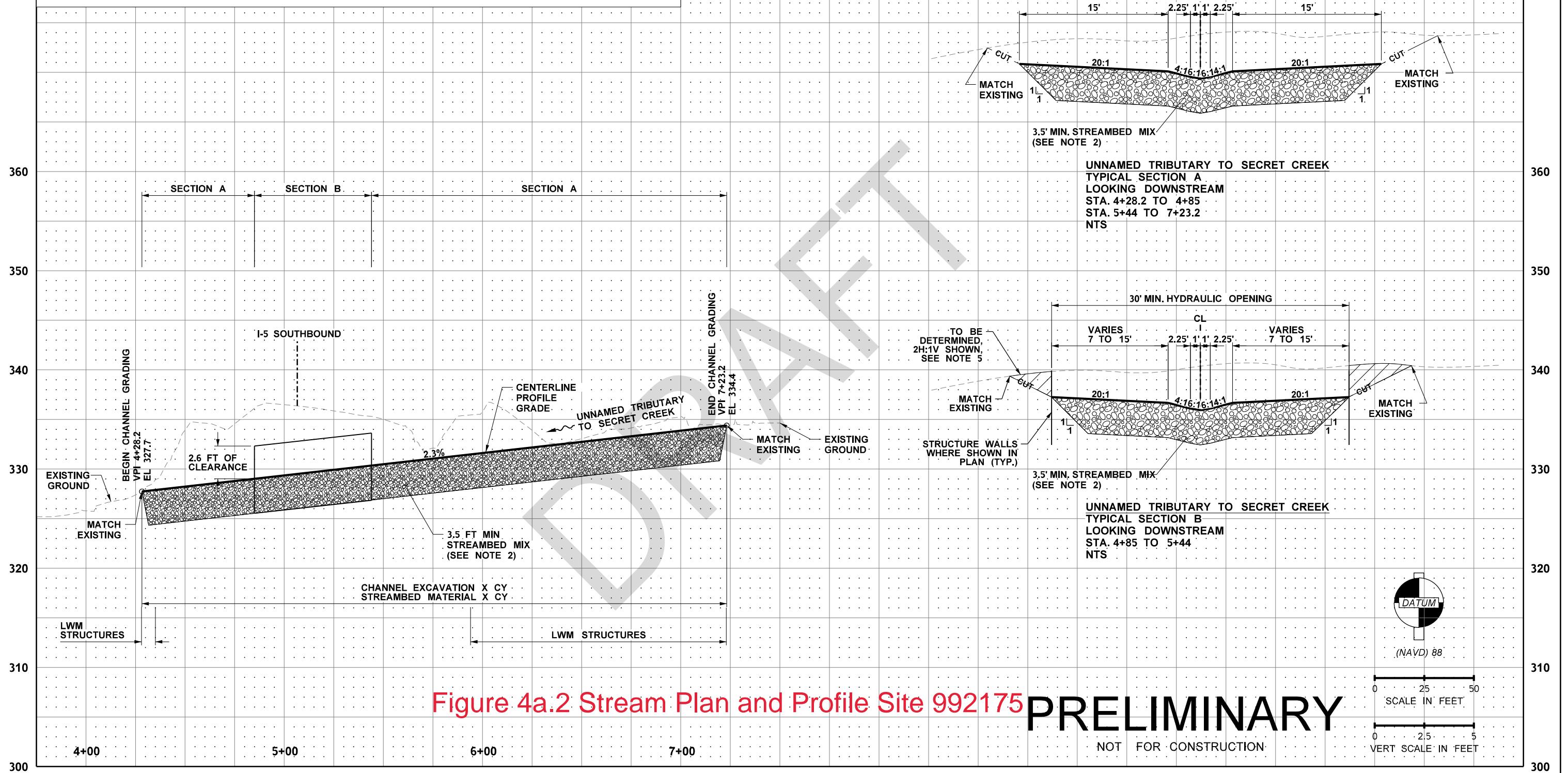
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1. SEE SPECIAL PROVISION "AGGREGATES FOR STREAMS, RIVERS, AND WATERBODIES" FOR STREAMBED MATERIAL AND MATERIAL LIFTS.
2. MATERIAL DEPTH IS APPROXIMATE. FINAL DEPTH TO BE DETERMINED FOLLOWING SCOUR ANALYSIS.
3. EXACT STRUCTURE TYPE, SIZE, LOCATION, AND WALLS TO BE DETERMINED.
4. FROM 4+28 TO 4+50 AND 7+00 TO 7+23, EVENLY TAPER SECTION A TO MATCH EXISTING CHANNEL.
5. SLOPES SHOWN OUTSIDE OF THE MINIMUM CHANNEL SECTION ARE FOR ILLUSTRATIVE PURPOSES ONLY TO DEPICT AREA OF POTENTIAL IMPACT. FINAL AREAS OF IMPACT TO BE DETERMINED PENDING GEOTECHNICAL AND STRUCTURAL INVESTIGATION, STRUCTURE TYPE, AND STRUCTURE LOCATION.



FILE NAME \\geoengineers.com\wan\Projects\010180380\CAD\001992175 LP66 Unnamed Trlb to Secret\01 - Flrst Draft PHD\Sheets\992175_TrlbSecret_HY_003.dgn																																								I-5										PLAN REF. NO.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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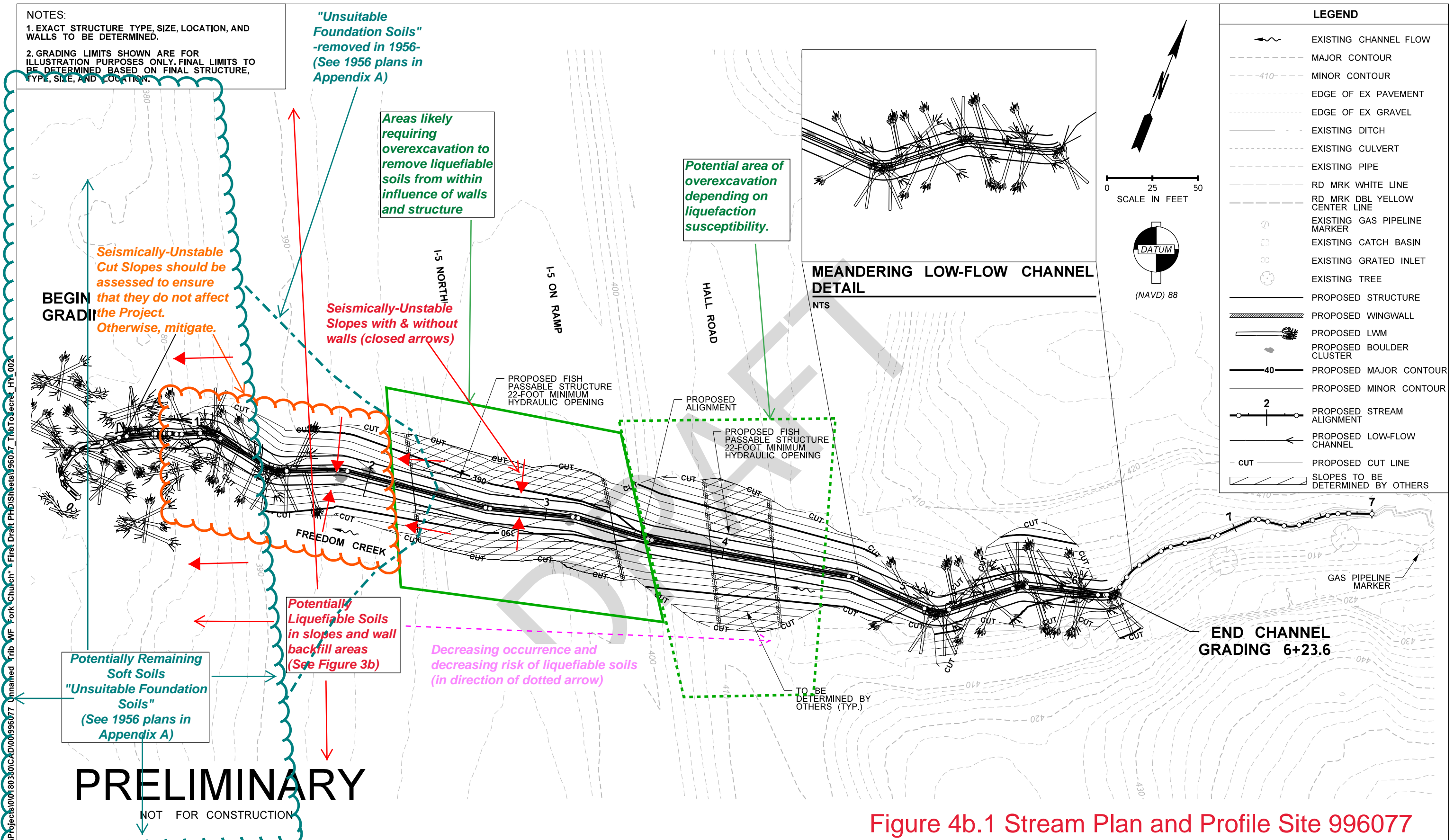


Figure 4b.1 Stream Plan and Profile Site 996077

FILE NAME: P:\010180330\CAD\00996077 Unnamed Trlb WF Fork Church\01 - First Draft PHD\Sheets\996077_Freedom_HY_002.dgn																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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- NOTES:
1. SEE SPECIAL PROVISION "AGGREGATES FOR STREAMS, RIVERS, AND WATERBODIES" FOR STREAMBED MATERIAL AND MATERIAL LIFTS.
 2. MATERIAL DEPTH IS APPROXIMATE. FINAL DEPTH TO BE DETERMINED FOLLOWING SCOUR ANALYSIS.
 3. EXACT STRUCTURE TYPE, SIZE, LOCATION, AND WALLS TO BE DETERMINED.
 4. FROM 0+55 TO 0+75 AND 6+00 TO 6+23, EVENLY TAPER SECTION A TO MATCH EXISTING CHANNEL.
 5. SLOPES SHOWN OUTSIDE OF THE MINIMUM CHANNEL SECTION ARE FOR ILLUSTRATIVE PURPOSES ONLY TO DEPICT AREA OF POTENTIAL IMPACT. FINAL AREAS OF IMPACT TO BE DETERMINED PENDING GEOTECHNICAL AND STRUCTURAL INVESTIGATION, STRUCTURE TYPE, AND STRUCTURE LOCATION.

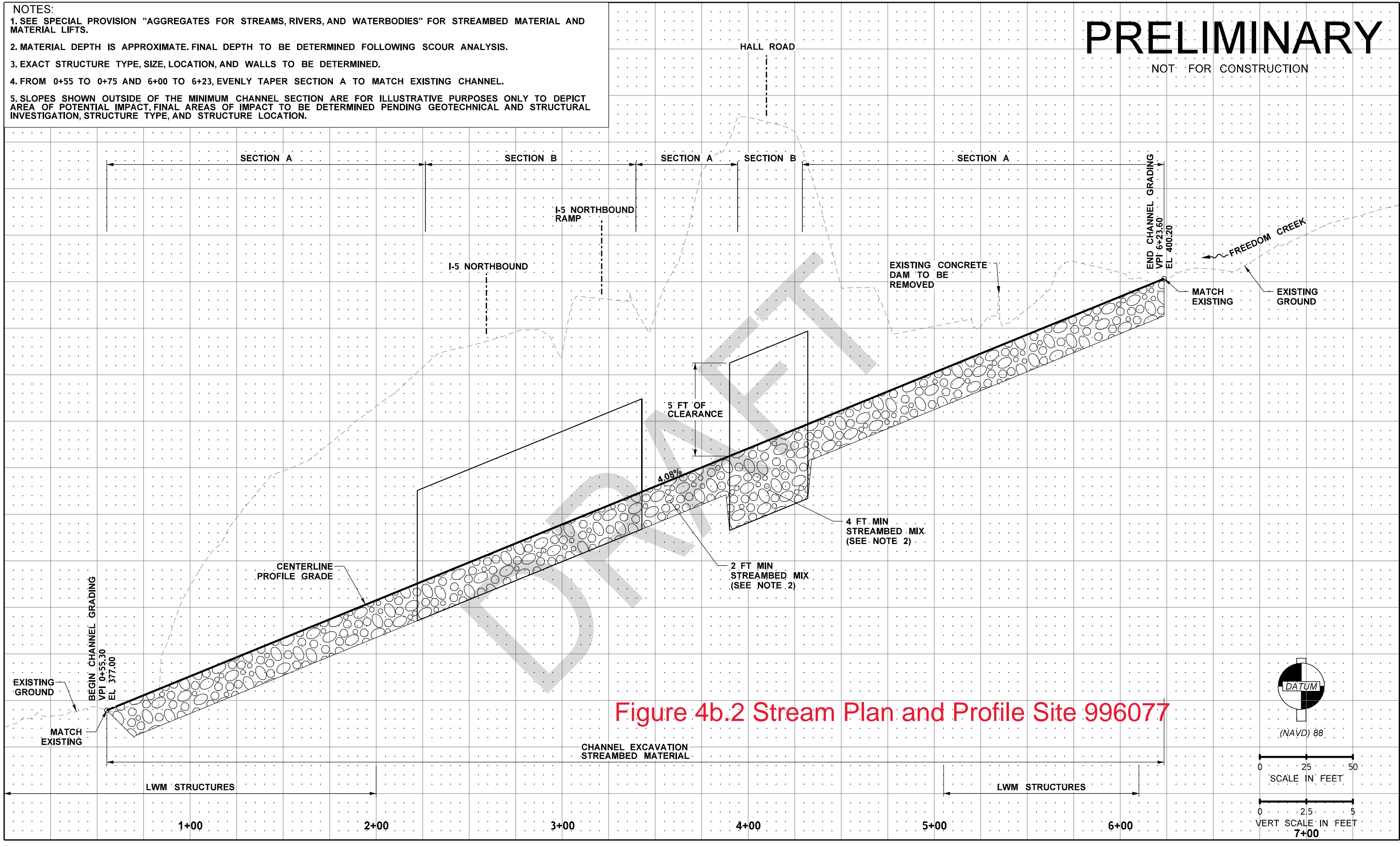

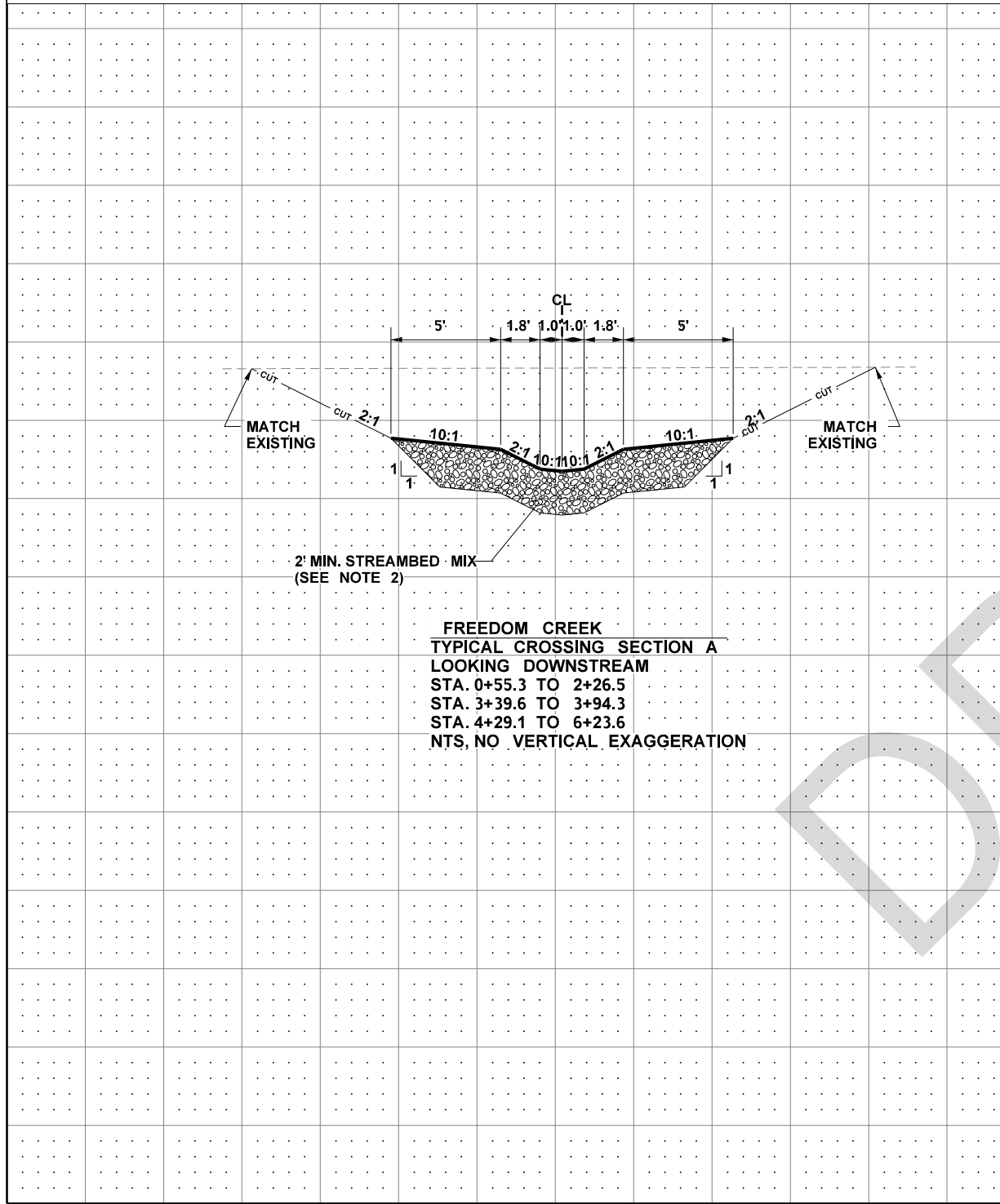


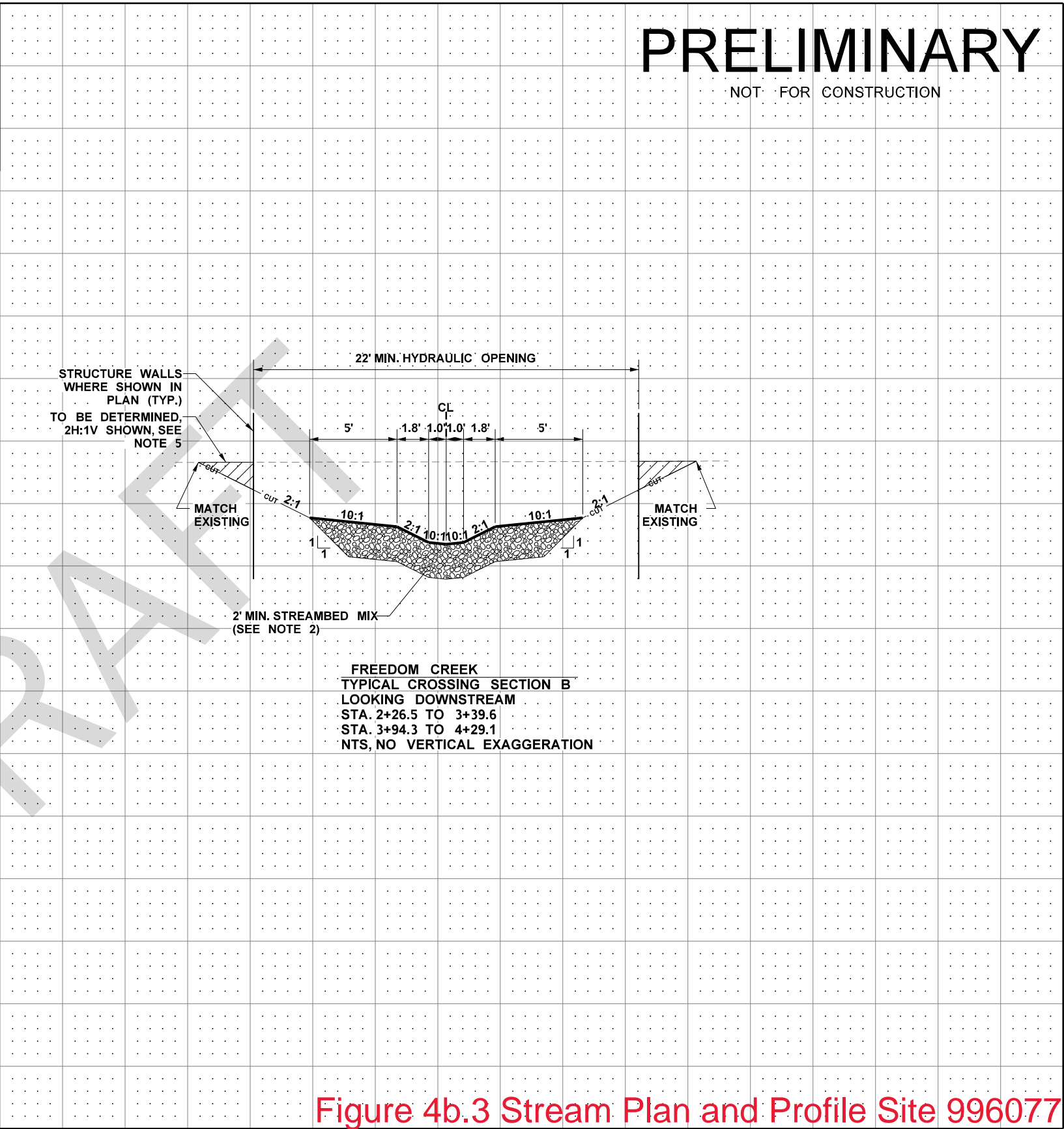
Figure 4b.2 Stream Plan and Profile Site 996077

FILE NAME P:\0\180380\CAD\001996077 Unnamed Trlb WF Fork Church\01 - First Draft PHD\Sheets\996077_Freedom_HY_003.dgn														 Washington State Department of Transportation		I-5 MP 214.38 FISH PASSAGE BARRIER REMOVAL				PLAN REF. NO. HY-003	
TIME 1:04:01 PM								REGION NO. STATE		FED.AID PROJ.NO.											
DATE 7/8/2021								10 WASH													
PLOTTED BY hmar								JOB NUMBER													
DESIGNED BY D FITZPATRICK										CONTRACT NO.		LOCATION NO.								SHEET 3 OF 4 SHEETS	
ENTERED BY H MARA																					
CHECKED BY M KLYM																					
PROJ. ENGR.																					
REGIONAL ADM.				REVISION		DATE		BY						DATE		DATE		STREAM PROFILE			
										P.E. STAMP BOX				P.E. STAMP BOX							

- NOTES:
1. SEE SPECIAL PROVISION "AGGREGATES FOR STREAMS, RIVERS, AND WATERBODIES" FOR STREAMBED MATERIAL AND MATERIAL LIFTS.
 2. MATERIAL DEPTH IS APPROXIMATE. FINAL DEPTH TO BE DETERMINED FOLLOWING SCOUR ANALYSIS.
 3. EXACT STRUCTURE TYPE, SIZE, LOCATION, AND WALLS TO BE DETERMINED.
 4. FROM 0+55 TO 0+75 AND 6+00 TO 6+23, EVENLY TAPER SECTION A TO MATCH EXISTING CHANNEL.
 5. SLOPES SHOWN OUTSIDE OF THE MINIMUM CHANNEL SECTION ARE FOR ILLUSTRATIVE PURPOSES ONLY TO DEPICT AREA OF POTENTIAL IMPACT. FINAL AREAS OF IMPACT TO BE DETERMINED PENDING GEOTECHNICAL AND STRUCTURAL INVESTIGATION, STRUCTURE TYPE, AND STRUCTURE LOCATION.



FREEDOM CREEK
TYPICAL CROSSING SECTION A
LOOKING DOWNSTREAM
STA. 0+55.3 TO 2+26.5
STA. 3+39.6 TO 3+94.3
STA. 4+29.1 TO 6+23.6
NTS, NO VERTICAL EXAGGERATION




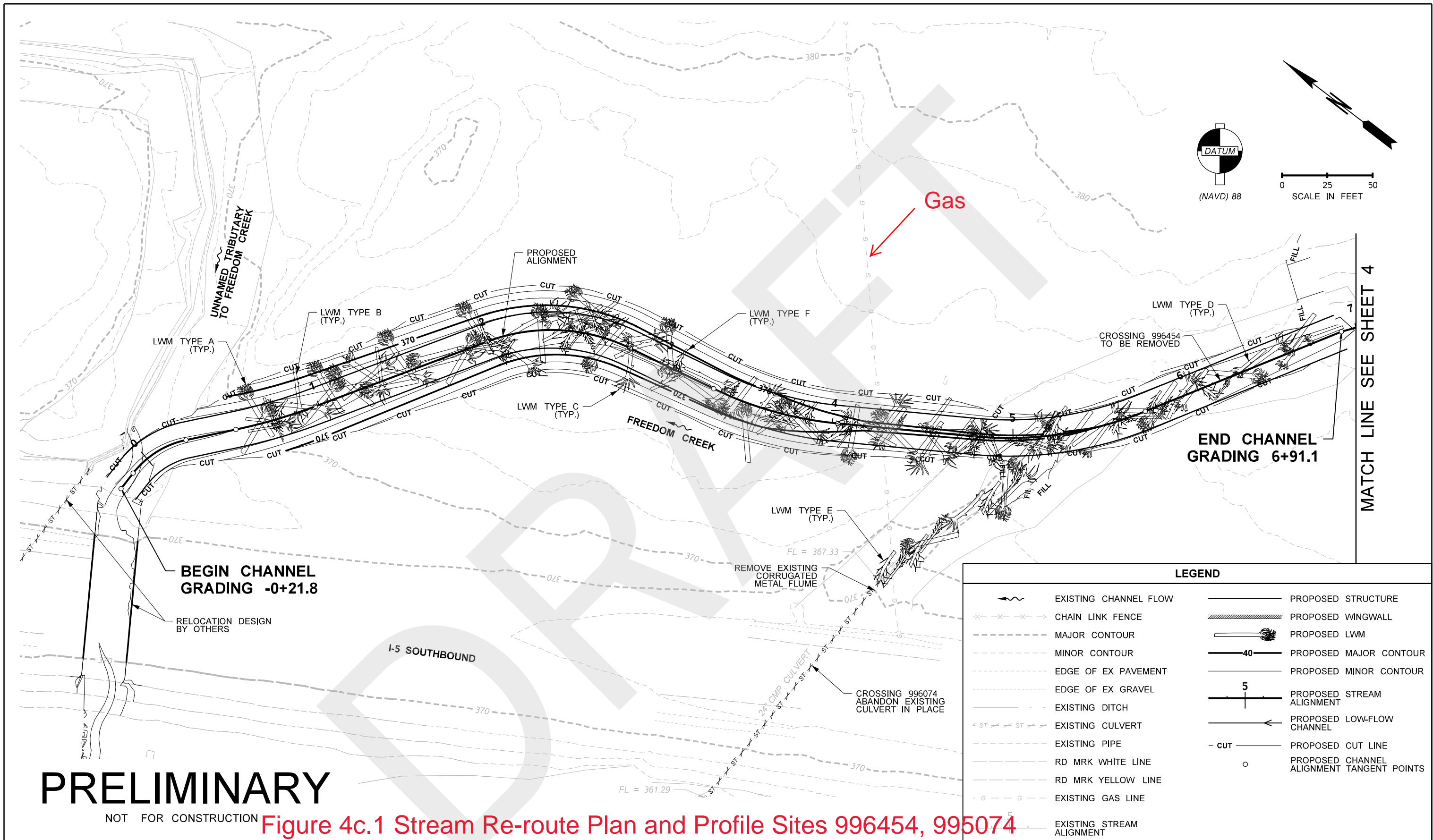
FREEDOM CREEK
TYPICAL CROSSING SECTION B
LOOKING DOWNSTREAM
STA. 2+26.5 TO 3+39.6
STA. 3+94.3 TO 4+29.1
NTS, NO VERTICAL EXAGGERATION

PRELIMINARY
NOT FOR CONSTRUCTION

Figure 4b.3 Stream Plan and Profile Site 996077

H. MARA


FILE NAME		P:\010180380\CAD\001996077 Unnamed Trlb WF Fork Church\01 - First Draft PHD\Sheets\996077_Freedom_HY_004.dgn														<div><div>Washington State Department of Transportation</div></div>		I-5 MP 214.38		PLAN REF. NO. HY004			
TIME		1:09:47 PM																					
DATE		7/8/2021						REGION NO.		STATE								FED.AID PROJ.NO.		FISH PASSAGE BARRIER REMOVAL		SHEET 4 OF 4 SHEETS	
PLOTTED BY		hmar						10		WASH													
DESIGNED BY		D FITZPATRICK								JOB NUMBER													
ENTERED BY		M KLYM								CONTRACT NO.		LOCATION NO.		DATE		DATE		STREAM SECTIONS					
CHECKED BY																							
PROJ. ENGR.														P.E. STAMP BOX		P.E. STAMP BOX							
REGIONAL ADM.				REVISION		DATE		BY															



PRELIMINARY

NOT FOR CONSTRUCTION

Figure 4c.1 Stream Re-route Plan and Profile Sites 996454, 995074

FILE NAME P:\010180380\CAD\001996074 Unnamed Trlb WF Church\01 - Flrst Draft PHD\Sheets\996074_FreedomCr_HY003.dgn														 Washington State Department of Transportation		I-5 MP 214.65 FISH PASSAGE BARRIER REMOVAL		PLAN REF NO HY003	
TIME 2:14:16 PM				REGION NO. 10	STATE WASH	FED.AID PROJ.NO.													
DATE 7/20/2021				JOB NUMBER															
PLOTTED BY hmara				CONTRACT NO.				LOCATION NO.											
DESIGNED BY A MORTON												SHEET 3 OF 6 SHEETS							
ENTERED BY H MARA																			
CHECKED BY M KLYM																			
PROJ. ENGR.																			
REGIONAL ADM.		REVISION	DATE	BY											PROPOSED CONDITIONS PLAN				
										DATE P.E. STAMP BOX		DATE P.E. STAMP BOX							

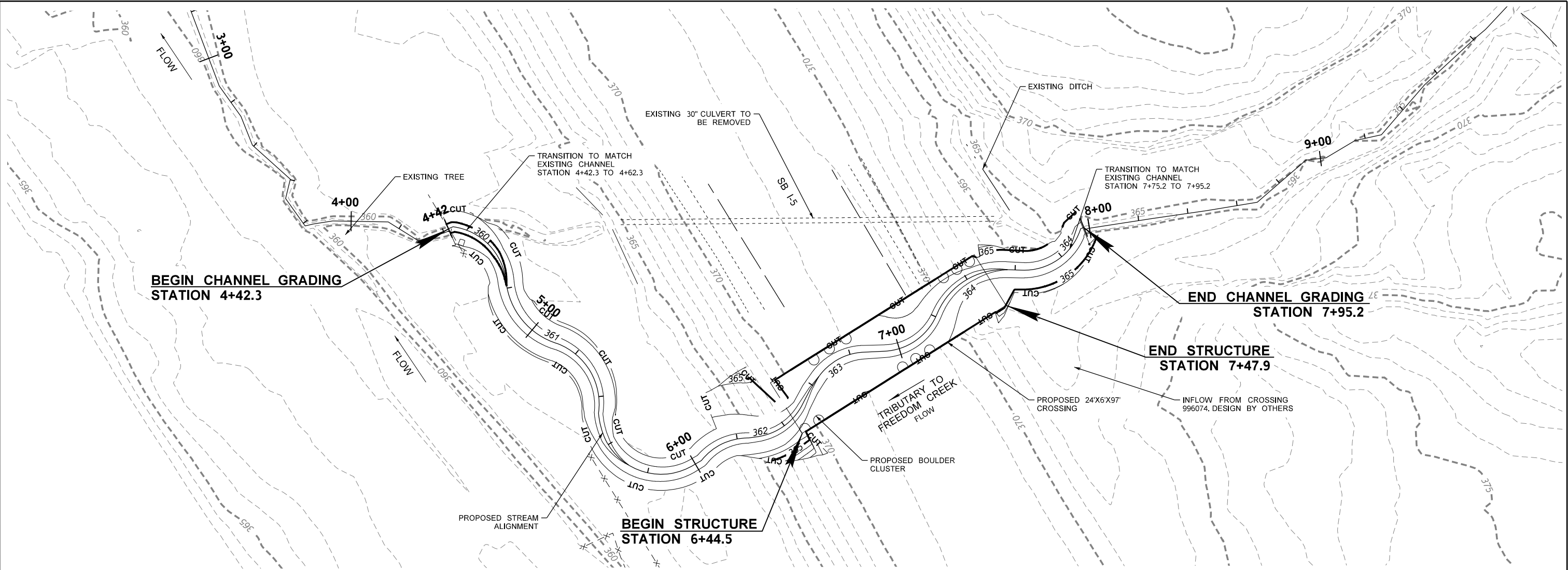


Figure 4d.1 Stream Plan and Profile Site 996073

NOTES:

1. SEE SPECIAL PROVISION "AGGREGATE FOR STREAMS, RIVERS, AND WATERBODIES FOR STREAMBED MATERIAL AND COARSENESED MATERIAL. FINAL INSTALLATION WILL PROVIDE A WELL GRADED MIX OF STREAMBED SEDIMENTS AND STREAMBED COBBLES.

2. MATERIAL DEPTH SHOWN IS MINIMUM FINAL DEPTH PENDING SCOUR ANALYSIS.


3. EXACT STRUCTURE TYPE, SIZE, LOCATION, AND WALL TO BE DETERMINED.

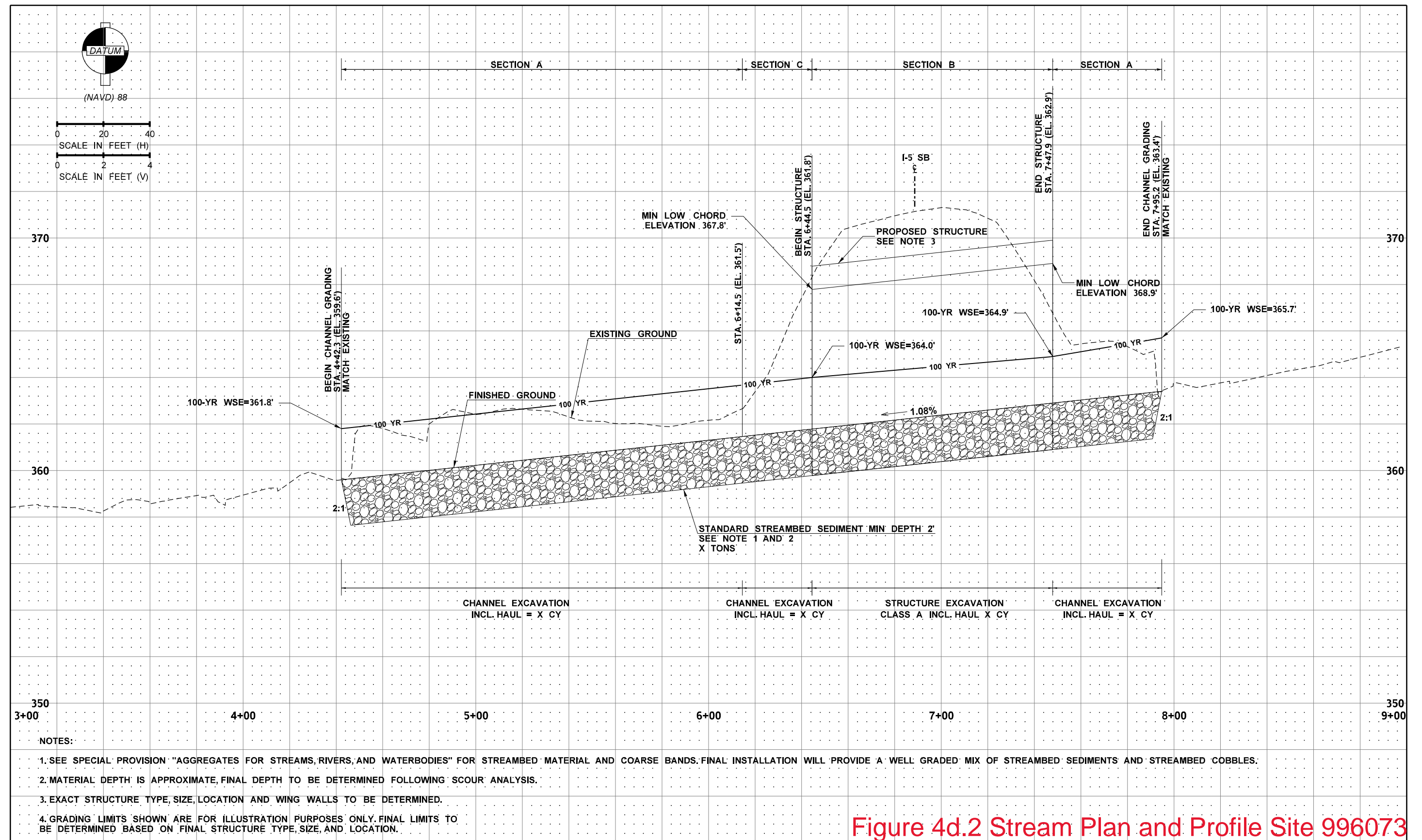
4. GRADING LIMITS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY. FINAL LIMITS TO BE DETERMINED BASED ON FINAL STRUCTURE TYPE, SIZE, AND LOCATION.

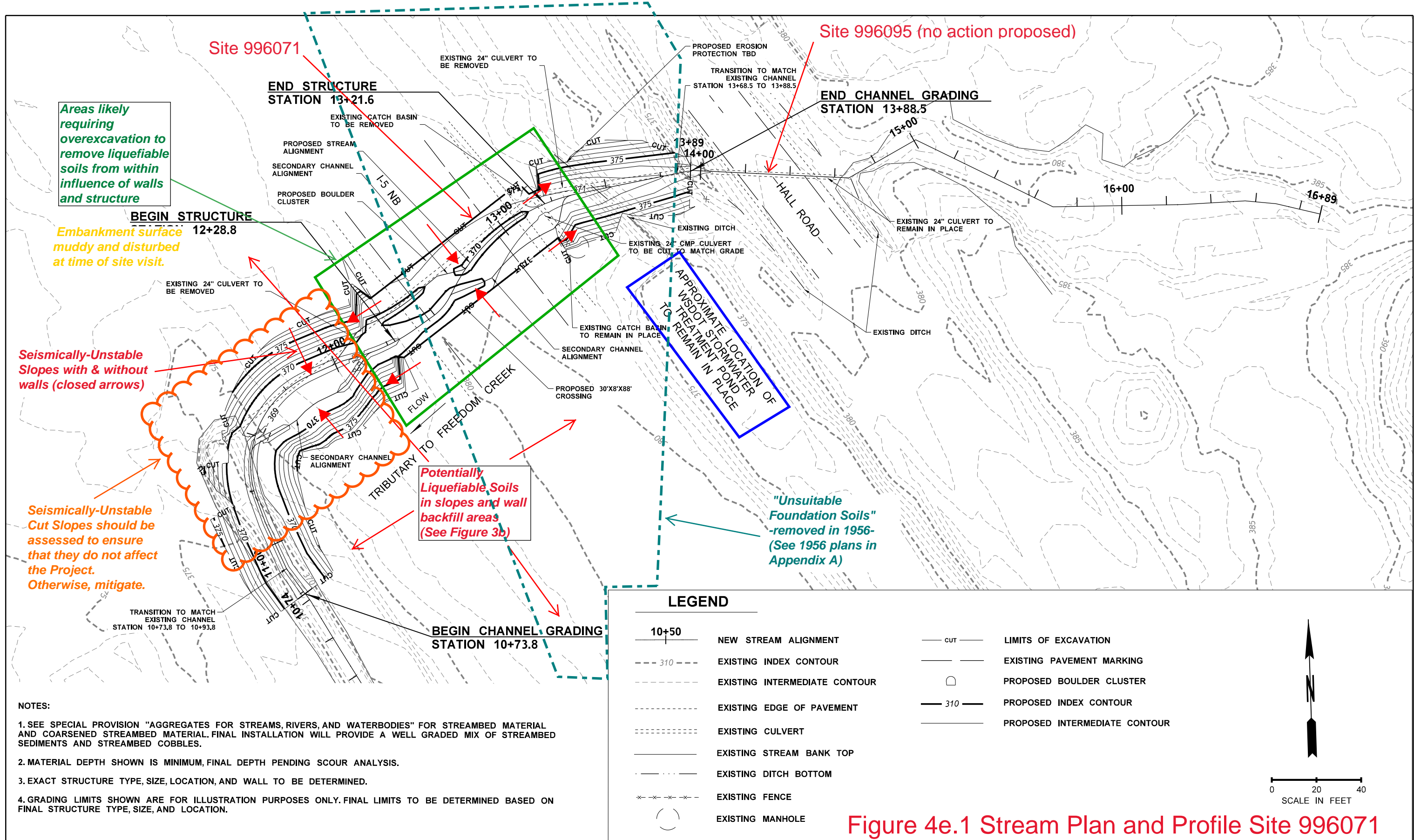
LEGEND

10+50	NEW STREAM ALIGNMENT	CUT	LIMITS OF EXCAVATION
310	EXISTING INDEX CONTOUR		EXISTING PAVEMENT MARKING
	EXISTING INTERMEDIATE CONTOUR		PROPOSED BOULDER CLUSTER
	EXISTING EDGE OF PAVEMENT		PROPOSED INDEX CONTOUR
	EXISTING EDGE OF GRAVEL DRIVE		PROPOSED INTERMEDIATE CONTOUR
	EXISTING CULVERT		
	EXISTING DITCH BOTTOM		
	EXISTING FENCE		

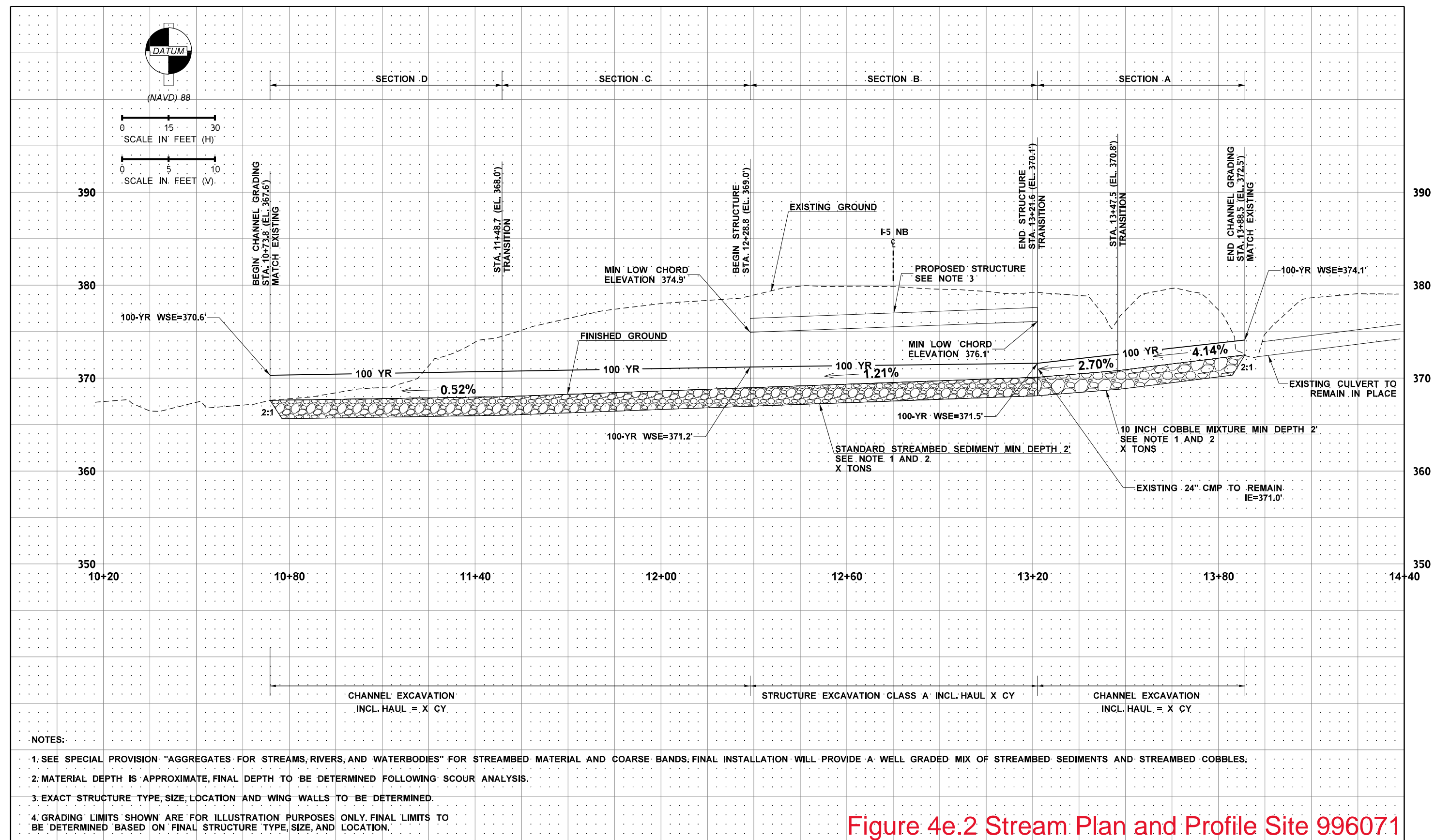
0 20 40
SCALE IN FEET

FILE NAME C:\Users\RHC-WORK\Desktop\200327 WSDOT NW Fish Passage\I-5MP214.74\CAD\Sheets\I05MP21474-Plan_Prop.dgn				FED.AID PROJ.NO.		 Washington State Department of Transportation		I-5 MP214.74 TRIBUTARY TO FREEDOM CREEK		PLAN REF NO SE2
TIME 8:47:16 AM				REGION NO. 10	STATE WASH			PROPOSED STREAM PLAN		SHEET 3 OF 5 SHEETS
DATE 5/25/2021				JOB NUMBER						
PLOTTED BY RHC-WORK				CONTRACT NO.						
DESIGNED BY M. KINSEY				LOCATION NO.						
ENTERED BY Y. WANG										
CHECKED BY N. VANBUECKEN										
PROJ. ENGR. J. HEILMAN										
REGIONAL ADM.	REVISION	DATE	BY							

[illegible]

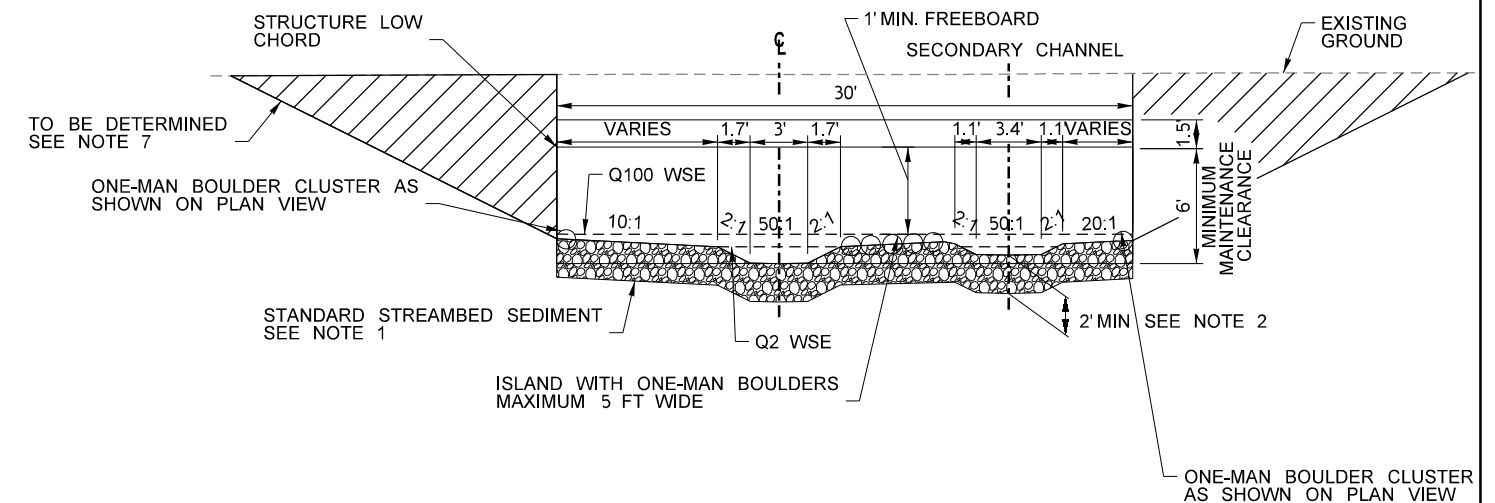


FILE NAME C:\Users\RHC-WORK\Desktop\200327 WSDOT NW Fish 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[illegible]

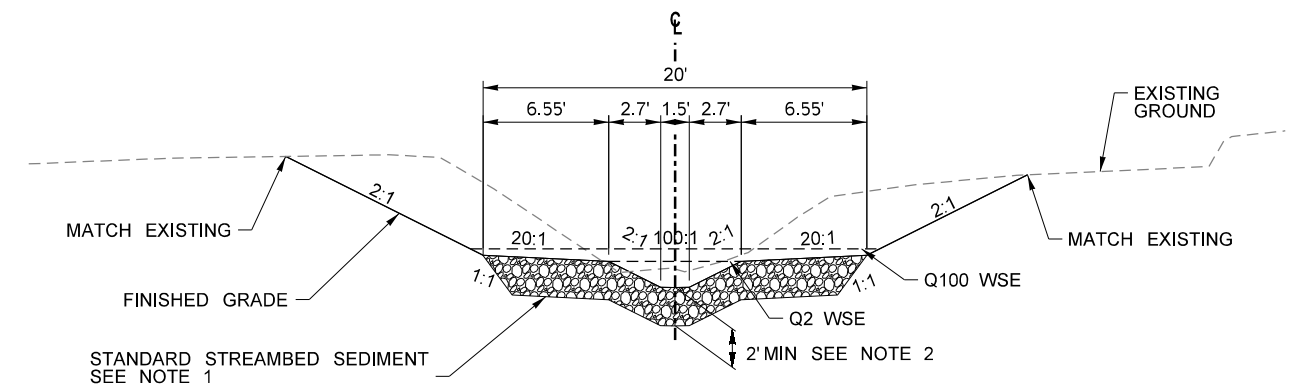
TYPICAL ANABRANCHING CHANNEL THROUGH CROSSING SECTION

SECTION B
STATION 12+28.8 TO 13+21.6



TYPICAL RIFFLE-POOL CHANNEL SECTION

SECTION D
STATION 10+73.8 TO 11+48.7



5. FROM 13+88.5 TO 13+98.5, EVENLY TAPER SECTION A TO MATCH EXISTING CHANNEL UPSTREAM.

6. FROM 10+63.8 TO 10+73.8, EVENLY TAPER SECTION D TO MATCH EXISTING CHANNEL DOWNSTREAM.

7. SLOPES SHOWN OUTSIDE OF MINIMUM CHANNEL SECTION ARE FOR ILLUSTRATIVE PURPOSES ONLY TO DEPICT ESTIMATED AREA OF POTENTIAL IMPACT. FINAL AREAS OF IMPACT TO BE DETERMINED PENDING GEOTECHNICAL AND STRUCTURAL INVESTIGATION, STRUCTURE TYPE, AND STRUCTURE LOCATION.

1. SEE SPECIAL PROVISION "AGGREGATES FOR STREAMS, RIVERS, AND WATERBODIES" FOR STREAMBED MATERIAL AND COARSENESED STREAMBED MATERIAL. FINAL INSTALLATION WILL PROVIDE A WELL GRADED MIX OF STREAMBED SEDIMENTS AND STREAMBED COBBLES.
2. MATERIAL DEPTH SHOWN IS MINIMUM, FINAL DEPTH PENDING SCOUR ANALYSIS.
3. A 1 FOOT MINIMUM FREEBOARD IS REQUIRED ABOVE THE 100-YEAR WATER SURFACE ELEVATION FOR THIS BANKFUL WIDTH.
4. MINIMUM HYDRAULIC OPENING IS 30' WIDE AND 6' TALL FROM THALWEG OF MAIN CHANNEL TO LOW CHORD.

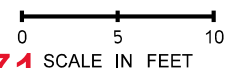


Figure 4e.3 Stream Plan and Profile Site 996071

FILE NAME C:\Users\IHC-WORK\Desktop\200327 WSDOT NW Fish Passage\I-5MP214.73\CAD\Sheets\I05MP21473_Section.dgn																			
TIME 11:24:40 AM		DRAFT PLANS NOT FOR CONSTRUCTION				REGION NO.		STATE		FED.AID PROJ.NO.									
DATE 4/5/2021						10		WASH											
PLOTTED BY RHC-WORK						JOB NUMBER													
DESIGNED BY M. KINSEY						CONTRACT NO.		LOCATION NO.											
ENTERED BY Y.WANG																			
CHECKED BY N. VANBUECKEN																			
PROJ. ENGR. J. HEILMAN																			
REGIONAL ADM.		REVISION				DATE		BY											

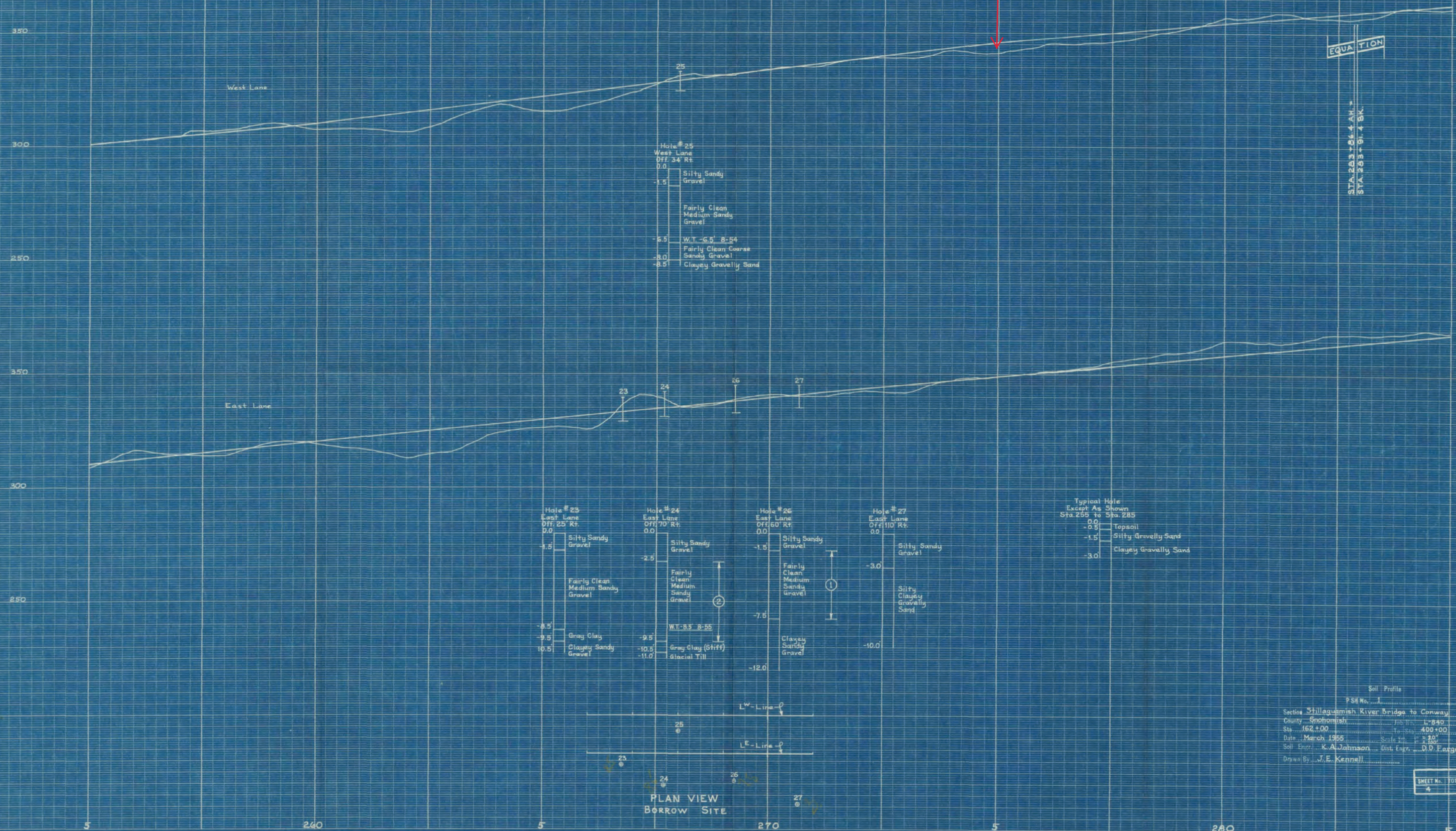
<div><div></div><div>Washington State Department of Transportation</div><div>Jacobs</div></div>										<div>I-5 MP214.73 TRIBUTARY TO FREEDOM CREEK</div> <div>STREAM DETAILS</div>										<div>PLAN REF NO SD1</div> <div>SHEET 5 OF 5 SHEETS</div>	
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Figure 4f: Site 930940
No Stream Plans Available.
No geotechnical annotations.

Appendix A: Historic Geotechnical Records

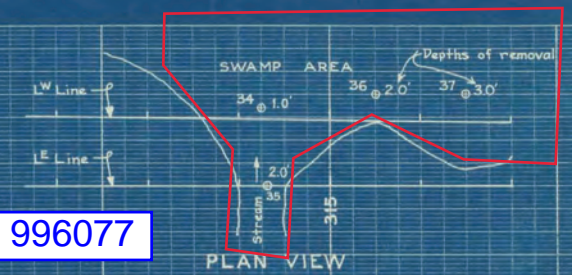
**I-5 Soil Profile
Stillaguamish River Bridge to Conway
Job No. L-840
WSDOT (1955)**

Site 992175

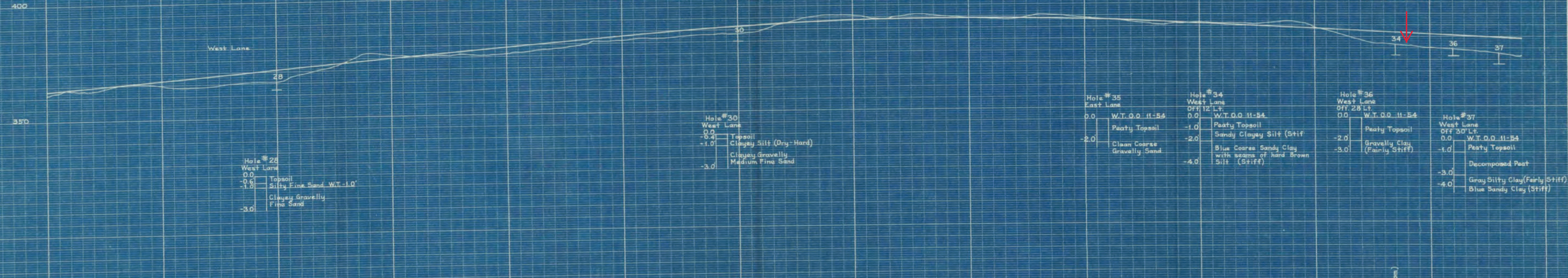


Soil Profile
PSM No. 1
Section Shillagumish River Bridge to Conway
County Snohomish Job No. 1-850
Sta. 162+00 To Sta. 400+00
Date March 1985 Scale 1" = 20'
Soil Eng. K. A. Johnson Dist. Engr. D. D. Farney
Drawn By J. E. Kennell

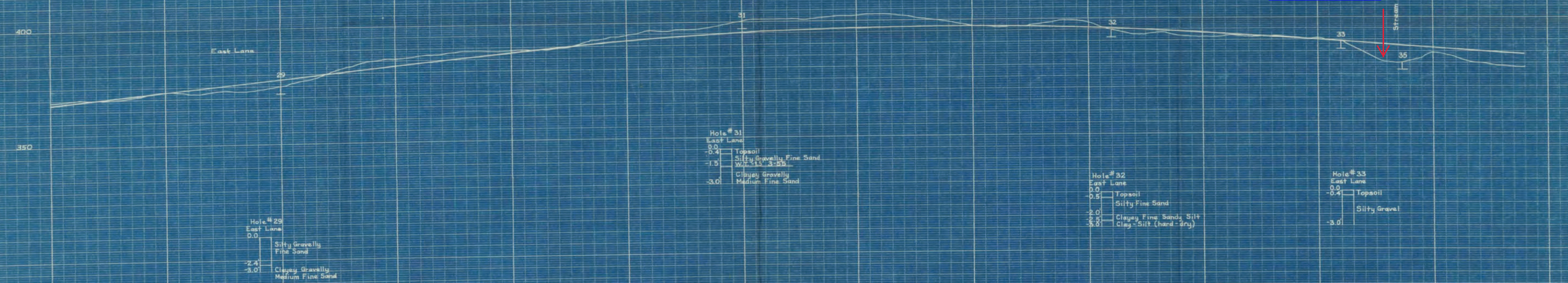
SHEET No.	TOTAL SHEETS
4	8



Site 996077

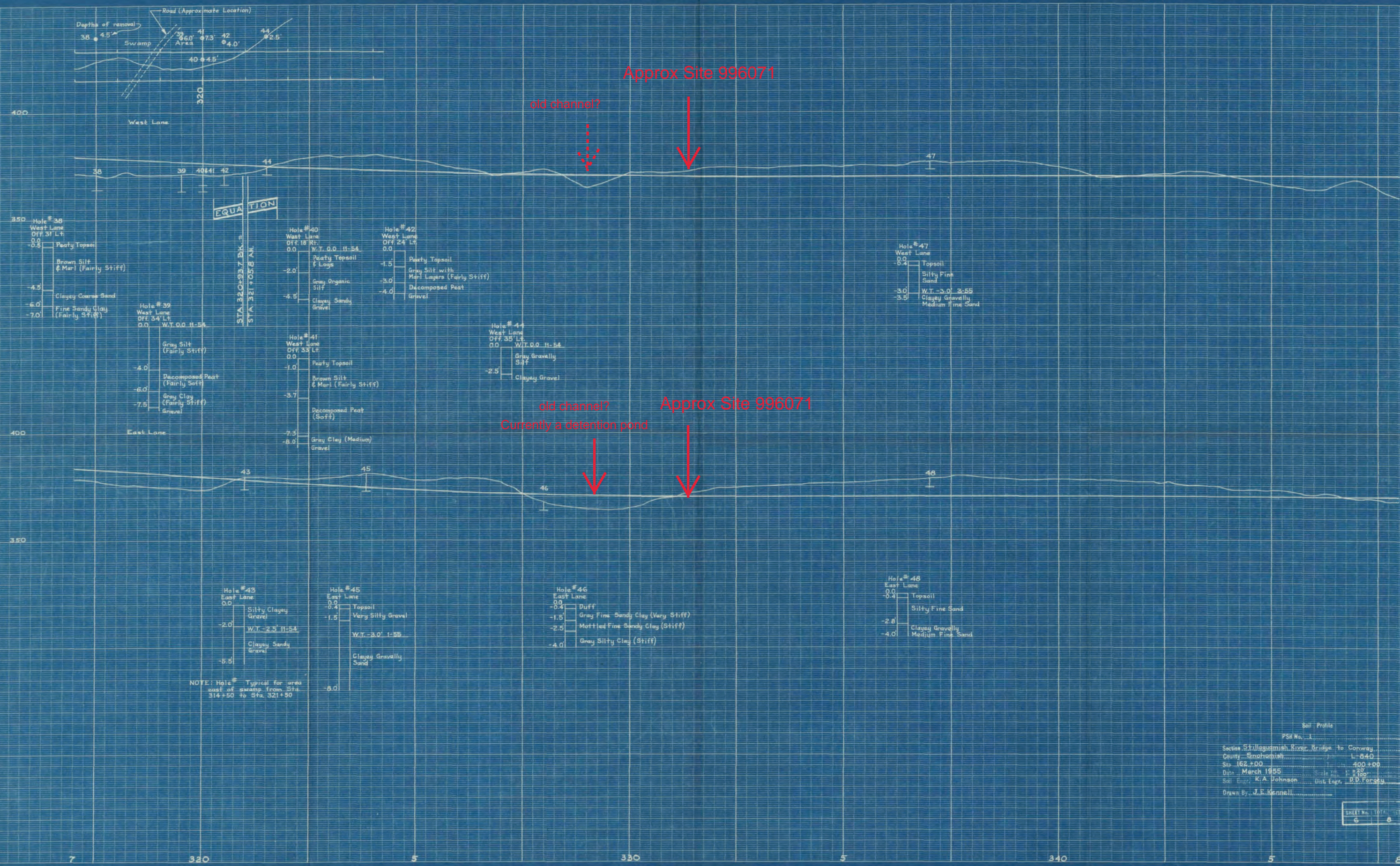


Site 996077



Soil Profile
PSH No. 1
Section: Stillaguamish River Bridge to Conway
County: Snohomish
Sta: 162+00 To Sta: 400+00
Date: March, 1955
Soil Engr.: K.A. Johnson
Drawn By: J.E. Kennell

SHEET NO.	TOTAL SHEETS
5	6



EQUATION

NOTE: Hole # Typical for area east of swamp from Sta. 314+50 to Sta. 321+30

Soil Profile
PSR No. 1
Section Stillaguamish River Bridge to Conway
County Snohomish L-840
Sta. 162+00 L-840
Date March 1955 Scale 1" = 20'
Soil Eng. K.A. Johnson Dist. Engr. D.D. Forster
Drawn By J.E. Kennell

SHEET No. 1 OF 2
6 8

Approx. Freeborn Road

West Lane

49

Hole # 49
West Lane
0.0
-3.0
Fine Sandy
Clay (Stiff)

51

Hole # 51
West Lane
0.0
-3.0
Silty, Slightly
Clayey Gravelly
Sand

Approx. Freeborn Road

East Lane

50

Hole # 50
East Lane
0.0
-0.4
-3.0
Topsoil
Clayey Gravelly
Sand

Small Stream

52

Hole # 52
East Lane
0.0
-1.5
-5.0
Fine Sandy
Clay (Stiff)
Silty Clay (Stiff)
Blue Gravelly
Fine Sandy Clay

Hole # 53
West Lane
0.0
-3.0
Clayey Gravelly
Sand

Soil Profile
PSH No. 1
Section Stillaguamish River Bridge to Conway
County Snohomish L-840
Sta. 162+00 400+00
Date March, 1955
Soil Color K.A. Johnson
Drawn By J.E. Kennell

SHEET 6 OF 7
7 8

**I-5 / Freeborn Overcrossing
Pilchuck Hill to North Burn Road
Contract No. 5423
WSDOT (1956)**

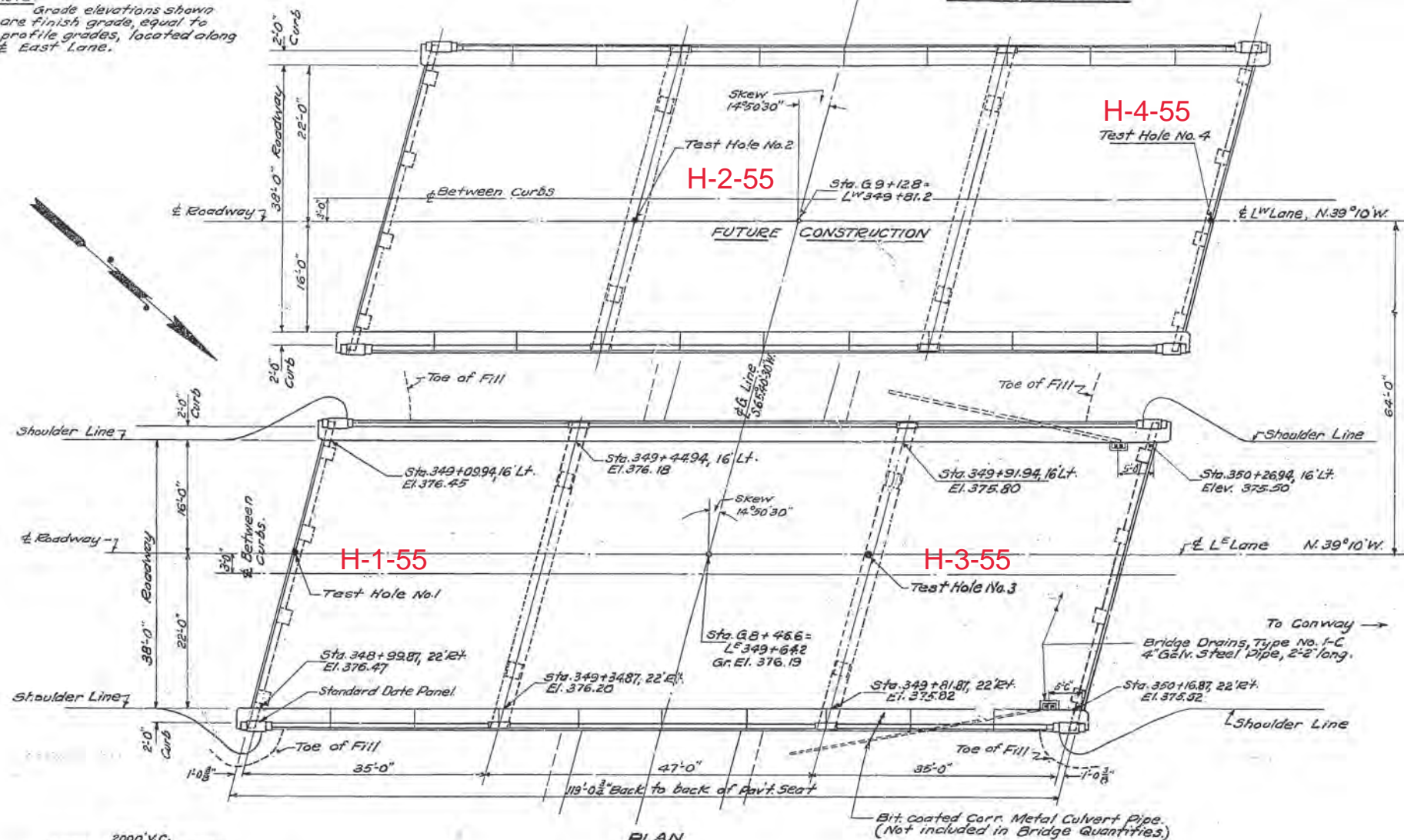
Designing Engineer	Nov. 1956
Checked	Nov. 1956
Reviewed	Nov. 1956
Quantity Surveyed	Nov. 1956
Quantity Checked	Nov. 1956

By	DATE
Y.Y.H.	Jan. 1956
Y.Y.H.	Jan. 1956
Y.Y.H.	Jan. 1956
Y.Y.H.	Jan. 1956
Y.Y.H.	Jan. 1956

NOTE: Grade elevations shown are finish grade, equal to profile grades, located along E. East Lane.

T. 32 N. R. 4 E. W. M.

FED. ROAD DIV. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
8	WASH.	11-6014(16)		26	29



GENERAL NOTES

All material and work shall be in accordance with the requirements of the State of Washington, Department of Highways, Standard Specifications for Road and Bridge Construction, dated April, 1948.

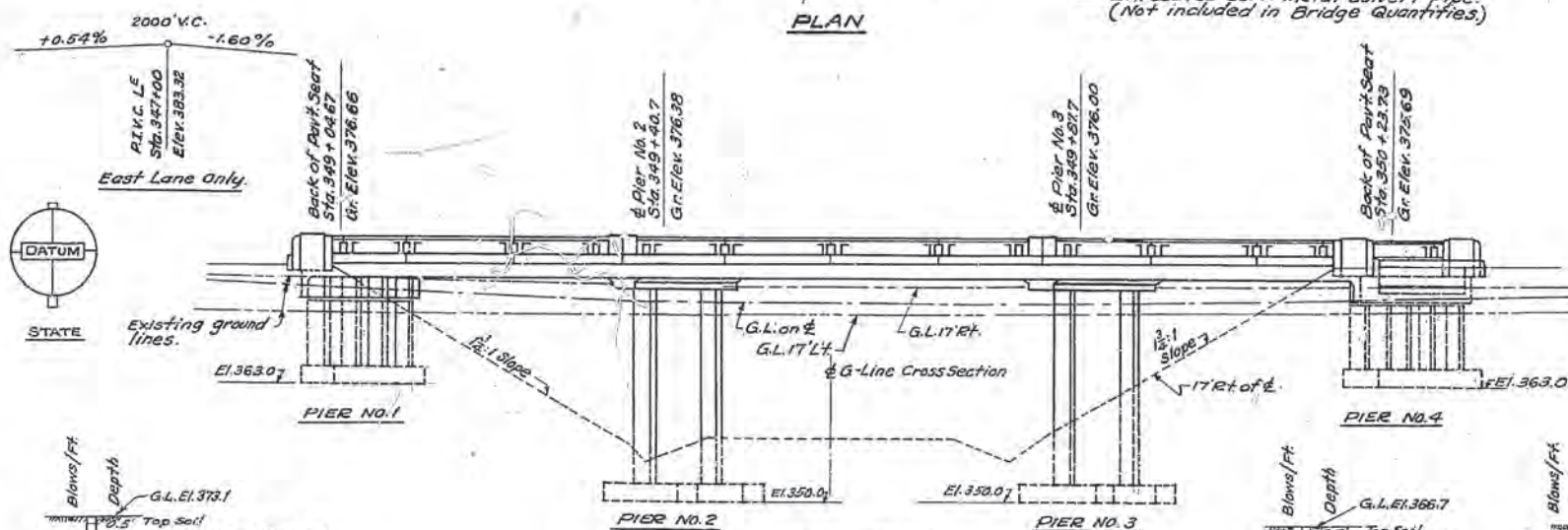
Footing elevations are subject to change depending upon foundation material encountered, and reinforcing steel for footings and columns shall not be cut until final footing elevations have been determined in the field.

Concrete in all footings shall be class B mix. All other concrete shall be class A mix.

Falsework shall not be released in any span until all concrete, except railings, has been in place the required length of time and has developed sufficient strength as outlined in the specifications. Falsework shall be carefully released to prevent impact or undue stresses in the structure.

SEQUENCE OF POURING		CLASS OF CONCRETE	
1.	Footings	Class B	Mix.
2.	Columns	"	"
3.	Column Tops, End Walls, Crossbeams & Roadway Slab.	"	"
4.	Curbs, Rail Bases and End Posts.	"	"
5.	Railings (Including Int. Posts)	"	"

APPROXIMATE QUANTITIES	
Structure Excavation	360 Cu. Yds.
Mechanical Tamper	60 Hours
Concrete Class A	370 Cu. Yds.
Concrete Class B	50 Cu. Yds.
Reinforced Concrete Bridge Railing	243 Lin. Ft.
Steel Reinforcing Bars	102,000 Lbs.
Bridge Drains	2 Only



ELEVATION
(Bridge on L^E)

TEST HOLE NO. 1
Sta. L^E 349+05 on E.

TEST HOLE NO. 2
Sta. L^E 349+58 on E.

TEST HOLE NO. 3
Sta. L^E 349+87 on E.

TEST HOLE NO. 4
Sta. L^E 350+40 on E.

H 20-S16-44 LOADING
PILCHUCK HILL TO NORTH BURN ROAD
PRIMARY STATE HIGHWAY NO. 1
FREEBORN OVERCROSSING
SNOHOMISH COUNTY

LAYOUT

WASHINGTON STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS
OLYMPIA, WASHINGTON

H. E. HENSEL, Member
E. C. HUNTLEY, Chairman
Oscar E. Stone, Member
J. A. Momo, Member

APPROVED: Nov. 23, 1956

ASST. DIRECTOR OF HIGHWAYS
CONTRACT NUMBER 5423

APPROVED: *[Signature]*
BRIDGE ENGINEER

11/16/56	Layout and details for increased Roadway Width	625	U.P.R.
DATE	REVISION	BY	APPROD.

SHEET 26 OF 29 SHEETS

1294

One Copy with Samples ✓
One Copy to Dist. Engr.
One Copy to Materials Engr.

DEPARTMENT OF HIGHWAYS
LOG OF TEST BORING

(Freeborn Interchange)

P.S.H. No. 1 Section Stillaguamish River Bridge to Conway Job No. L-840
S.S.H. Hole No. 3 Station LE-349+87 Offset 0 Ground Elev. 364.8
Type of Boring Highway Auger Size 20" Casing None
Inspector Christman Date 12-27-55 Sheet No. 1 of 1

[illegible]

One Copy with Samples ✓
One Copy to Dist. Engr.
One Copy to Materials Engr.

DEPARTMENT OF HIGHWAYS
LOG OF TEST BORING

(Freeborn
Innterchange)

P. S. H. No. 1 Section Stillaguamish River Bridge to Conway Job No. L-840
~~S. S. H.~~
Hole No. 4 Station LW 350+40 Offset 0 Ground Elev. 351.6
Type of Boring Highway Auger Size 20" Casing None
Inspector Christman Date 12-23-55 Sheet No. 1 of 1

[illegible]

**I-5 Original Ground Profiles & Areas of Unsuitable Material
P.S.H. No. 1 (I-5) Pilchuck Hill to Conway Junction
Contract No. 5423
WSDOT (1956)**

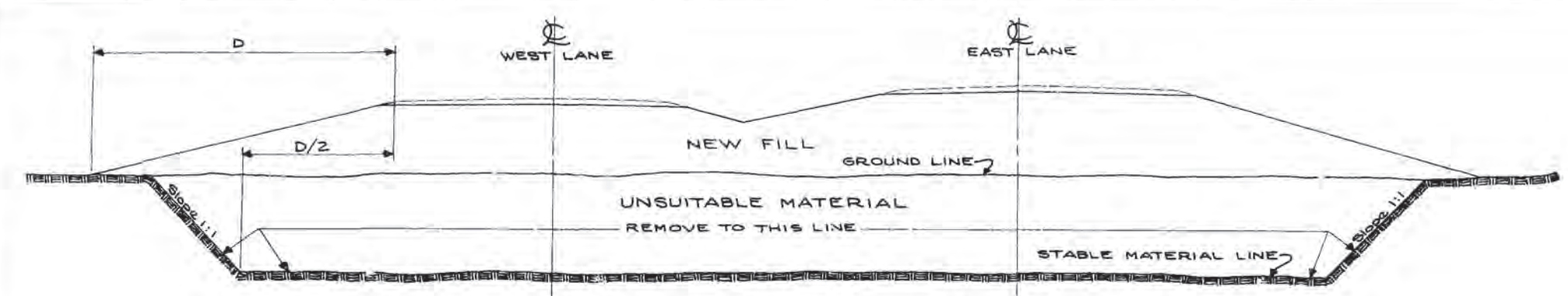
T. 32 N. R. 4 E. W. M.



- Scale 1" = 400'

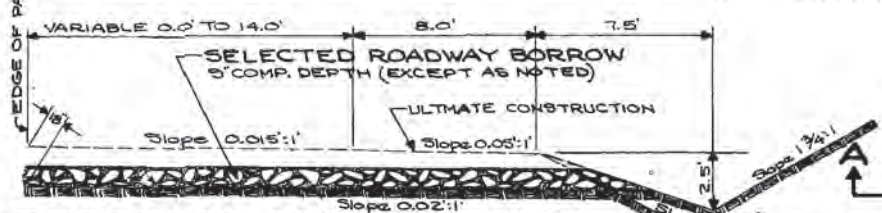
CONTRACT NUMBER 5423

FED. ROAD DIV. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
8	WASH.			29	



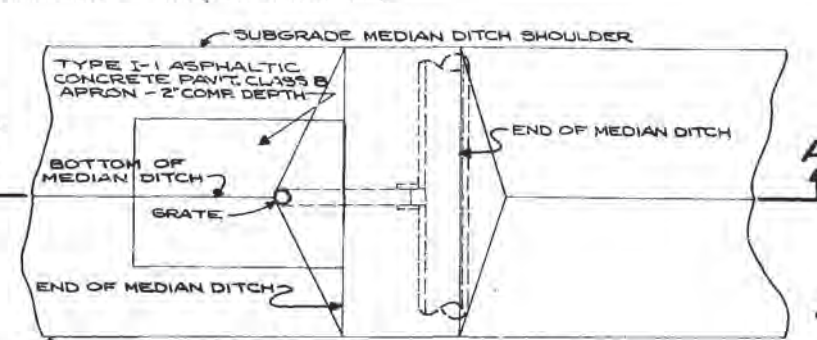
UNSUITABLE MATERIAL SECTION

AVERAGE DEPTH	
STA. 226+00.0 TO STA. 228+30.0	2.8' (WEST LANES ONLY)
STA. 232+00.0 TO STA. 233+15.0	2.2' (EAST LANES ONLY)
STA. 237+80.0 TO STA. 239+30.0	1.5'
STA. 243+40.0 TO STA. 244+50.0	1.6'
STA. 252+80.0 TO STA. 253+50.0	2.0' (WEST LANES ONLY)
STA. 258+50.0 TO STA. 300+00.0	1.5'
STA. 327+80.0 TO STA. 337+60.0	1.6'
STA. 371+50.0 TO STA. 373+30.0	1.5' (EAST LANES ONLY)

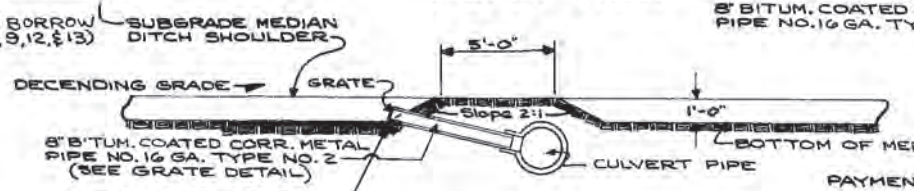


SPEED CHANGE LANE

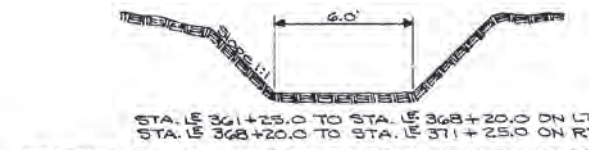
EXIST. STA. 149+50.0 TO EXIST. STA. 152+00.0 ON LT. - USE SELECTED MATERIAL
 STA. 157+50.0 TO STA. 159+50.0 ON RT. - USE SELECTED MATERIAL
 STA. 161+61.0 TO STA. 164+61.0 ON LT. - OMIT SELECTED ROADWAY BORROW
 STA. 168+48.4 TO STA. 173+175 ON RT. - USE SELECTED MATERIAL
 STA. 174+46.1 TO STA. 174+48.4 ON RT. - OMIT SELECTED MATERIAL
 STA. 174+50.0 TO STA. 177+70.9 ON LT. - OMIT SELECTED ROADWAY BORROW
 STA. 177+93.5 TO STA. 177+50.0 ON LT. - OMIT SELECTED ROADWAY BORROW
 STA. 181+88.1 TO STA. 186+38.1 ON RT. - USE SELECTED MATERIAL
 STA. 186+08.4 TO STA. 191+08.4 ON LT. - OMIT SELECTED ROADWAY BORROW
 STA. 194+00.3 TO STA. 194+00.3 ON RT.
 STA. 198+92.3 TO STA. 198+92.3 ON RT.
 STA. 198+77.4 TO STA. 198+77.4 ON LT. - OMIT SELECTED ROADWAY BORROW
 FOR VARIABLE PAVEMENT WIDTHS SEE PLAN & PROFILE SHEET NOS. 7, 8, 9, 12, & 13



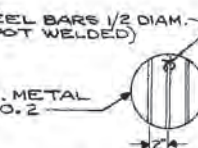
PLAN VIEW



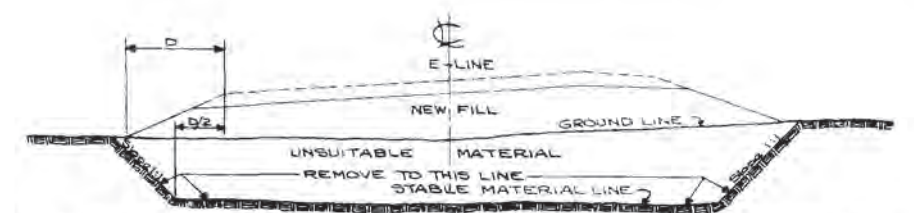
SECTION A-A MEDIAN DRAINAGE DETAIL



SPECIAL DITCH SECTION

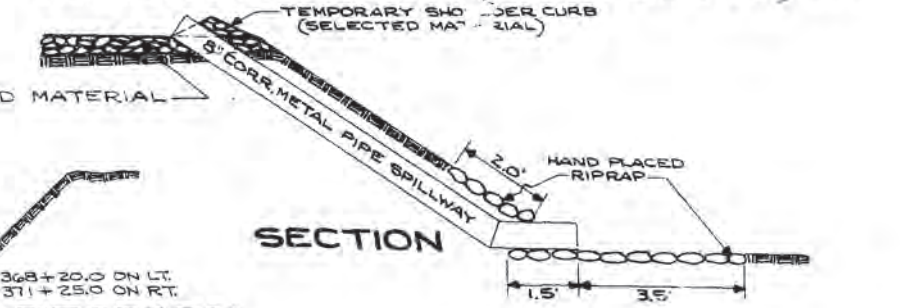


GRATE DETAIL

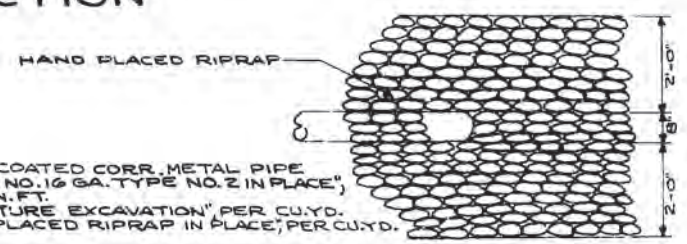


UNSUITABLE MATERIAL SECTION

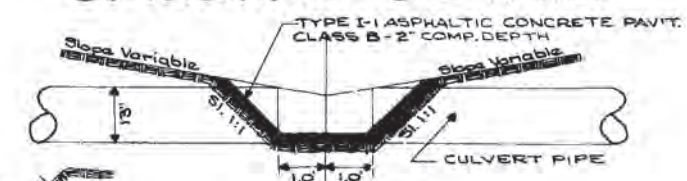
STA. E 0+25.0 TO STA. E 3+80.0 (AVERAGE DEPTH 2.5')



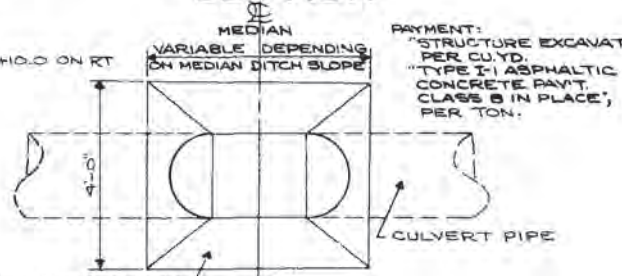
SECTION



PLAN SPILLWAY DETAIL



SECTION

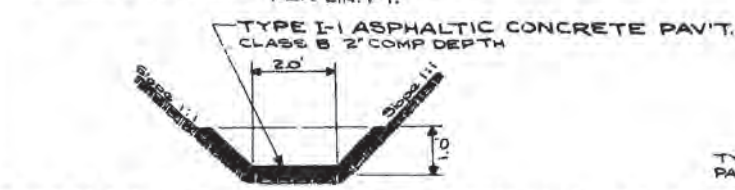


PLAN ASPHALT LINED BASIN DETAIL



ASPHALT LINED MEDIAN DITCH

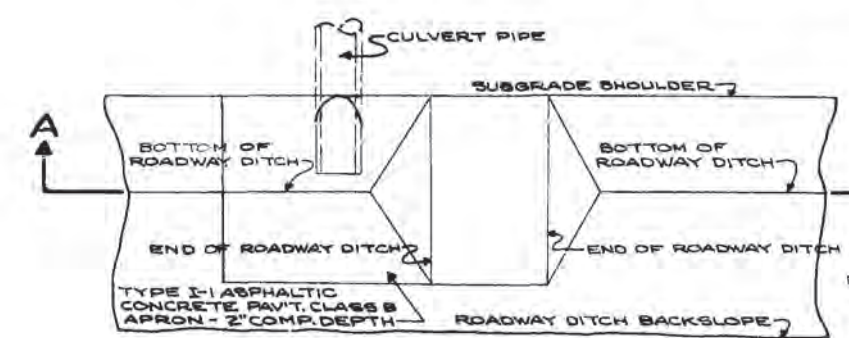
PAYMENT: "ASPHALT LINED MEDIAN DITCH" PER LIN. FT.



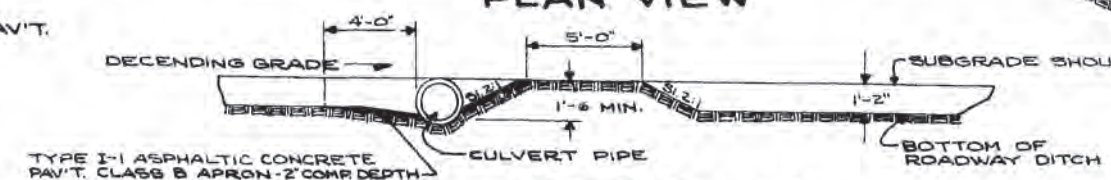
ASPHALT LINED SPILLWAY

PAYMENT: "ASPHALT LINED SPILLWAY" PER LIN. FT.

"COMMON TRENCH EXCAVATION" PER CU. YD.

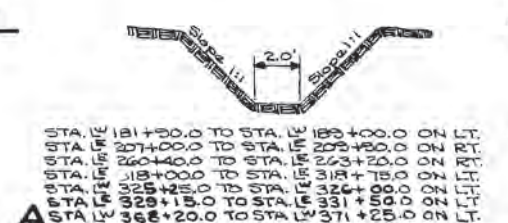


PLAN VIEW

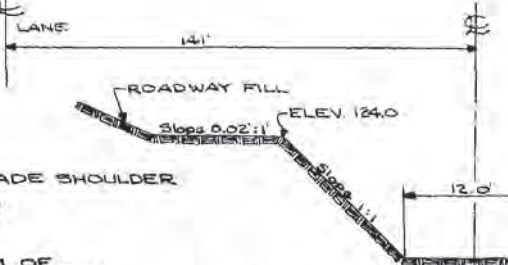


SECTION A-A CULVERT INLET DETAIL

PAYMENT: "TYPE I-1 ASPHALTIC CONCRETE PAVT. CLASS B IN PLACE" PER TON.



SPECIAL DITCH SECTION



CHANNEL CHANGE SECTION

STA. E 166+00.0 TO STA. E 167+20.0 ON RT.

PRIMARY STATE HIGHWAY NO. 1 PILCHUCK HILL TO NORTH BURN ROAD

SNOHOMISH COUNTY

WASHINGTON STATE HIGHWAY COMMISSION
 DEPARTMENT OF HIGHWAYS
 1150 4TH AVENUE



APPROVED Nov. 1, 1956

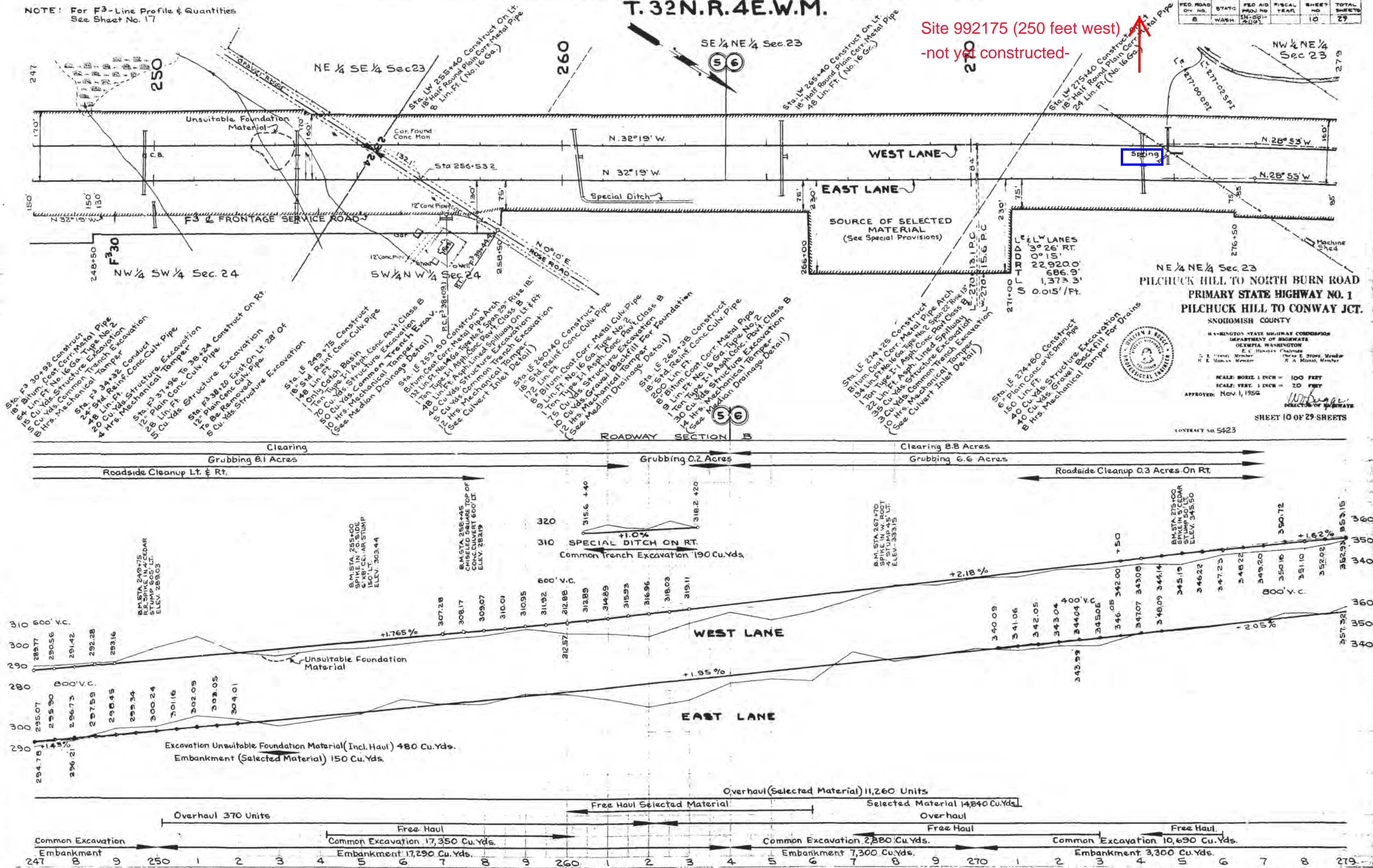
SHEET 4 OF 29 SHEETS
 CONTRACT NUMBER 5423

NOTE: For F3-Line Profile & Quantities
See Sheet No. 17

T. 32N.R. 4E.W.M.

FED. ROAD DIV. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
8	WASH.	157-25- 2409		10	29

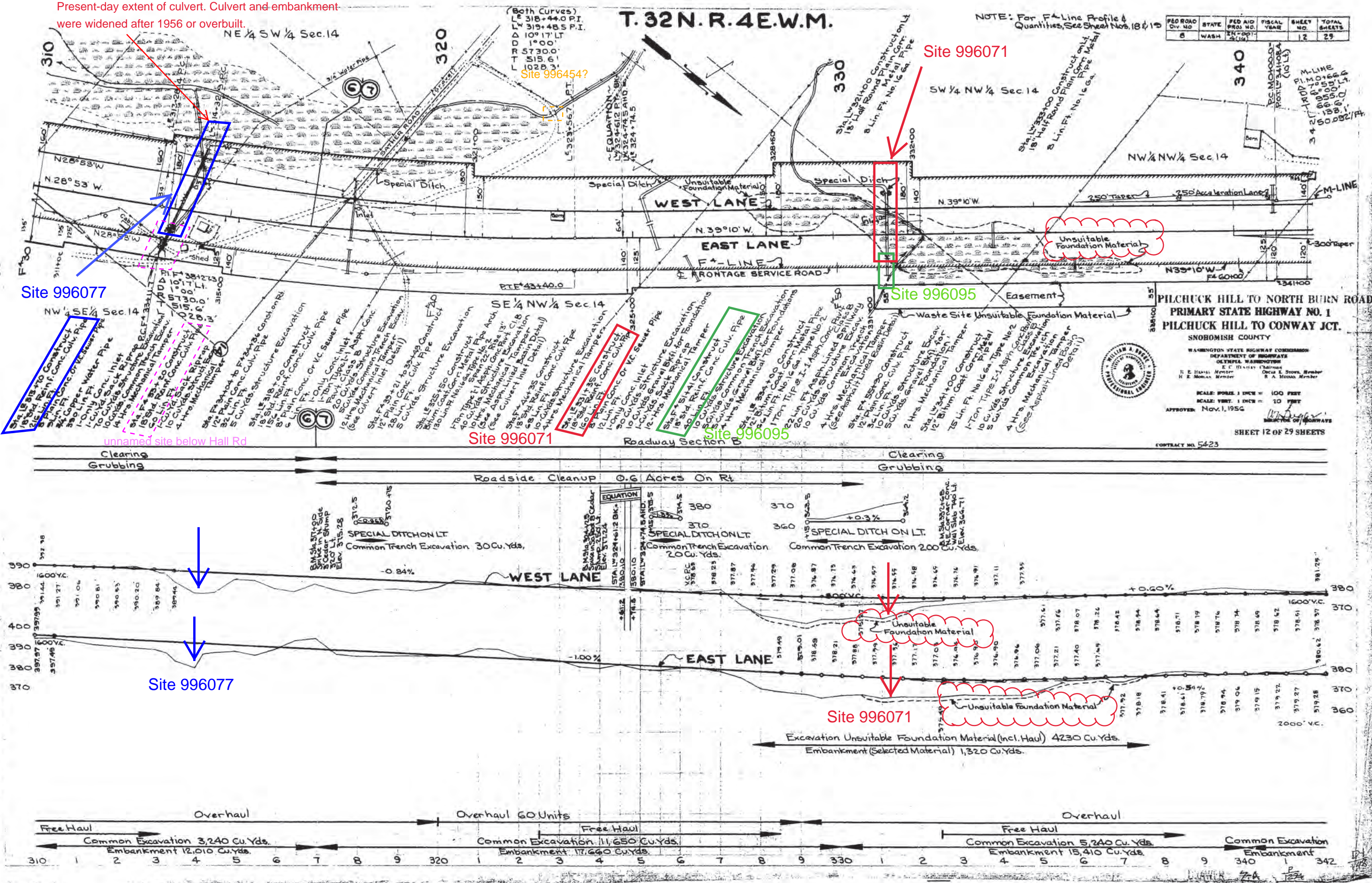
Site 992175 (250 feet west)
-not yet constructed-



NE 1/4 NE 1/4 Sec. 23
PILCHUCK HILL TO NORTH BURN ROAD
PRIMARY STATE HIGHWAY NO. 1
PILCHUCK HILL TO CONWAY JCT.
SKAGOMISH COUNTY
WASHINGTON STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS
OLYMPIA, WASHINGTON
E. C. HARRIS, Chairman
H. E. MANN, Member
J. E. STONE, Member
R. A. MUIR, Member
SCALE: HORIZ. 1 INCH = 100 FEET
SCALE: VERT. 1 INCH = 20 FEET
APPROVED: NOV. 1, 1956
DIRECTOR OF HIGHWAYS
SHEET 10 OF 29 SHEETS
CONTRACT NO. 5423

Sheet 10 of 19 Sheets

Present-day extent of culvert. Culvert and embankment were widened after 1956 or overbuilt.



T. 32 N. R. 4 E. W. M.

NOTE: For F+Line Profile & Quantities, See Sheet Nos. 18 & 19

PROJ. ROAD	STATE	FED. AID	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
6	WASH.	2N-001-4(14)		12	29

Site 996077

Site 996454?

Site 996071

Site 996095

Site 996071

Site 996095

Site 996077

Site 996071

Sheet 12 of 19 Sheets

PILCHUCK HILL TO NORTH BURN ROAD
PRIMARY STATE HIGHWAY NO. 1
SNODOMISH COUNTY

WASHINGTON STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS
OLYMPIA, WASHINGTON

E. C. HANLEY, Chairman
D. E. HANLEY, Member
H. E. MORGAN, Member

SCALE: HORIZ. 1 INCH = 100 FEET
SCALE: VERT. 1 INCH = 10 FEET
APPROVED: Nov. 1, 1956

SHEET 12 OF 29 SHEETS

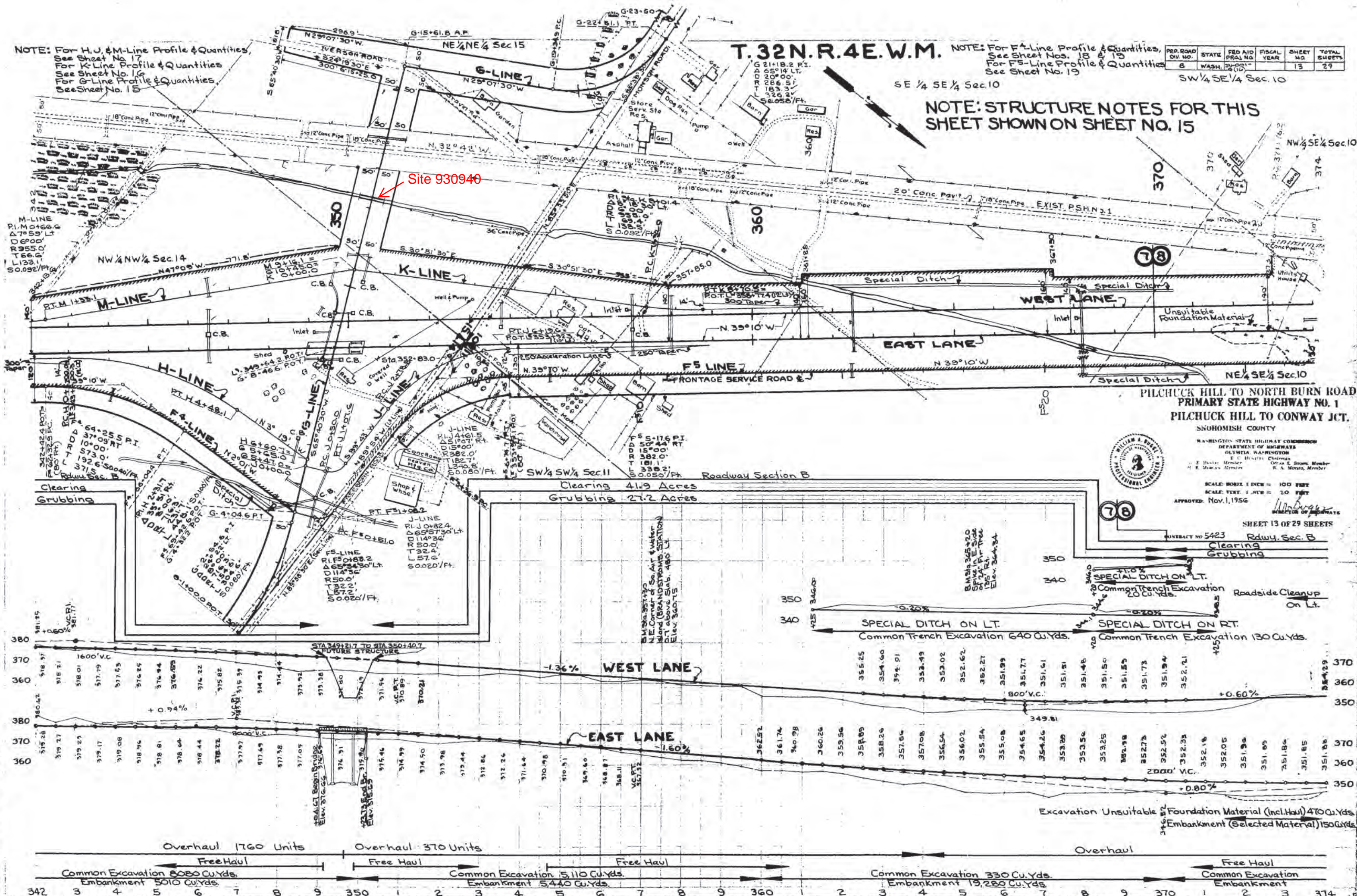
CONTRACT NO. 5423

SW 1/4 SE 1/4 Sec. 10

SE 1/4 SE 1/4 Sec. 10

SW 1/4 SE 1/4 Sec. 10

NOTE: STRUCTURE NOTES FOR THIS SHEET SHOWN ON SHEET NO. 15

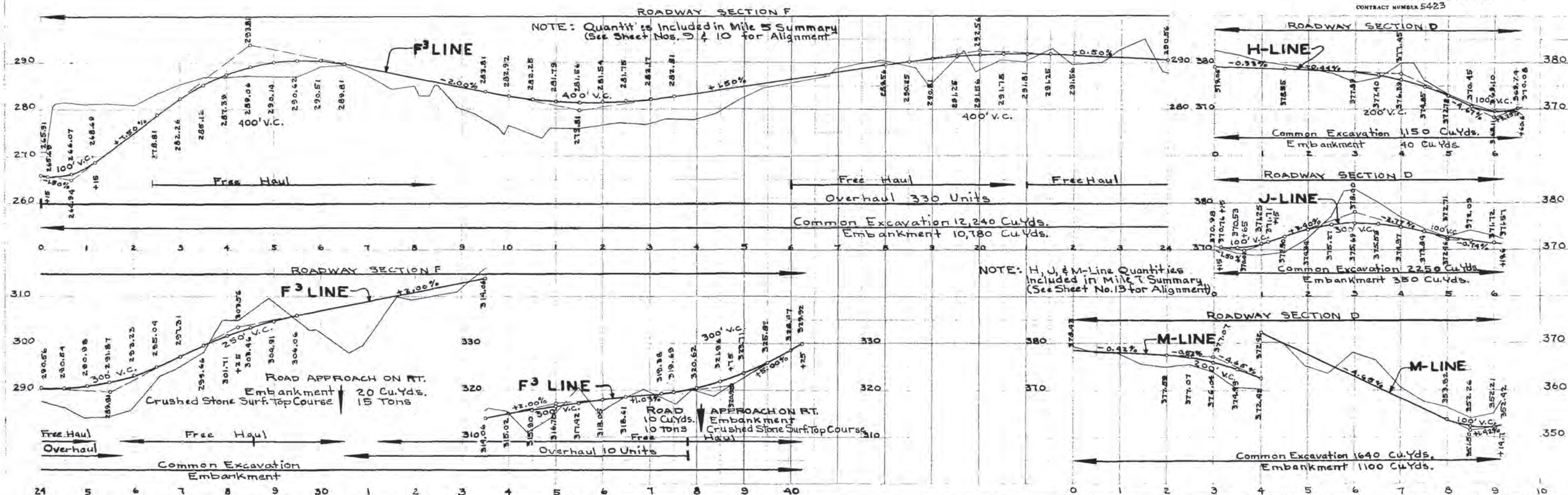


SNOHOMISH COUNTY

E. C. HUNTER, <i>Chairman</i>	
H. E. MORGAN, <i>Member</i>	H. A. MOISE, <i>Member</i>
CHARLES E. STONE, <i>Member</i>	B. E. HENSEL, <i>Member</i>

W. B. G. 4

SHEET 17 OF 29 SHEETS
CONTRACT NUMBER 5423



PRIMARY STATE HIGHWAY NO. 1
PILCHUCK HILL TO NORTH BURN ROAD

SNOHOMISH COUNTY

WASHINGTON STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS
OLYMPIA, WASHINGTON

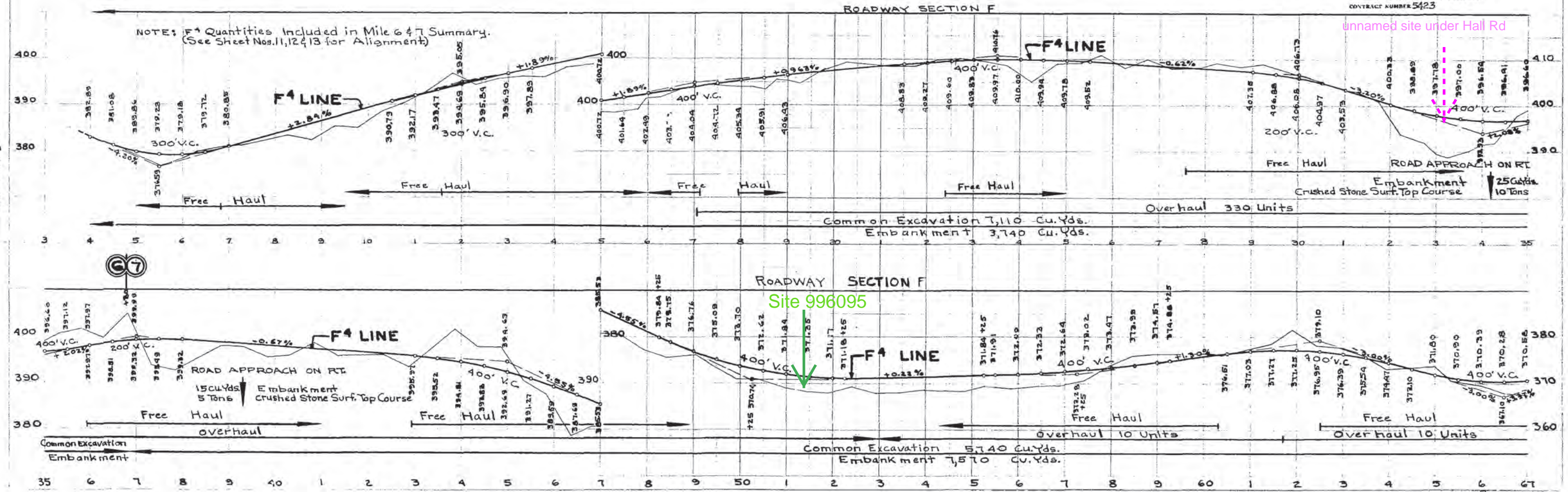


F. C. HUNTLEY, Chairman
H. F. MORAN, Member
WILLIAM A. BRUNDAGE, Member
R. A. MORSE, Member
R. E. HENSEL, Member

SCALE: HORIZ. 1 INCH = 100 FEET
SCALE: VERT. 1 INCH = 10 FEET
APPROVED: NOV. 1, 1956

W. A. Brundage
DIRECTOR OF HIGHWAYS

SHEET 18 OF 29 SHEETS
CONTRACT NUMBER 5423



A.W. TOLIN 1222
R.J. Mc Kay

C-1 18

SNOHOMISH COUNTY

WASHINGTON STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS
OLYMPIA, WASHINGTON

F. C. CUNLEY, Chairman
H. E. Munn, Member
W. E. Stroh, Member
R. A. Munro, Member
R. E. Hansen, Member

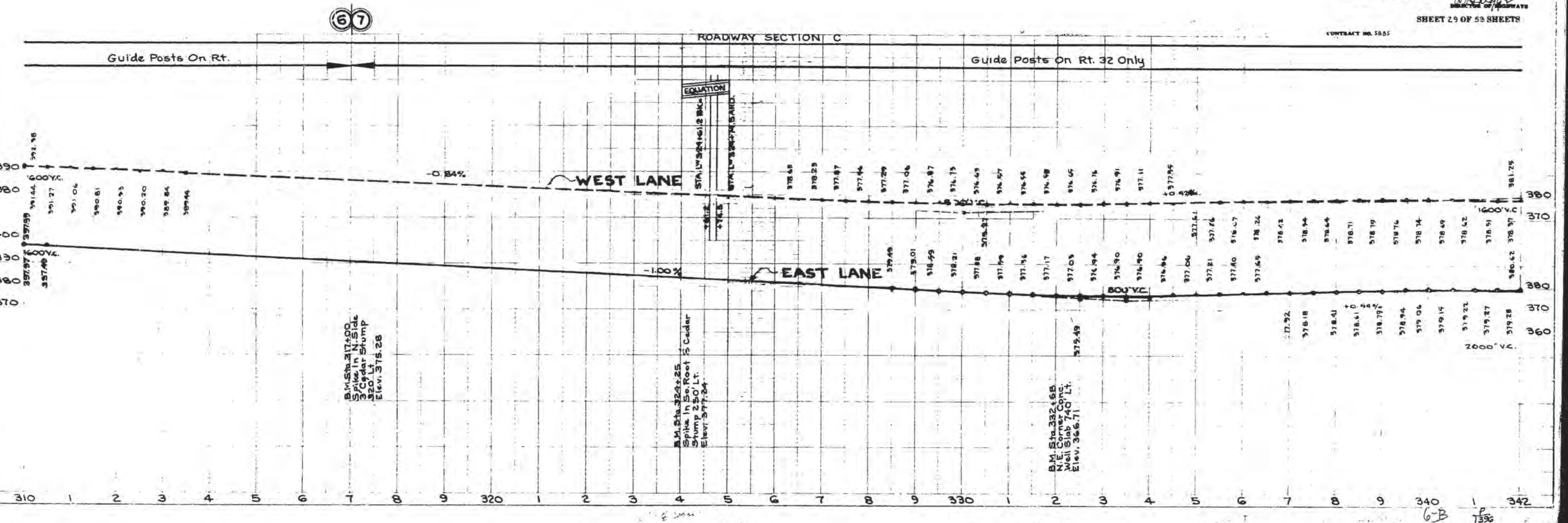
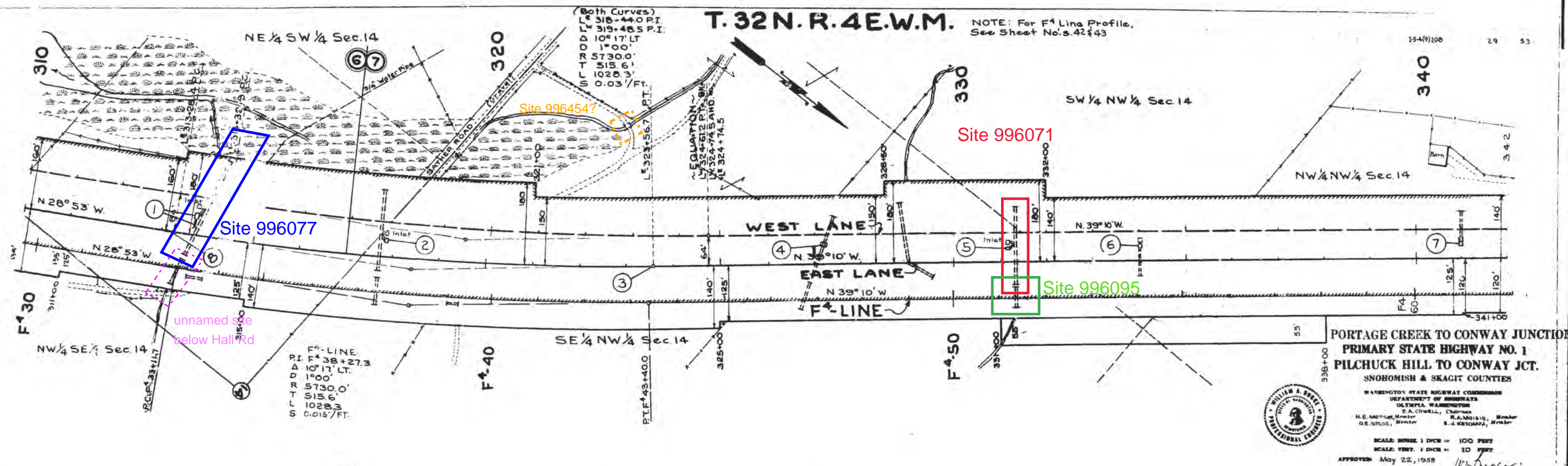
SCALE: HORIZ. 1 INCH = 100 FEET
SCALE: VERT. 1 INCH = 10 FEET
APPROVED: Nov. 1, 1956

W. S. Sawyer,
DIRECTOR OF HIGHWAYS

SHEET 19 OF 29 SHEETS
CONTRACT NUMBER 5423



**I-5 Original Ground Profiles & Areas of Unsuitable Material
P.S.H. No. 1 (I-5) Pilchuck Hill to Conway Junction
Contract No. 5885
WSDOT (1958)**



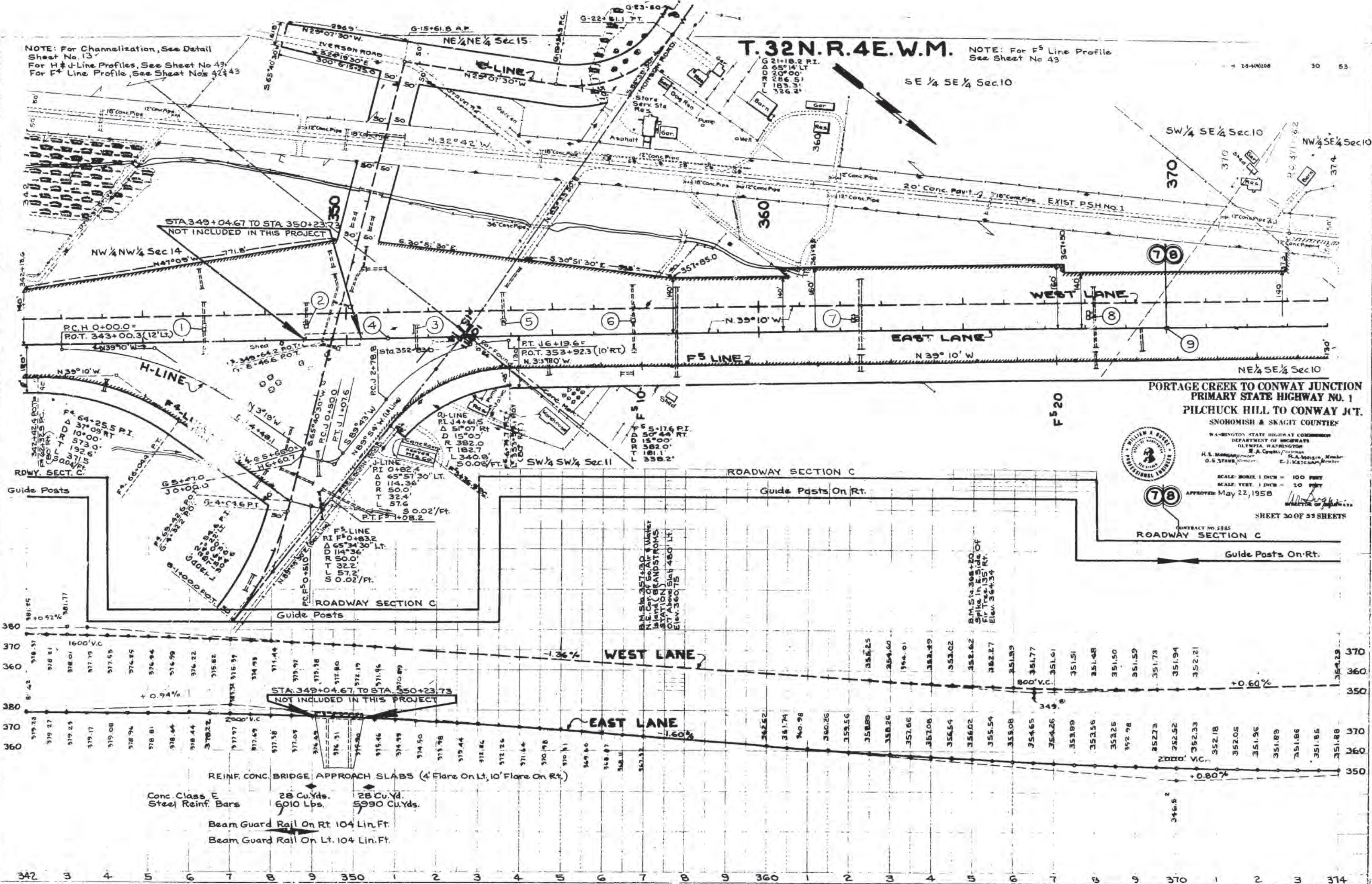
NOTE: For Channelization, See Detail Sheet No. 13.
For H-Line Profiles, See Sheet No. 43.
For F-Line Profile, See Sheet No. 43.

T. 32N. R. 4E. W.M.

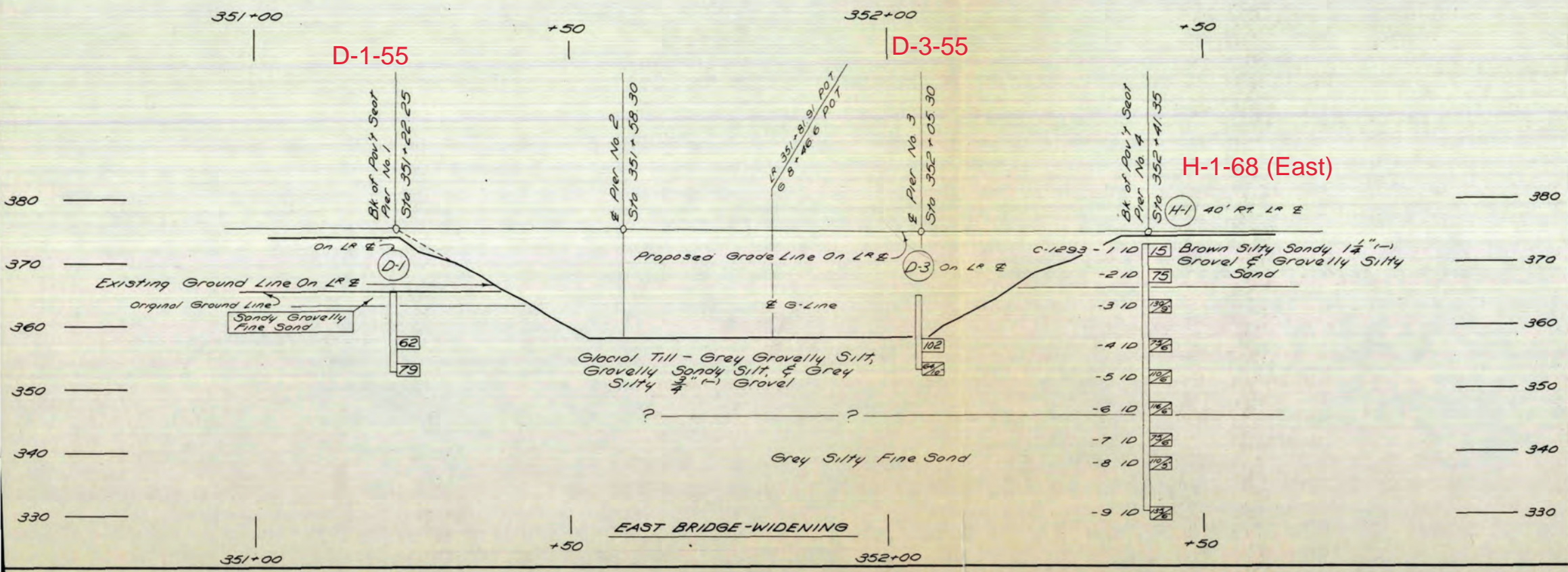
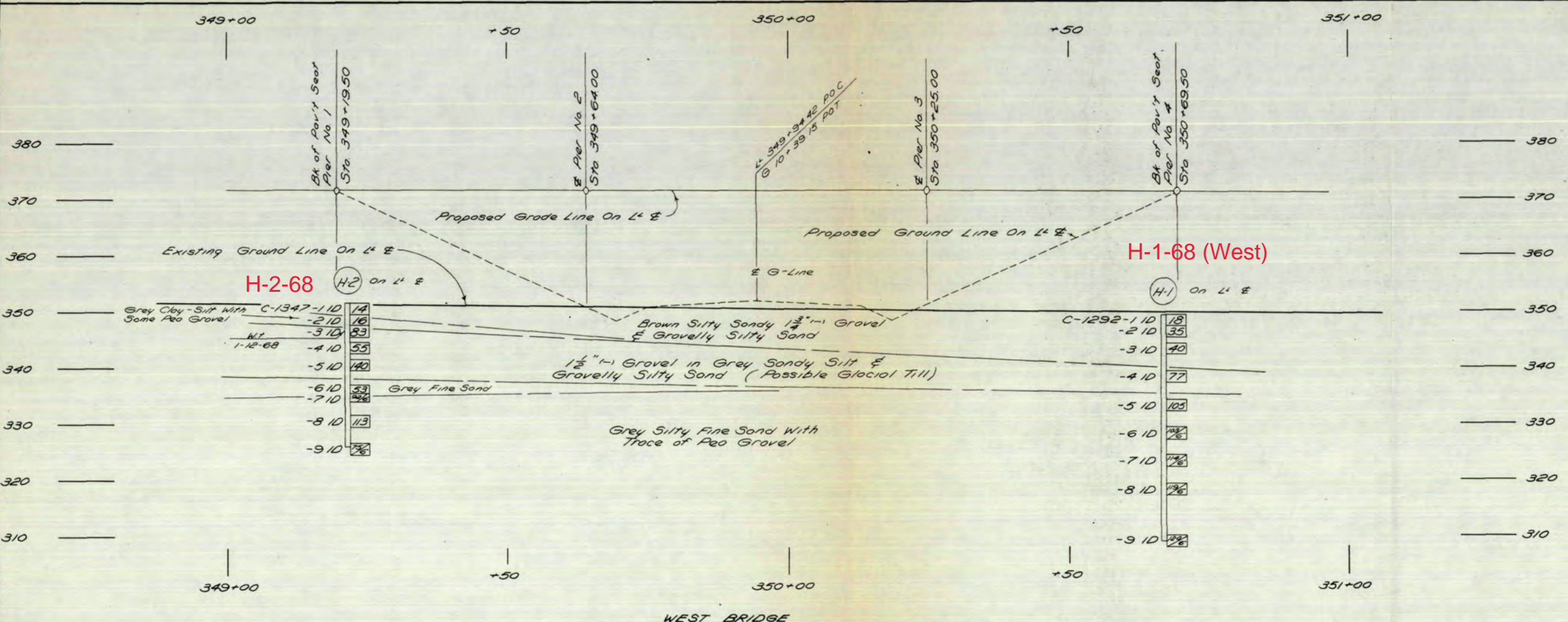
NOTE: For F-Line Profile See Sheet No. 43

4-25-401208

30 53



**I-5 / Freeborn Road O'Xing Soil Profile, Borings, As-builts
S.R. 5 Stillaguamish River to Conway Junction
Job No. L-2849, Contract No.
WSDOT (1968)**



TEST HOLE LEGEND

(H-1) TEST HOLE NUMBER

C-1292-1 10 18 STANDARD PENETROMETER TEST (BLOWS PER FOOT)

IDENTIFICATION SAMPLE

WT WATER TABLE & DATE

**THIS PRINT
REDUCED 50%**

JOB NO. 42849 P.S.H. NO. 1 (S.R. 5) C.S. 3/04

**STILLAGUAMISH RIVER TO
CONWAY JCT.
FREEBORN RD. O'XING**

FOUNDATION PROFILE

WASHINGTON
STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS
MATERIALS DIVISION

DATE May 1968
SCALE 1" = 10' VERT.
1" = 10' HORIZ.
SHEET 1 OF 1

Drawn By G.A. Simms

WASHINGTON
STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS


Original to Materials Engineer
Copy to Bridge Engineer
Copy to District Engineer
Copy to _____

LOG OF TEST BORING

P S.H. 1 S.R. 5 Section Stillaguamish River to Conway Jct. Job No. L-2849
Hole No. H-1 Sub Section Freeborn Road O'xing Cont. Sec. 3104
Station 350 + 67 Offset On CL Line Ground El. 349.4
Type of Boring Rotary with mud Casing 4" to 10' W.T. El. 348.9*
Inspector R. G. Bennett. Date January 12, 1968 Sheet 1 of 2

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
			6 Std	
	13		8 Pen	SILTY SAND AND GRAVEL - all sizes, with
			10 1	
			15 *	scattered layers (2" to 4") of silty very fine
	35		15 Std	
			15 Pen	sand, brown, wet, slightly compact to dense
			20 2	
			21 ↓	
5				
	40		20 Std	
			20 Pen	
			20 3	
			26 ↓	
				TILL - all sizes sand and gravel in a very
10				hard gray fine sandy clayey silt
	77		20 Std	
			57 Pen	
			4	
				FINE SAND - Slightly clayey silty, gray
15				very dense, damp
	105		32 Std	
			73 Pen	
			5	
20				

Hole No. H-1 Sub Section Freeborn Road O'xing Sheet 2 of 2

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
	103/6"		103/6" Std Pen 6	(Cemented)
25				
	114/6"		114/6" Std Pen 7	
30				
	116/6"		116/6" Std Pen 8	
35				
	105/6"		105/6" Std Pen 9	
40				
	120/6"		120/6" Std Pen 10	Test Boring Stopped at 40.5'
				*W.T. - 6" below ground elevation
				Surface water, probable dry hole

WASHINGTON
STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS

Original to Materials Engineer
Copy to Bridge Engineer
Copy to District Engineer

Copy to _____

LOG OF TEST BORING

P S.H. 1 S.R. 5 Section Stillaguamish River to Conway Jct. Job No. L-2849
Hole No. H-1 Sub Section Freeborn Road O'xing (Widening) Cont. Sec. 3104
Station 352 + 41 Offset 40' Rt ϕ Ground El. 372.9
Type of Boring Rotary with mud Casing 4" to 10' W.T. El. Dry Hole
Inspector R. G. Bennett Date January 11, 1968 Sheet 1 of 2

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
	15		5 Std 6 Pen 9 1 15 ↓	GRAVELLY SILTY FINE SAND - all sizes gravel, brown, damp, slightly compact to very dense
5	75		33 Std 42 Pen 2	
				TILL - all sizes sand and gravel in a very hard gray fine sandy clayey silt. fairly dry to damp
10	130/9"		80 Std 50/3" Pen 3	
15	75/6"		75 Std Pen 4	
20				

Hole No. H-1 Sub Section Freeborn Road O'xing Sheet 2 of 2

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
	110/6"		110 ↓ Std Pen 5	
25				
	116/6"		116 ↓ Std Pen 6	
				FINE SAND - slightly silty, very dense,
				gray, damp
30				
	75/6"		75 ↓ Std Pen 7	
	110/5"		110 ↓ Std Pen 8	
35				
40				
	135/6"		135 ↓ Std Pen 9	Test Boring Stopped at 42.5'
45				

WASHINGTON
STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS

Original to Materials Engineer
Copy to Bridge Engineer
Copy to District Engineer
Copy to _____

LOG OF TEST BORING

P. S.H. 1 S.R. 5 Section Stillaguamish River to Conway Jct. Job No. L-2849
Hole No. H-2 Sub Section Freeborn Road O'xing (New Bridge) Cont. Sec. 3104
Station 349 + 21.4 Offset On $\frac{1}{2}$ L Line Ground El. 350.7
Type of Boring Rotary with mud Casing 4" to 10' W.T. El. 346.5
Inspector R. G. Bennett Date January 16, 1968 Sheet 1 of 2

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
			6 Std	
	14		7 Pen	SAND AND GRAVEL - Slightly silty, brown,
			7 1	damp, slightly compact, all sizes sand and gravel
			7	GRAY SILTY SANDY GRAVELLY CLAY, wet,
			7 Std	
	16		8 Pen	slightly compact and stiff
			8 2	
			10	TILL - all sizes sand and gravel in a
5	83		21 Std	
			62 Pen	very fine sandy, gray clayey silt, damp, dense
			3	
			20 Std	
	55		22 Pen	
			33 4	
			40	
10				
	140		60 Std	
			80 Pen	
			5	
				FINE SAND - Slightly silty, with 1" to 2"
15				layers of a clayey silty extremely fine sand
			15 Std	
	53		16 Pen	dense, damp
	92/6"		37 6-A	
			92 6-B	FINE SAND - Slightly clayey silty,
				very dense, gray
20				(occasional fine gravel)

Hole No. H-2 Sub Section Freeborn Road O'xing Sheet 2 of 2

[illegible]

WASHINGTON
STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS

Original to Materials Engineer
Copy to Bridge Engineer
Copy to District Engineer
Copy to

LOG OF TEST BORING

P. S.H. 1 S.R. 5 Section Stillaguamish River to Conway Jct. Job No. L-2849
Hole No. D-1 Sub Section Freeborn Road O'xing Cont. Sec. 3104
Station 351 + 22 Offset 0 Ground El. 365.4
Type of Boring Auger Casing _____ W.T. El. _____
Inspector Christman Date December 23, 1955 Sheet 1 of 1

DEPTH	BLOWS PER FT.	PROFILE	SAMPLE TUBE NOS.	DESCRIPTION OF MATERIAL
				Top soil
				SILTY GRAVELLY FINE SAND
				CLAYEY GRAVELLY FINE SAND (Glacial Till)
5				
	62		<div style="text-align: center;"> Std Pen 1 </div>	
10				
	79		<div style="text-align: center;"> Std Pen 2 </div>	
				Test Boring Stopped at 13' 6"
15				W.T.: Not Obtained

I-5 / BonneView Interchange Soil Profile (Site 03.0183 1.20)
Bridge No. 5/701
Jct. SSH 1-Y to Conway Hill
Job No. L-2849
WSDOT (1968)

A hand-drawn diagram of a vertical test hole. At the top, a circle contains the number '42', with the text 'TEST HOLE NUMBER' written to its right. The hole is represented by a vertical line with several horizontal segments. From top to bottom, the segments are labeled as follows:

- A segment labeled 'C-117410' on the left and 'B' in a box on the right, with the text 'STANDARD PENETROMETER TEST (BLOWS PER FOOT)' to the right.
- A segment labeled 'IDENTIFICATION SAMPLE' to the right.
- A segment labeled 'SOIL SAMPLE NUMBER' to the right.
- A segment labeled 'C-1181' on the left and '1700' in a box on the right, with the text 'ANGLE OF INTERNAL FRICTION (ϕ IN DEGREES)' to the right.
- A segment labeled 'CONSOLIDATION TEST CONDUCTED' to the right.
- A segment labeled 'COHESION IN LBS/SQ. FT.' to the right.
- A segment labeled 'WATER TABLE & DATE' to the right.

 Arrows point from the text labels to their corresponding segments or boxes. At the bottom of the hole, a horizontal line with an arrow pointing right is labeled 'W.T.' (Water Table).

TEST HOLE NUMBER

42

C-117410 B STANDARD PENETROMETER TEST (BLOWS PER FOOT)

IDENTIFICATION SAMPLE

SOIL SAMPLE NUMBER

C-1181 1700 C ANGLE OF INTERNAL FRICTION (ϕ IN DEGREES)


CONSOLIDATION TEST CONDUCTED

COHESION IN LBS/SQ. FT.

WATER TABLE & DATE

W.T.

JOB NO. L-2849 P.S.H. NO. 1 P.R. 5 C.S. 2901
JCT. SSH-1-Y TO CONWAY HILL
BONNEVIEW I'CHGE
OVERCROSSING
 FOUNDATION PROFILE

	WASHINGTON STATE HIGHWAY COMMISSION DEPARTMENT OF HIGHWAYS MATERIALS DIVISION		DATE <i>MARCH 1968</i>
	E. V. LICKING MATERIALS ENGINEER		SCALE $1" = 10'$ VERT. $1" = 20'$ HORIZ. SHEET <i>1</i> OF <i>1</i>

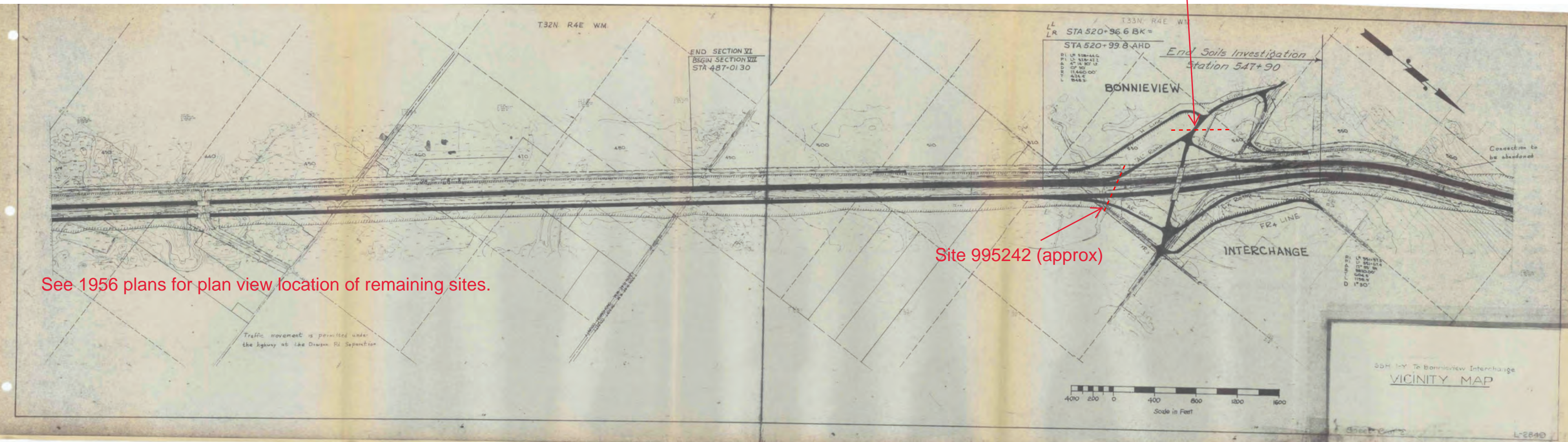
Drawn By G.A. Simms

**I-5 Soil Profile and Shallow Borings
S.R. 5 SSH 1-Y [SR-532] to Conway Junction
Job No. L-2849
WSDOT (1969)**

Site 03.0183 1.20 (approx)

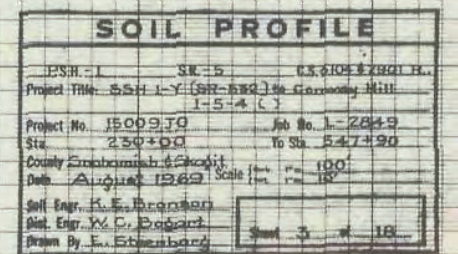
See 1956 plans for plan view location of remaining sites.

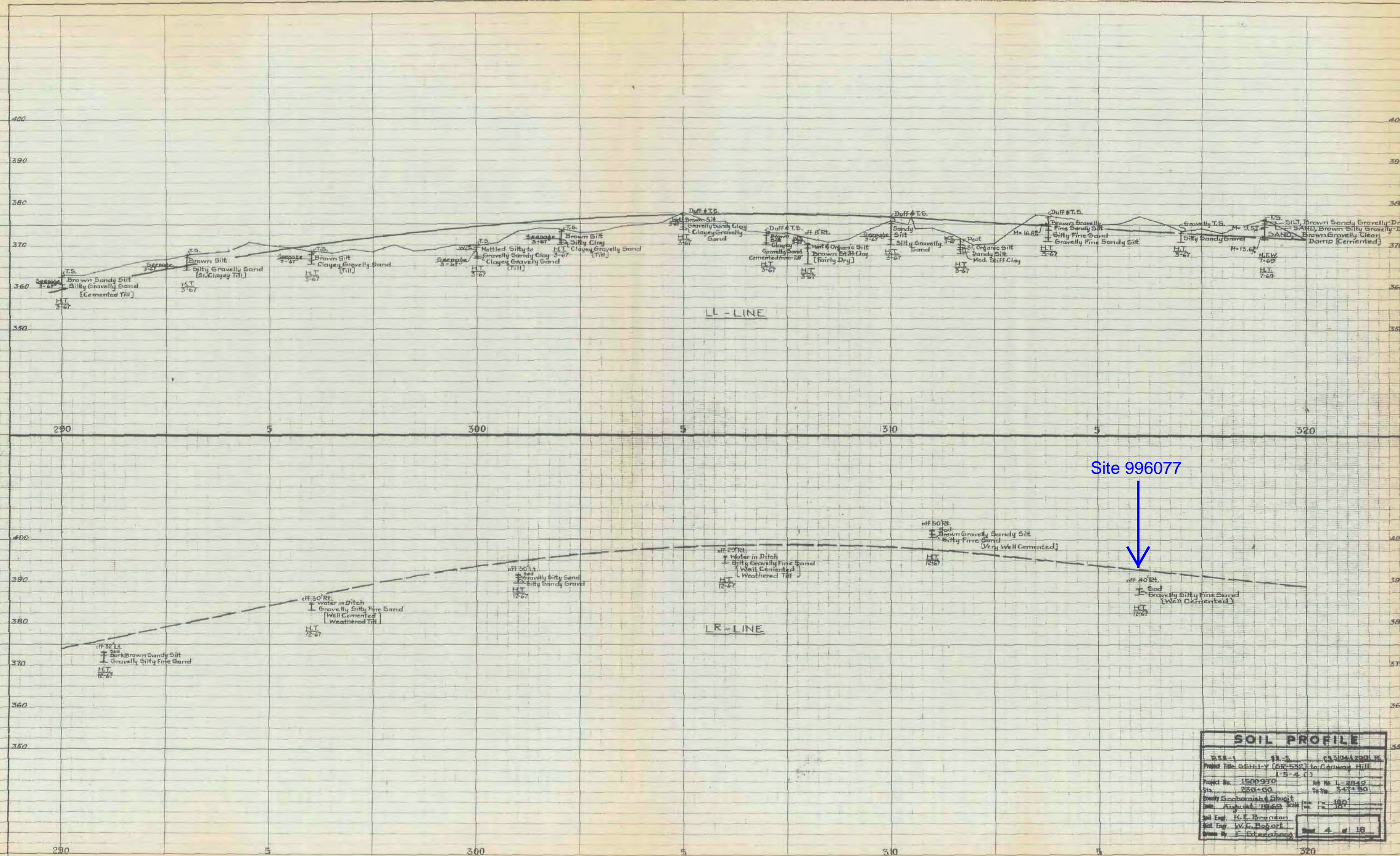
Site 995242 (approx)

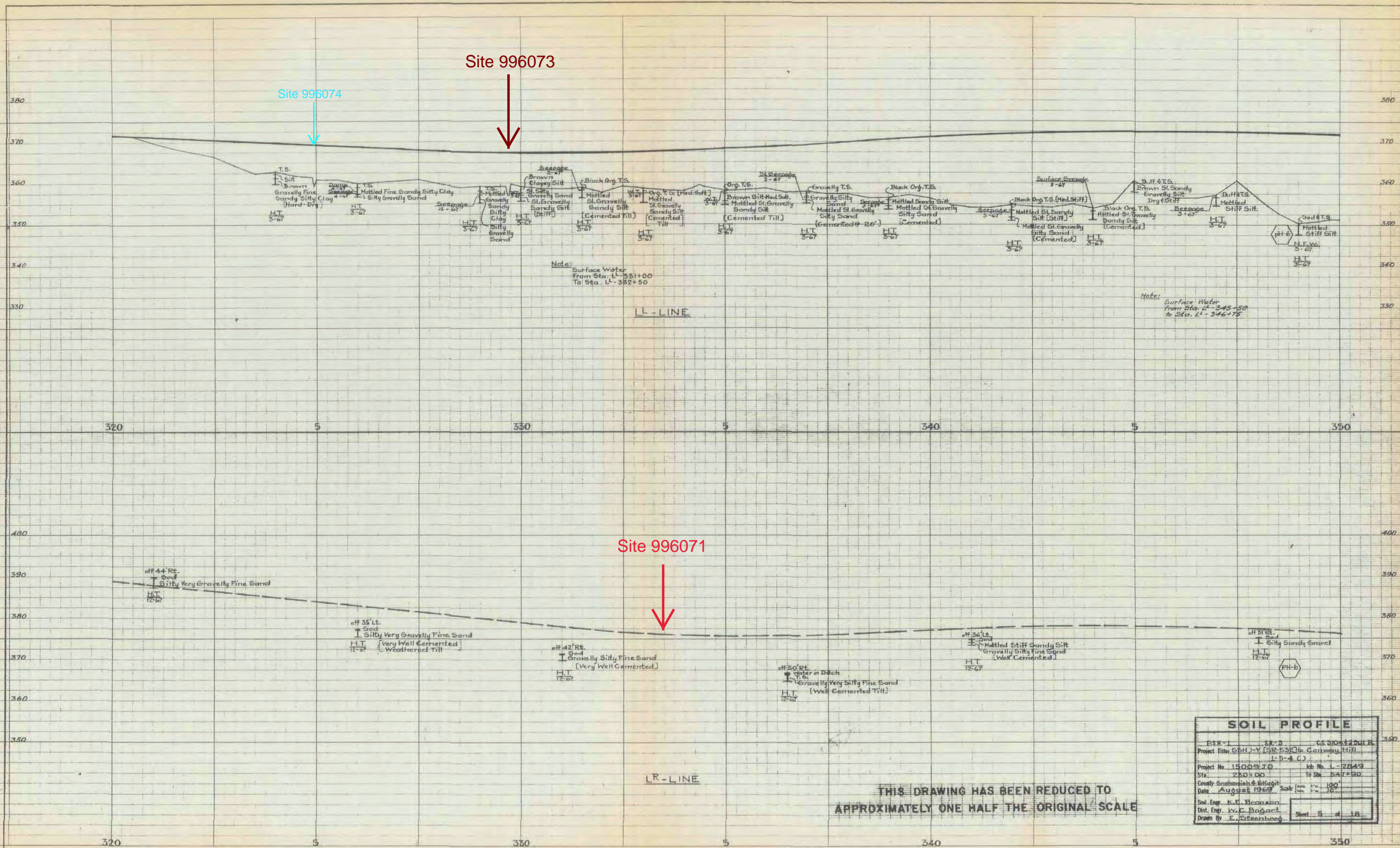


A geological cross-section labeled "E-L Line" showing porosity distribution. The section is divided into four segments by vertical dashed lines. The first segment is labeled "Pore Water" and shows a high porosity area with a value of 265. The second segment shows a lower porosity area with a value of 13. The third segment shows a higher porosity area with a value of 23.5. The fourth segment shows a lower porosity area with a value of 13. A scale bar at the bottom right indicates "Scale: 1" = 100'".

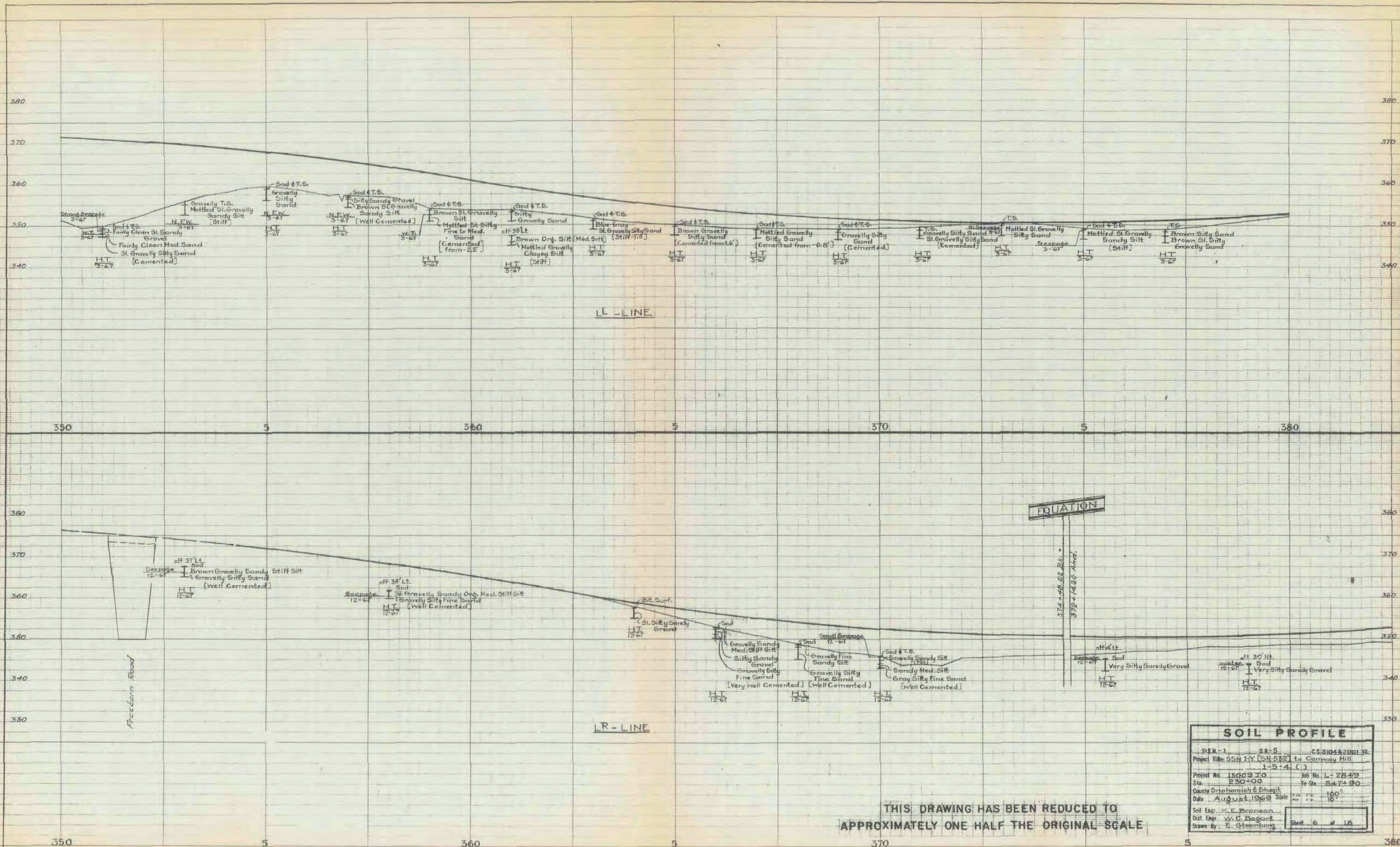
Intermittent Ponded Water and shaller deposits of soft foundation material occur to an approximate depth of -2.0' between Sta. 17-262+50 & Sta. 266+50 and between Sta. 267+50 & Sta. 268+50.



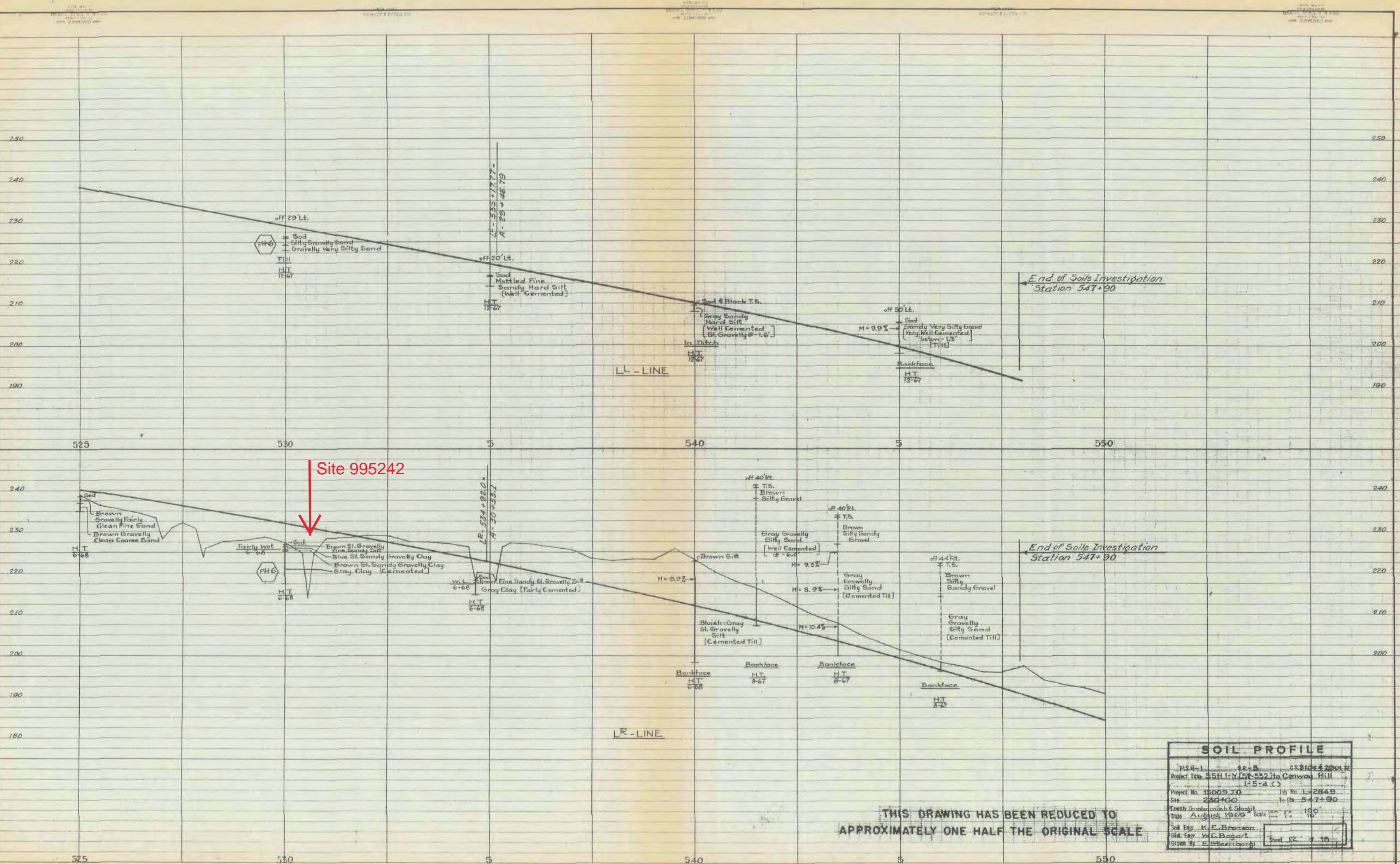




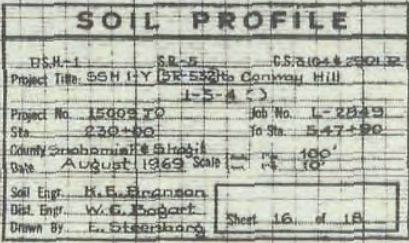
SOIL PROFILE			
BSR-1	SR-2	CS-210-11201R	
Project Title: 55H-1-Y (SR-55R) to Conway Hill			
Project No. 15009.10			
Sta. 250+00 To Sta. 254+30			
County: Snohomish & Skagit			
Date: August 1969			
Soil Eng. K.E. Branson			
Dist. Eng. W.C. Bogart			
Drawn By E. Steinhilber			
Sheet 5 of 18			

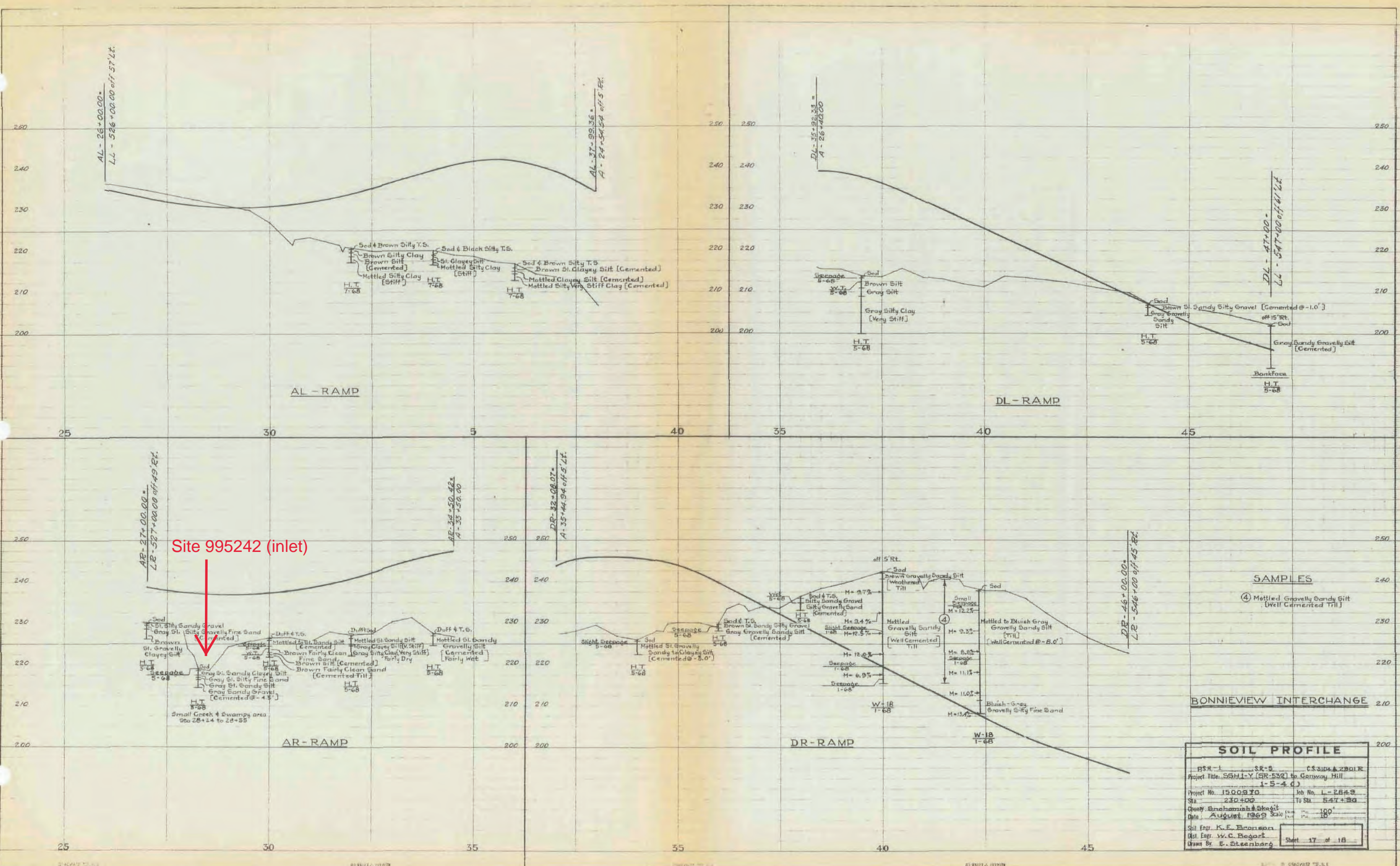


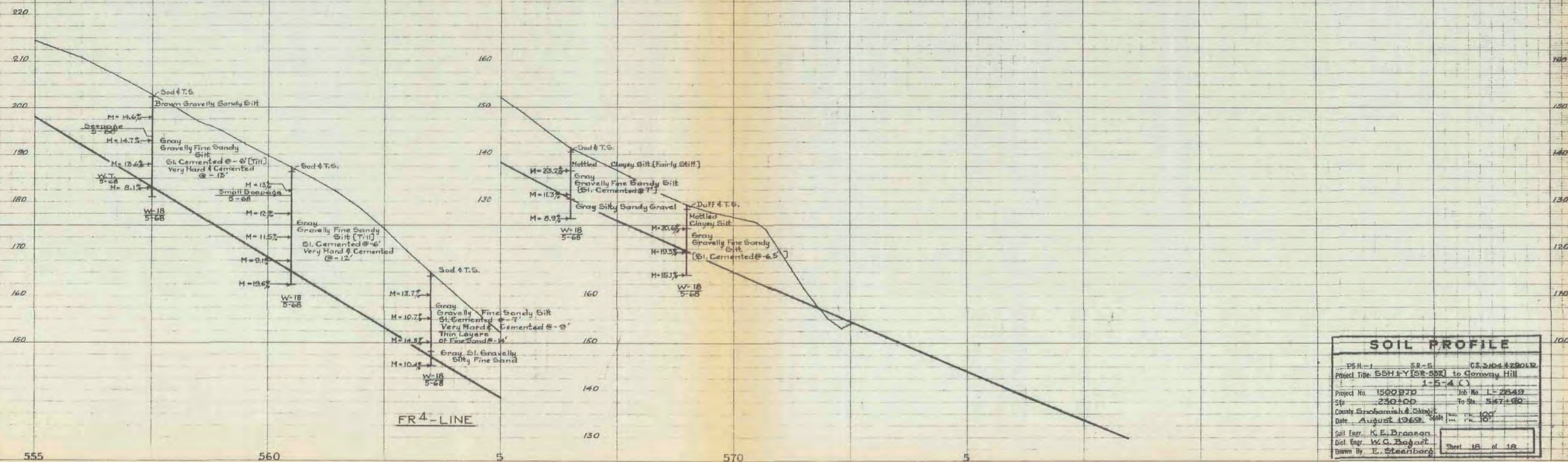
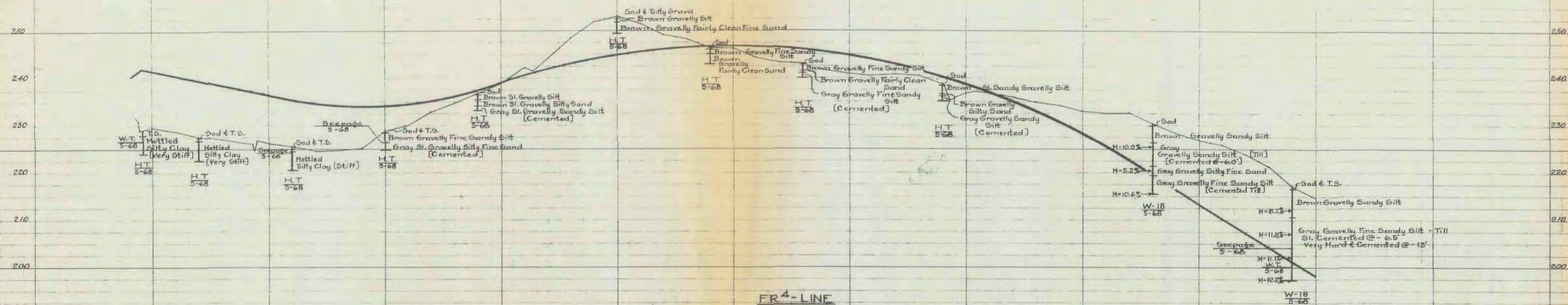
SOIL PROFILE		
P&H-1	SR-5	C.S. 510442001 R
Project Title: 554.1Y (SR-532) to Conway Hill		
1:5+41 (1)		
Project No. 15009 TO	Job No. L-2849	
Sta. 250+00	To Sta. 547+20	
County: Snohomish & Skagit		
Date: August 1969	Scale: 100'	
Soil Eng. K.E. Branson		
Dist. Engr. W.C. Bogart		
Drawn By: E. Steenborg	Sheet 6 of 18	



~~AL - 37+99.36 -
A - 24+54.54 off 5 Rt.~~

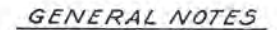
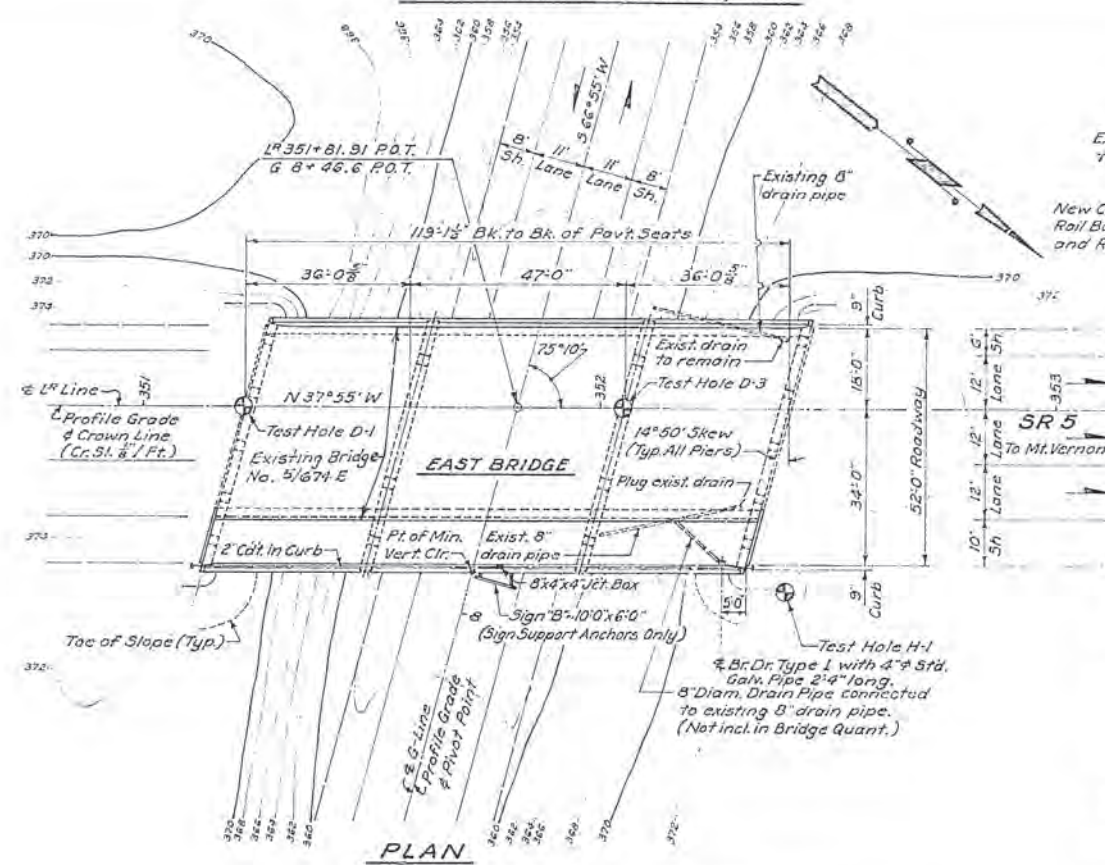




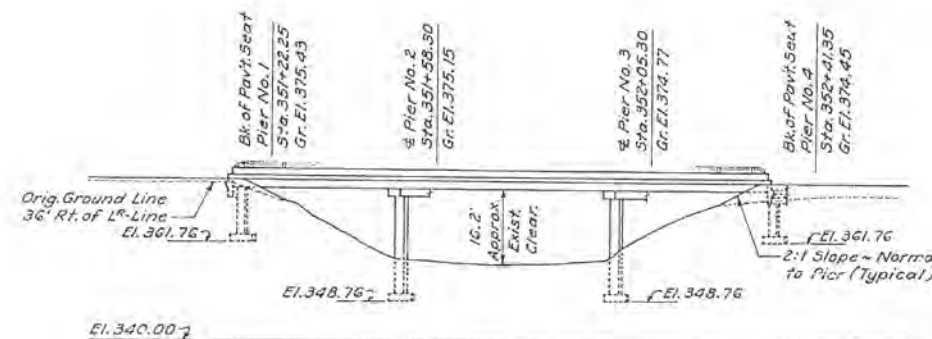
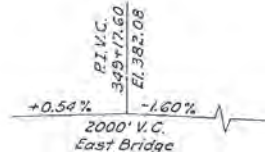
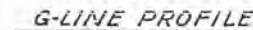


SOIL PROFILE		
PSH-1	SR-5	C.S. 1045+220 to 1045+220.5
Project Title: SSHY (SR-582) to Conway Hill		
1-5-4 (C)		
Project No. 1500879	Job No. 1-2342	
Sta. 230+00	To Sta. 547+00	
County Spartanburg & Saluda		
Date August 1969	Scale 1 in. = 100'	100'
Soil Eng. K. E. Branson		
Dist. Engr. W. G. Baggett		
Drawn By E. Steenborg		
Sheet 16		of 18

**I-5/ Freeborn Road Bridge Plan and Details
SR 532 to Conway Junction
Freeborn Road Overcrossing
Contract Number 8874
WSDOT (1970)**



Unless otherwise shown on the plans, concrete cover measured from the face of the concrete to the face of any reinforcement bar shall be 1" at the bottom of Rdwy. slabs and at the top of curbs, $2\frac{1}{2}$ " at the bottom of footings and $1\frac{1}{2}$ " at all other locations including stirrups and ties.

ELEVATION

Grade elevations shown are finish grades on L^R-Line and are equal to Profile Grade.

12-2-70	Added Sign Support Anchorages & Conduits in Curb	Y.F.C.	work
3-15-70	Round to Square Col3 on West Bridge	R.L.S.	for
DATE	REVISION	BY	APP

WEST BR.	EAST BR.	
100	80	Cu. Yds.
1	—	Only
350	—	Lin. Ft.
14	—	Only
29,000	3,500	Lbs.
45	6	Cu. Yds.
75	10	Cu. Yds.
L.S.	—	Lump Sum
—	L.S.	Lump Sum
325	150	Dollars
—	L.S.	Lump Sum

SNOHOMISH COUNTY

FREEBORN ROAD OVERCROSSING

LAYOUT

WASHINGTON STATE HIGHWAY COMMISSION



U.S. GOVERNMENT PRINTING OFFICE: 1964

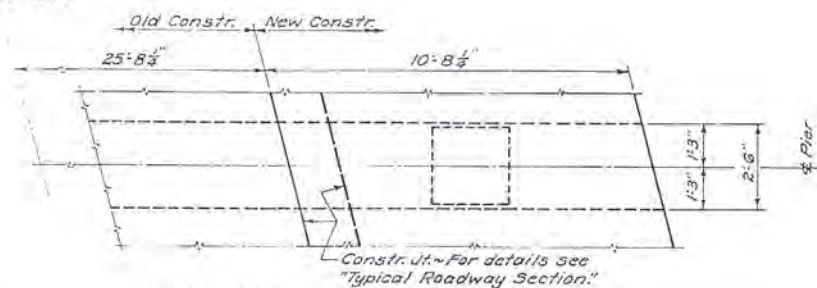
BRIDGE INSURANCE
CONTRACT NUMBER 8871

APPROVED July 2, 1970
PAGE 13 -- 37

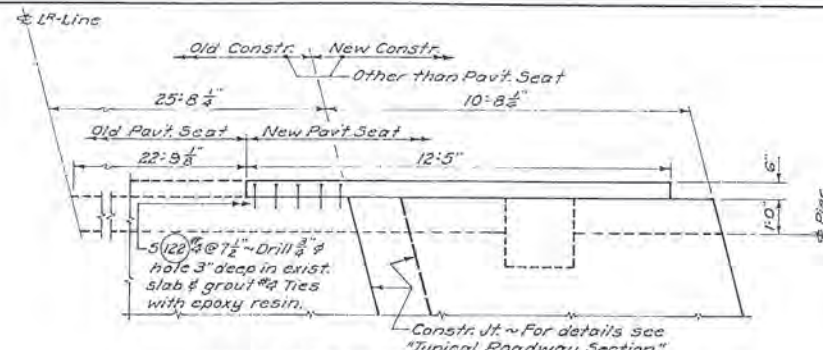
SR-5
2093

SHEET 13 OF 27 SHEETS

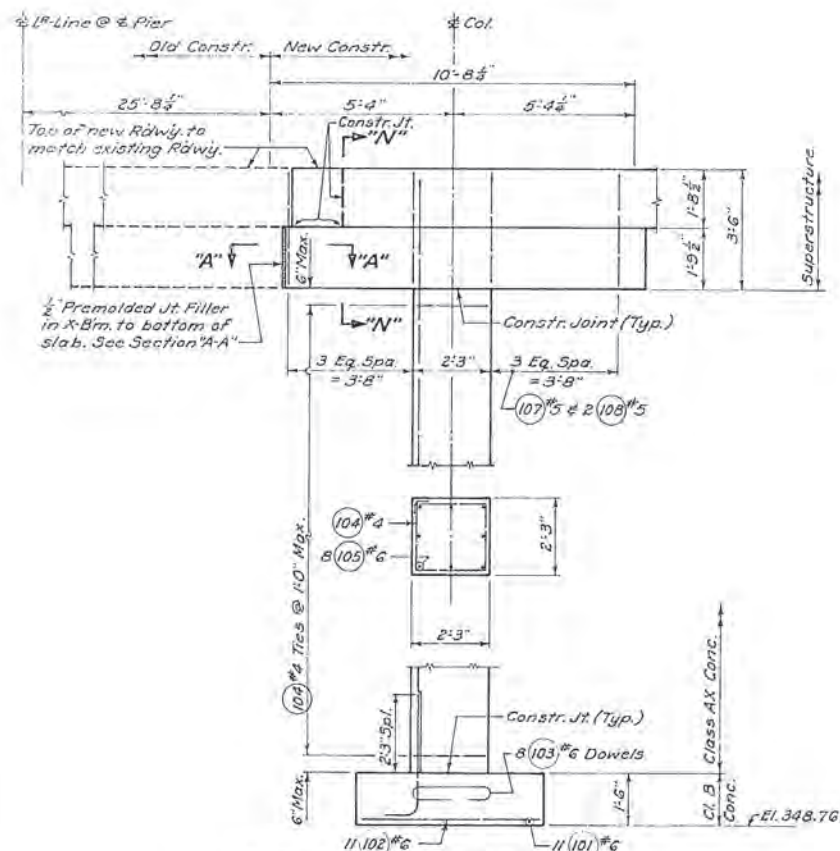
SR 5-1503-G
H.S.D. July 1968
G.A.R.



CROSSBEAM PLAN ~ PIERS NO. 2 & 3

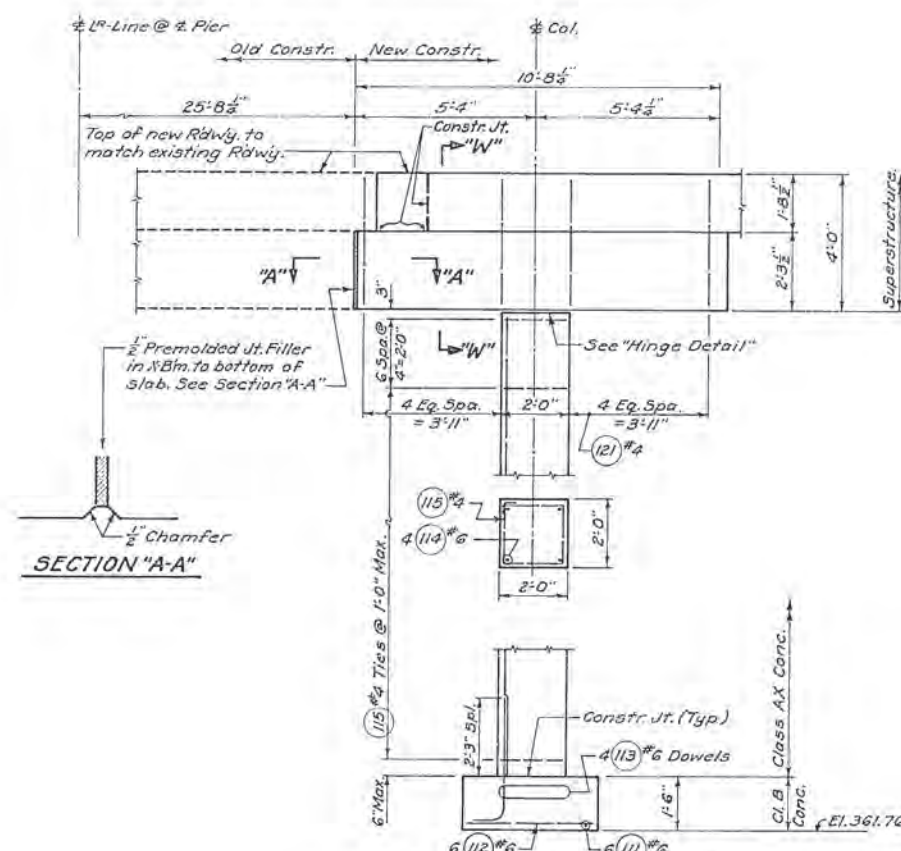


CROSSBEAM PLAN ~ PIERS NO. 1 & 4



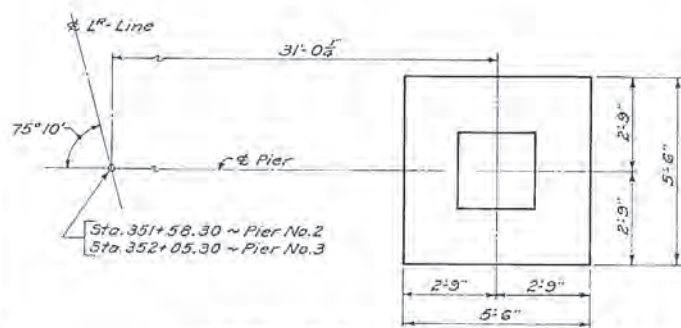
ELEVATION ~ PIERS NO. 2 & 3

Looking ahead on Stationing ~ Normal to skew.
Curb & Rail Base not shown.
Transverse dimensions are along & Pier.

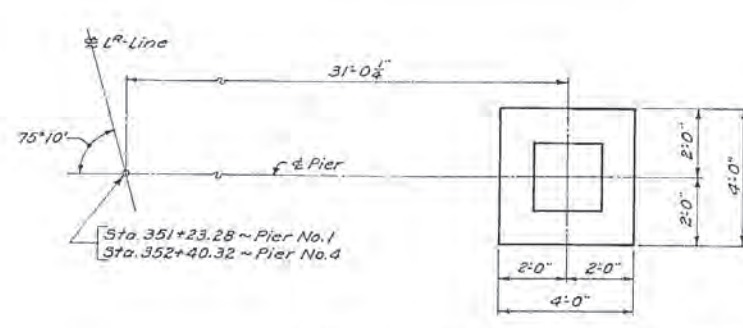


ELEVATION ~ PIERS NO. 1 & 4

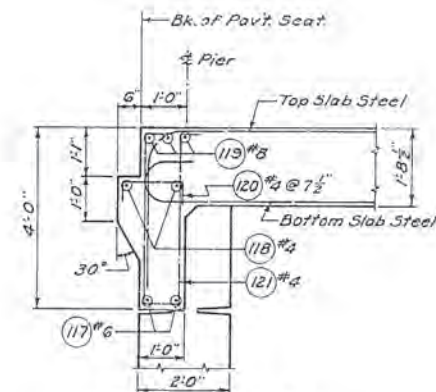
Looking ahead on Stationing ~ Normal to skew.
Shown for Pier No. 4 ~ Pier No. 1 similar.
Curb & Rail Base not shown.
Transverse dimensions are along & Pier.



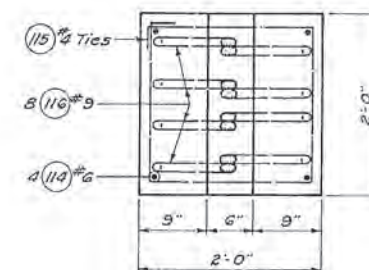
FOOTING PLAN ~ PIERS NO. 2 & 3



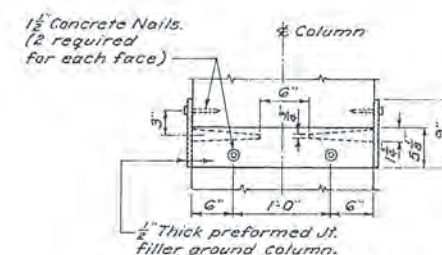
FOOTING PLAN ~ PIERS NO. 1 & 4



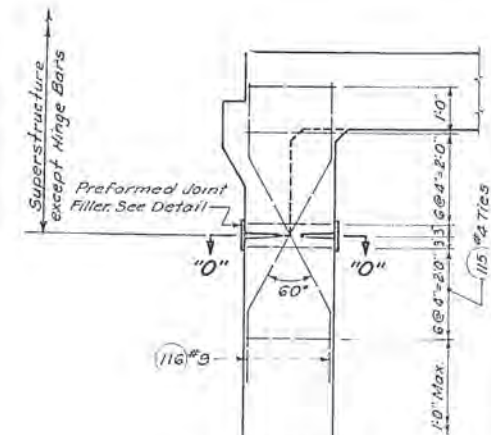
SECTION "W-W"



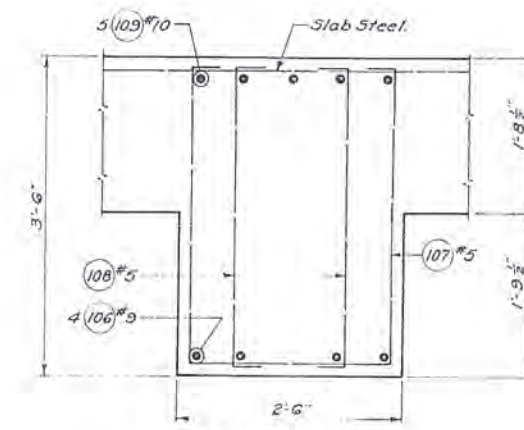
SECTION "O-O"



HINGE COVER DETAIL



HINGE DETAIL



SECTION "N-N"

SR 5 MP 212.63 TO MP 216.77
SR 532 INTERCH. TO CONWAY HILL O'XINGS
SNOHOMISH COUNTY
FREEBORN ROAD OVERCROSSING

EAST BRIDGE ~ PIERS

WASHINGTON STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS
OLYMPIA, WASHINGTON

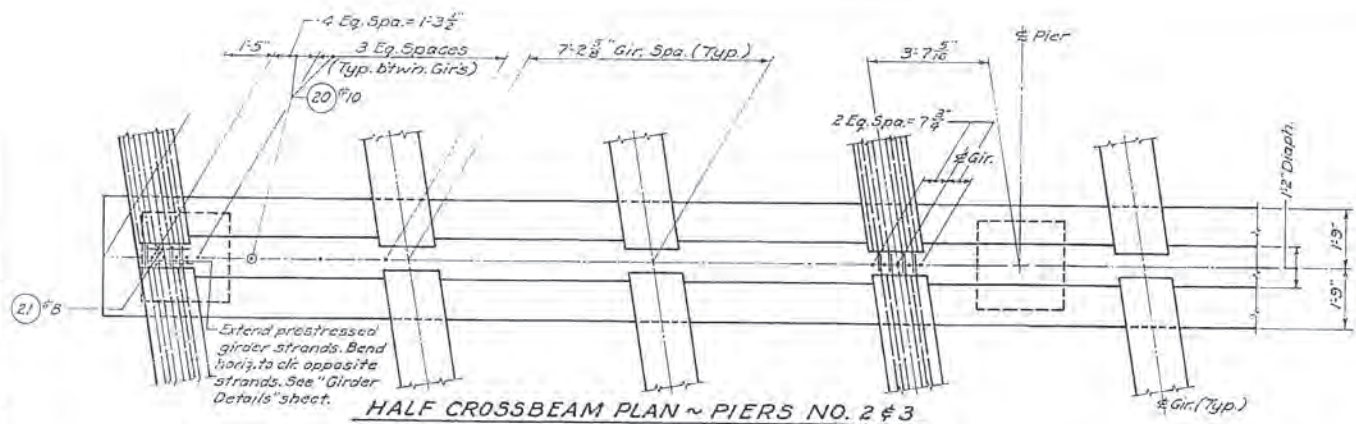


Signature
PROJECT NUMBER 8874

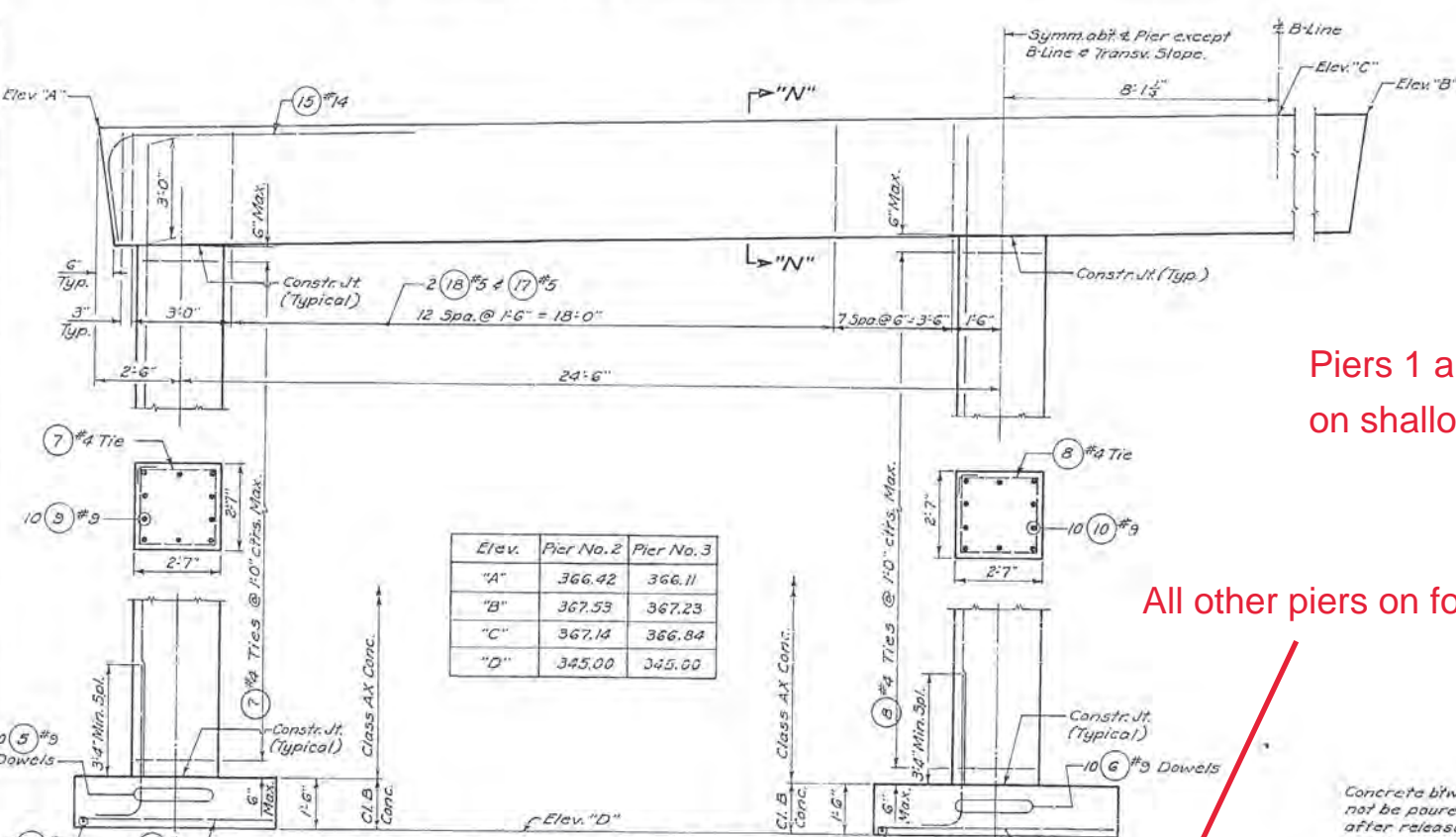
APPROVED July 2, 1970
SHEET 18 OF 27 SHEETS

54' 3" 2343 7077

G.A.R.



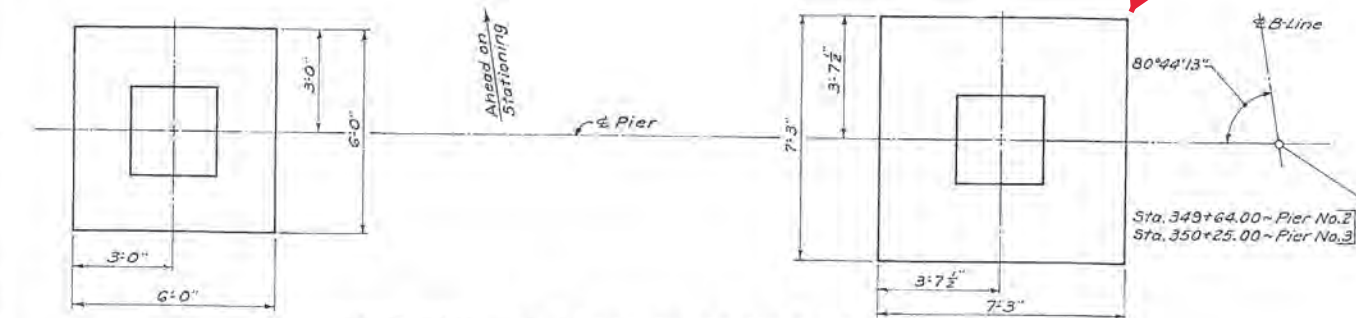
HALF CROSSBEAM PLAN ~ PIERS NO. 2 & 3



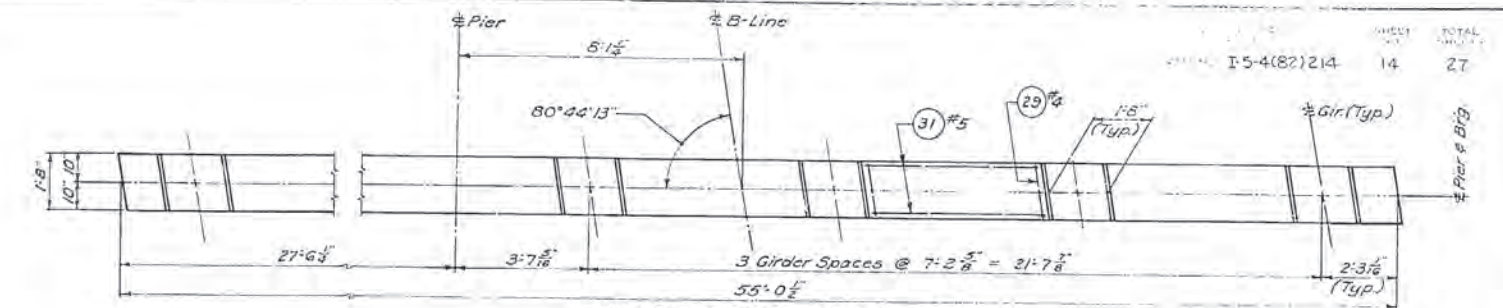
Elev.	Pier No.2	Pier No.3
"A"	366.42	366.11
"B"	367.53	367.23
"C"	367.14	366.84
"D"	345.00	345.00

HALF ELEVATION ~ PIERS NO. 2 & 3
Looking ahead on Stationing

Looking ahead on Stationing.
Shown for Pier No. 2 ~ Normal to Skew.
Elevations & Transv. dimensions are along \perp Pier.

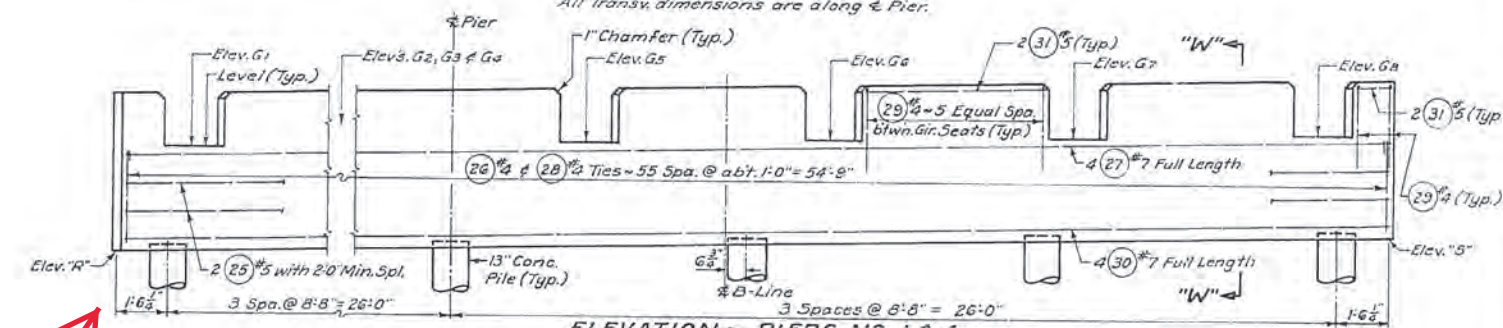


HALF FOOTING PLAN~PIERS NO. 2 & 3



PLAN ~ PIERS NO. 1 & 4

All Transv. dimensions are along & Pier.



ELEVATION ~ PIERS NO. 1 & 4

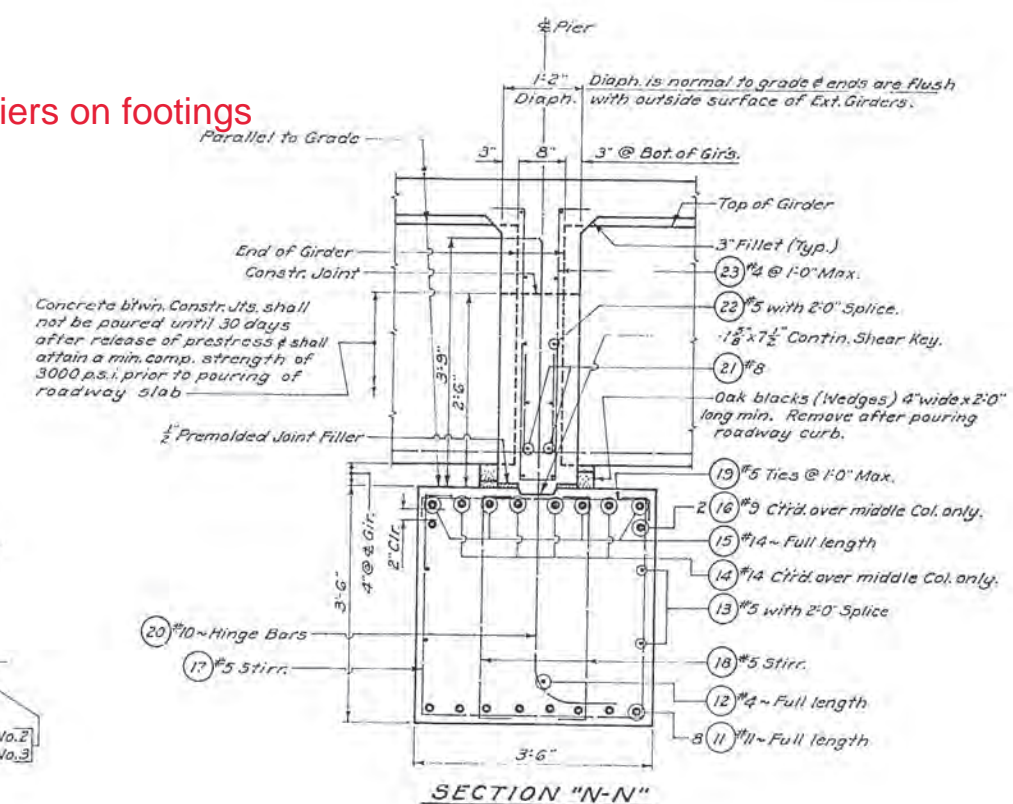
Looking ahead on Stationing.
Shower, normal to slow

Shown normal to skew.
All transv. dimensions are along \pm Pier.

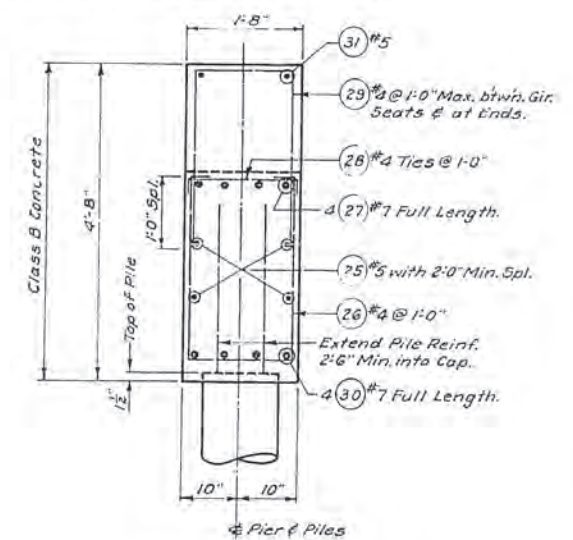
Elevation	G ₁	G ₂	G ₃	G ₄	G ₅	G ₆	G ₇	G ₈	"R"	"S"
Pier No. 1	366.91	367.04	367.19	367.36	367.50	367.63	367.77	367.92	363.78	364.91
Pier No. 4	366.19	366.33	366.46	366.61	366.76	366.91	367.06	367.21	363.05	364.18

Piers 1 and 4 of West Bridge
on shallow concrete-filled steel piles driven to refusal

All other piers on footings



SECTION "N-N"



SECTION "W-W"

SR 5 MP 212.63 TO MP 216.77
SR 532 INTERCH. TO CONWAY HILL O'XINGS
SNOHOMISH COUNTY
FREEBORN ROAD OVERCROSSING

WEST BRIDGE ~ PIERS

WASHINGTON STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS
OLYMPIA WASHINGTON



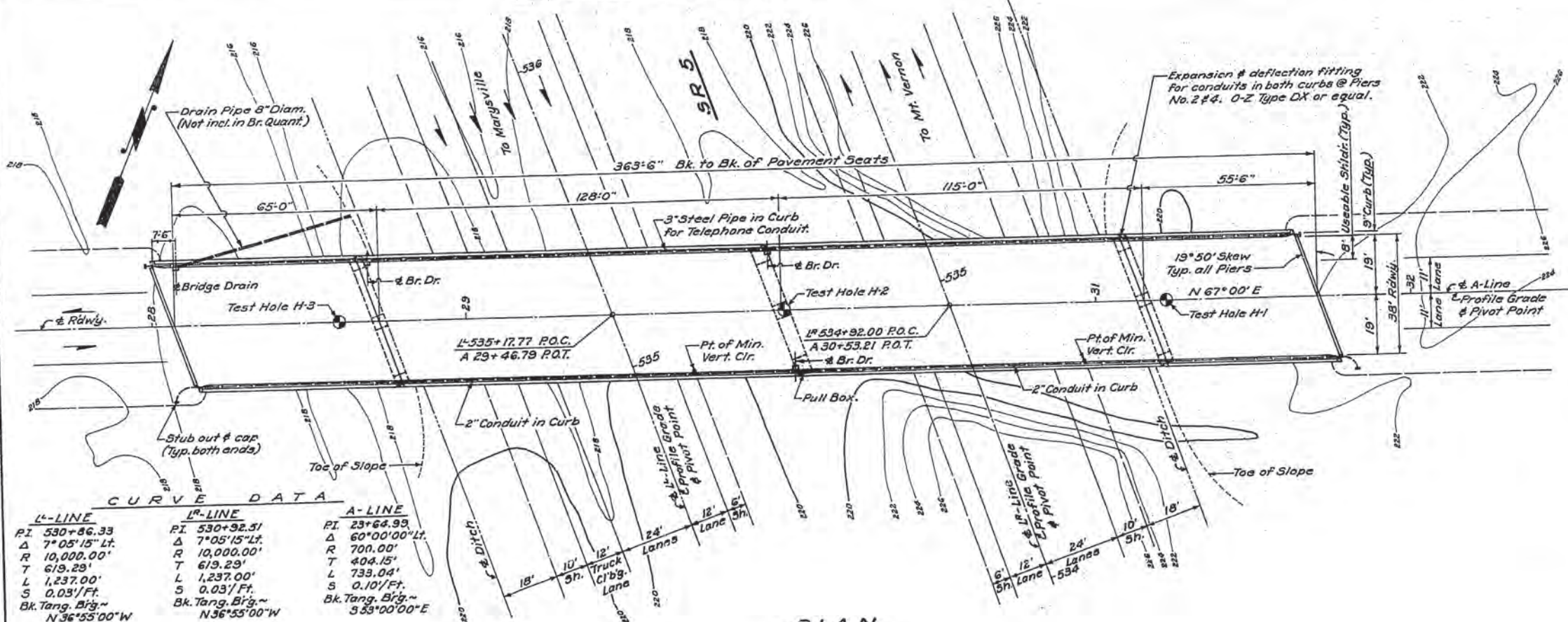
George A. Brown
 GEORGE A. BROWN

APPROVED July 2, 1970
SHEET 14 OF 27 SHEETS

9-15-70	Round to Square Col. @ Piers No. 263	R.L.S.	<i>[Signature]</i>
DATE	REVISION	BY	APP'D.

I-5/ Bonnieview Interchange Bridge Plan and Details
Contract Number 9260
WSDOT (1971)

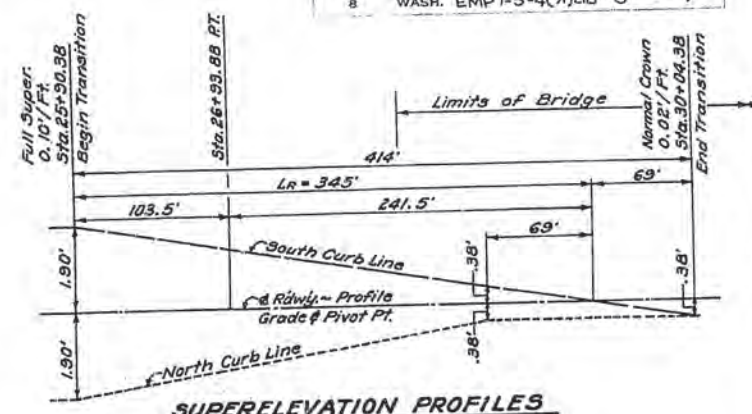
SEC. 32, T.33 N., R.4 E., W.M.



CURVE DATA

L ¹ -LINE	L ² -LINE	A-LINE
PI 530+86.33	PI 530+92.31	PI 23+64.99
Δ 7°05'15" Lt.	Δ 7°05'15" Lt.	Δ 60°00'00" Lt.
R 10,000.00'	R 10,000.00'	R 700.00'
T 619.29'	T 619.29'	T 404.15'
L 1,237.00'	L 1,237.00'	L 733.04'
S 0.03'/Ft.	S 0.03'/Ft.	S 0.10'/Ft.
Bk. Tang. Brg.~ N 36°55'00"W	Bk. Tang. Brg.~ N 36°55'00"W	Bk. Tang. Brg.~ S 53°00'00"E

PLAN



SUPERELEVATION PROFILES

GENERAL NOTES

All material and work shall be in accordance with the requirements of the State of Washington, Department of Highways, Standard Specifications for Road and Bridge Construction, dated 1963.

Footings elevations are subject to change depending upon foundation material encountered. Reinforcing steel for the footings, columns and walls shall not be cut until final footing elevations have been determined in the field.

The concrete in the footings of all piers and the walls of Piers No. 1 & 5 shall be Class B mix. All other cast in place concrete shall be Class AX mix.

The Roadway Slab between Piers No. 2 & 4 shall be placed in one continuous pour after the falsework for Piers No. 2, 3 & 4 has been removed. Falsework shall be carefully released to prevent impact or undue stresses in the structure.

Each pile shall be driven to a depth sufficient to develop a minimum load bearing capacity of fifty five (55) tons.

Unless otherwise shown on the plans, concrete cover measured from the face of the concrete to the face of any reinforcement bar shall be 1" at the bottom of slabs and at the top of curbs and 1 1/2" at all other locations including stirrups and ties.

APPROXIMATE QUANTITIES

Structure Excavation	670 Cu.Yds.
Furnishing and Driving Concrete Test Piles-55 Ton	3 Only
Furnishing Concrete Piling-55 Ton	1300 Lin. Ft.
Driving Concrete Piles-55 Ton	66 Only
Furnishing and Driving Steel Test Piles	2 Only
Furnishing Steel Piling	850 Lin. Ft.
Driving Steel Piles	18 Only
Steel Reinforcing Bars	57,800 Lbs.
Concrete Class B	195 Cu.Yds.
Concrete Class AX	165 Cu.Yds.
Superstructure - A-Line Undercrossing	Lump Sum
Water Reducing Additive	Est. 600 Dollars
Downspouts	97 Lin. Ft.

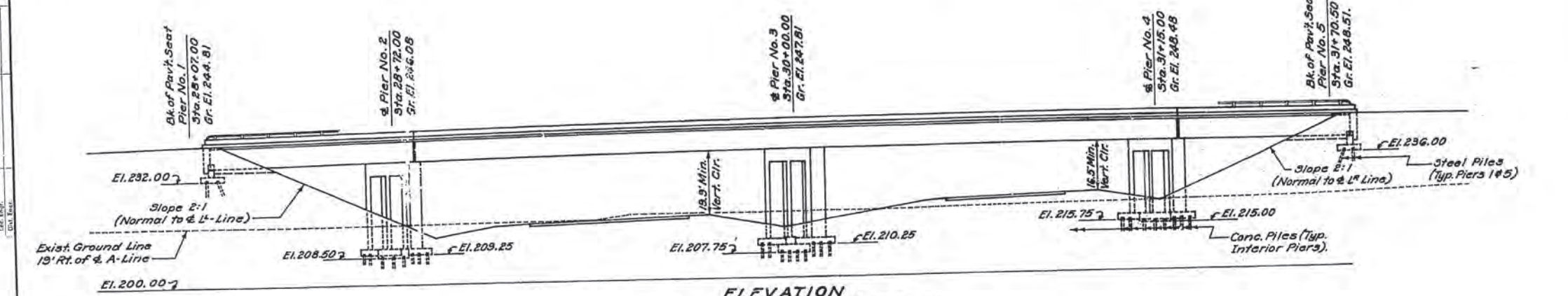
LOADING: H5-20 OR TWO 24" AXLES @ 4' CTRS.

SR 5 MP 218.54
BONNIEVIEW INTERCHANGE UNDERCROSSING
 SKAGIT COUNTY
A - LINE UNDERCROSSING

LAYOUT

WASHINGTON STATE HIGHWAY COMMISSION
 DEPARTMENT OF HIGHWAYS
 OLYMPIA, WASHINGTON

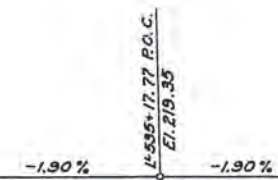
APPROVED November 26, 1971
 SHEET 3 OF 9 SHEETS



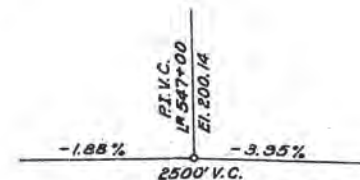
ELEVATION

Grade elevations shown are finish grades on A-Line and are equal to profile grade.

DATUM
 U.S.C. & G.S.



L1 LINE PROFILE

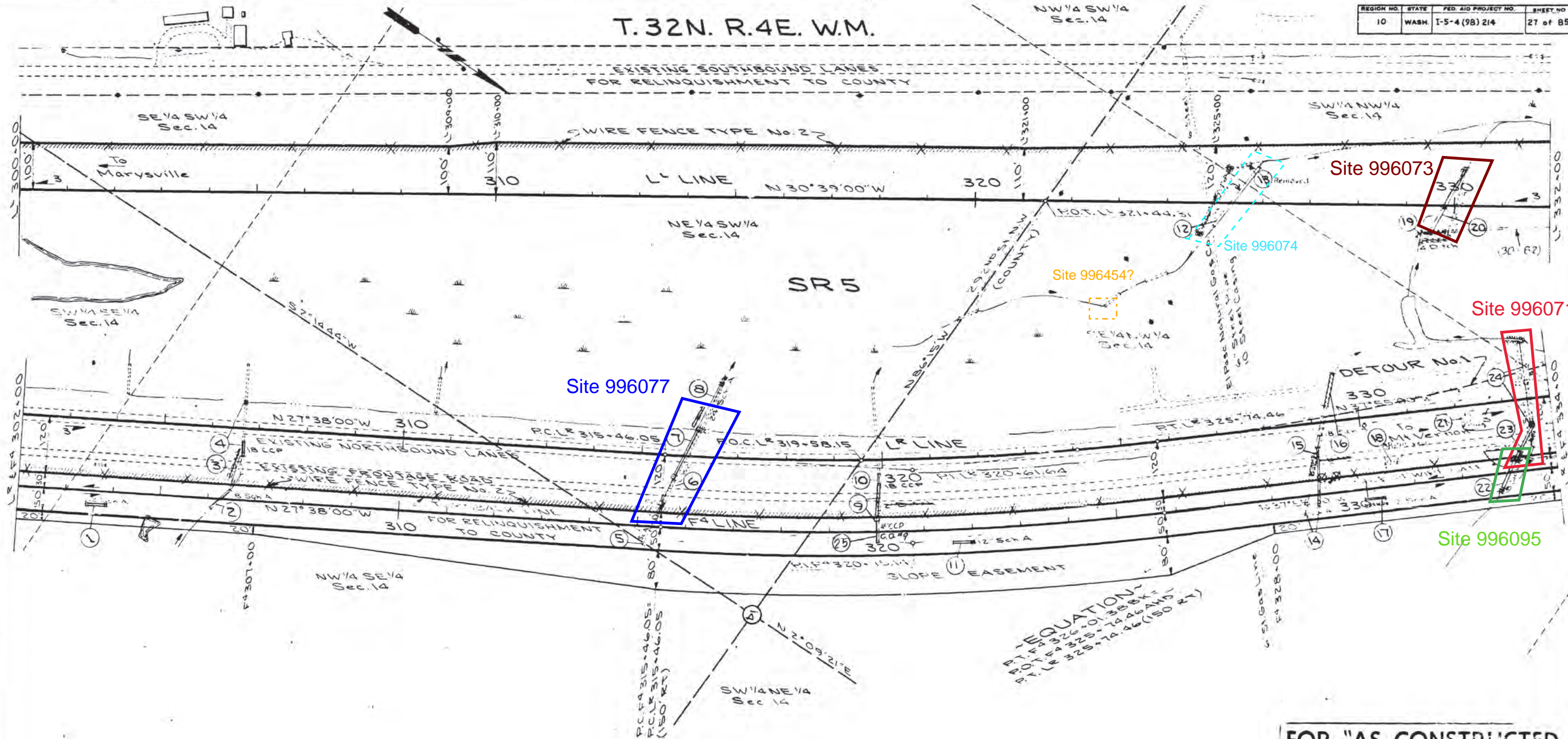


L2 LINE PROFILE

**SR 5 / 284th St NW to Conway Hill
Contract No. 9403
WSDOT (1972)**

T.32N. R.4E. W.M.

REGION NO.	STATE	FED. AID PROJECT NO.	SHEET NO.
10	WASH.	I-5-4 (98) 214	27 of 85



Site 996077

Site 996073

Site 996074

Site 996454?

Site 996071

Site 996095

EQUATION
PT. 4 320+01.388X
PT. 1 325+74.46
PT. 1 325+74.46 (150 RT)

FOR "AS CONSTRUCTED PLANS" ONLY

SR 5 MP 213.51 TO MP 218.82
284TH STREET N.W. TO CONWAY HILL
SNOHOMISH & SKAGIT COUNTIES

DRAINAGE PLAN

WASHINGTON STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS
OLYMPIA WASHINGTON



DATE: 3/24/72
BY: J. E. PARRISH

March 24, 1972
SHEET 28 of 87 SHEETS

7493

SEE CHANNELIZATION DETAIL
FOR ALIGNMENT DATA FOR
DETOUR No. 1.

SCALE IN FEET
100' 0 100' 200'

CURVE DATA

PI STATION	Δ	R	T	L	S
320+61.64	10°17'17"	5,730'	515.59'	1,028.41'	005/11'
320+75.14	10°17'17"	5,880'	529.09'	1,055.33'	NONE

DATE	BY
3-10	W. HILLER
3-10	W. HILLER
3-10	W. HILLER

DATE	BY
3-10	W. HILLER
3-10	W. HILLER
3-10	W. HILLER

2349 1/2 SIDER & 2001R
1/2 SIDER & 2001R
1/2 SIDER & 2001R

SHEET 29 of 87 SHEETS

SR 5/2169



CURVE DATA				
P.I. STATION	Δ	R	T	S
LC 358+74.04	6°16' LT	35,000	19,596	3828.10 0.02/ST
LC 358+49.15	2°30' RT	16,000	349.12	698.13 0.02/ST
CB 2+54.6	24°22' LT	716.3	154.6	304.6 0.06/ST
FA 341+57.24	23°12' RT	1,000	205.27	404.72 0.06/ST
FS 349+27.91	46°36' LT	150	64.60	122.00 0.10/ST
FS 359+69.46	24°24' RT	1,000	216.71	425.86 0.06/ST
US 13+12.63	21°38' LT	1,000	191.06	377.57 0.04/ST
US 18+16.22	30°00' RT	600	160.77	314.16 0.05/ST
US 22+08.84	13°00' RT	600	78.99	151.08 0.05/ST
US 25+33.52	23°22' LT	1,000	206.19	407.85 0.04/ST
A 13+94.24	27°21' 20" LT	600	146.02	286.47 0.05/ST
A 17+69.86	62°33' RT	66	40.09	72.05 NONE
A-341+55.59	7°32' RT	3,000	197.51	394.44 0.04/ST
AL 347+88.59	1°15' RT	10,000	109.09	218.17 NONE
AR 346+83.57	11°00' RT	1,400	135.01	269.19 0.06/ST
BL 354+90.21	7°05' 34" LT	4,000	247.90	495.47 0.03/ST
BR 352+10.89	12°55' LT	700	79.24	157.81 0.05/ST
DR 353+22.30	14°26' RT	2,000	274.87	755.73 0.04/ST

**FOR "AS CONSTRUCTED
PLANS" ONLY**

SR 5 **MP 213.51 TO MP 218.82**
234TH STREET N.W. TO CONWAY HILL
 SNO WOMISH & SKAGHT COUNTIES

DRAINAGE PLAN

WASHINGTON STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS
OLYMPIA, WASHINGTON



ICONS: 114
A, B: 114

March 24, 1972

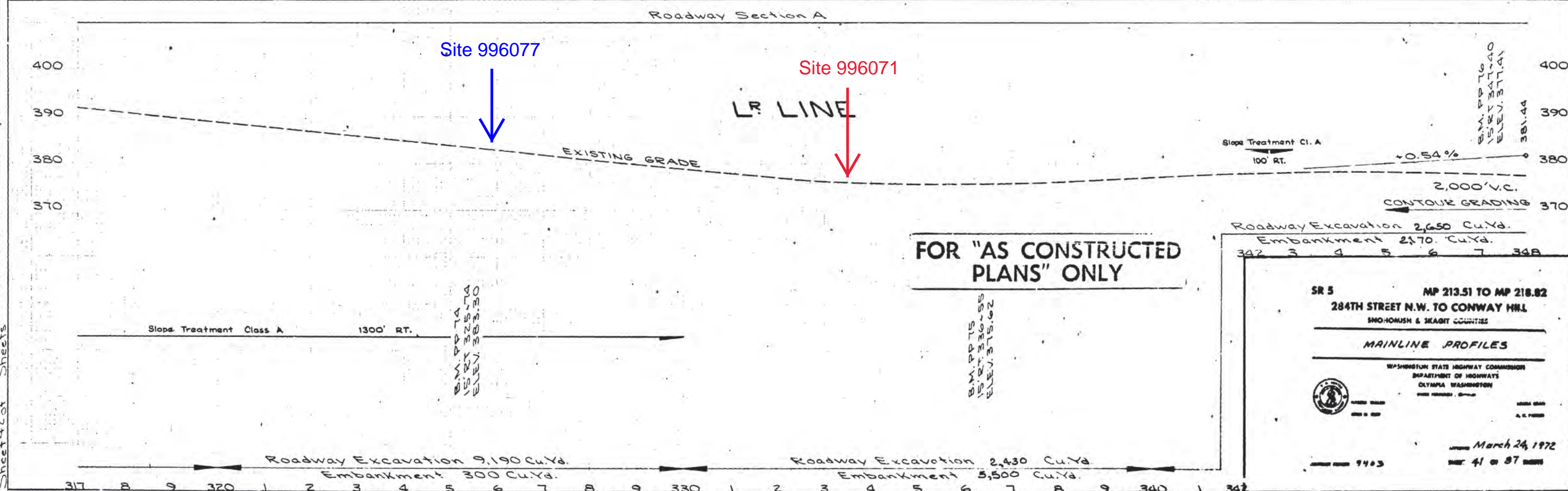
EXHIBIT 29 of 87 IMAGES

© 1995 Blackwell Science Ltd

SR 5 2169

	BY	DATE
GROUND LINE PLOTTED		
GROUND LINE CHECKED		
TEMPLATE PLOTTED		
TEMPLATE CHECKED		

PROGRAM	BY	DATE
TRACKED	N.E.	3-69
CHECKED		
PROVENGE	H.Y. HILLER	
PROVENGE	W. PROBERT	



**FOR "AS CONSTRUCTED
PLANS" ONLY**

SR 5 MP 213.51 TO MP 218.82
284TH STREET N.W. TO CONWAY HILL
SNO-HOMISH & SEAGIT CITIES

MAINLINE PROFILES



WASHINGTON STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS
OLYMPIA WASHINGTON

DATE: March 24, 1972
PAGE: 41 of 57 PAGES

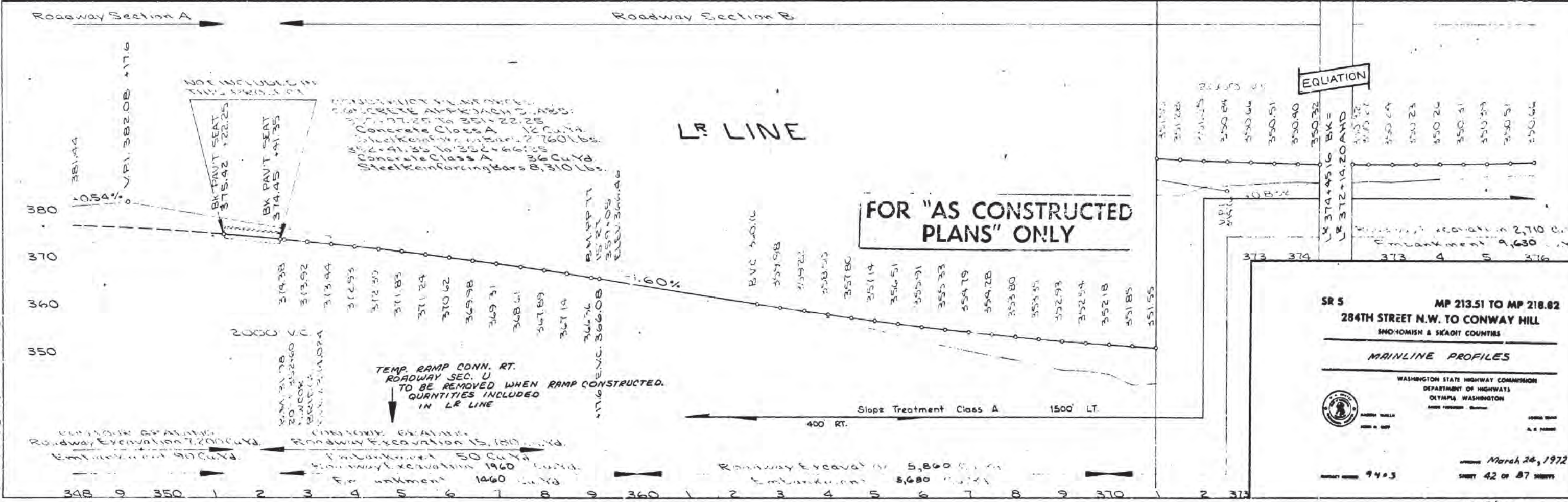
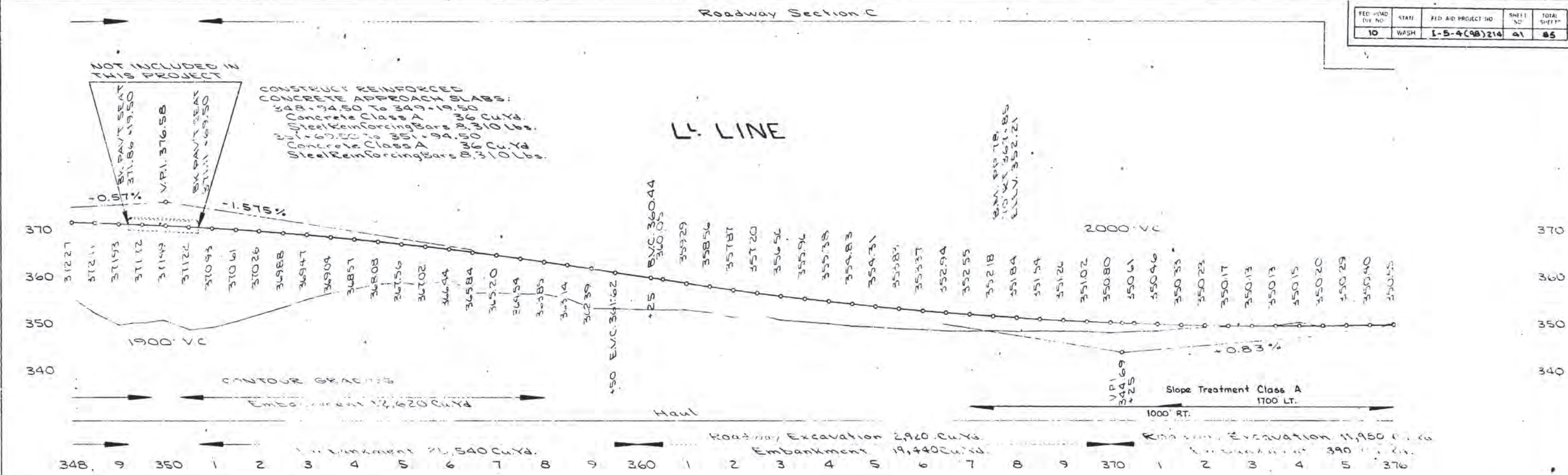
SR 5/2169

FED. ROAD DIST. NO.	STATE	FED. AID PROJECT NO.	SHEET NO.	TOTAL SHEETS
10	WASH.	1-5-4(98)214	41	85

DATE	BY	GROUND LINE	PROPOSED LINE	REVISION

DATE	BY	GROUND LINE	PROPOSED LINE	REVISION

DATE	BY	GROUND LINE	PROPOSED LINE	REVISION



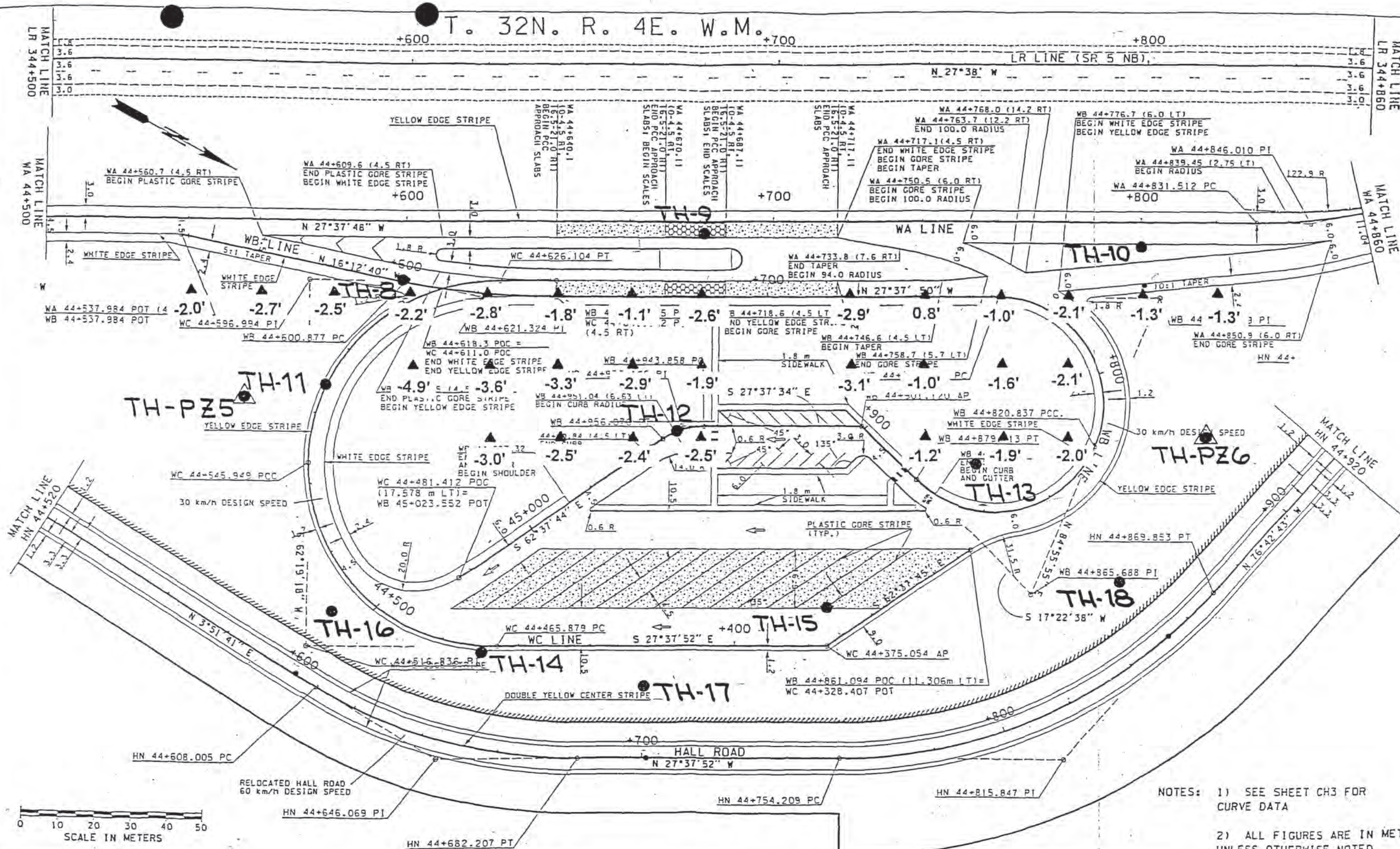
SR 5 **MP 213.51 TO MP 218.82**
284TH STREET N.W. TO CONWAY HILL
 SNOHOMISH & SKAGIT COUNTIES

MAINLINE PROFILES

WASHINGTON STATE HIGHWAY COMMISSION
 DEPARTMENT OF HIGHWAYS
 OLYMPIA, WASHINGTON

March 24, 1972
 SHEET 42 OF 87 SHEETS

**I-5 Stanwood/Bryant Vicinity
NB Weigh Station, MP 214
Job No. 0L-1602
WSDOT (1997)**



NOTES: 1) SEE SHEET CH3 FOR CURVE DATA

2) ALL FIGURES ARE IN METERS UNLESS OTHERWISE NOTED

DESIGNED BY	ENTERED BY	CHECKED BY	PROJ. ENGR.	REGIONAL ADM.	DATE	DATE	REVISION	BY
M. SINDEN	M. SINDEN	M. BRITTON	W. JAMES	J. OKAMOTO	27 JAN 97			
FED. AID PROJ. NO. 10 WASH								
JOB NUMBER OL-1602								
CONTRACT NO.								

ENVIRONMENTAL AND ENGINEERING
SERVICE CENTER



Washington State
Department of Transportation

SR 5
STANWOOD/BRYANT VICINITY
NORTHBOUND WEIGH STATION

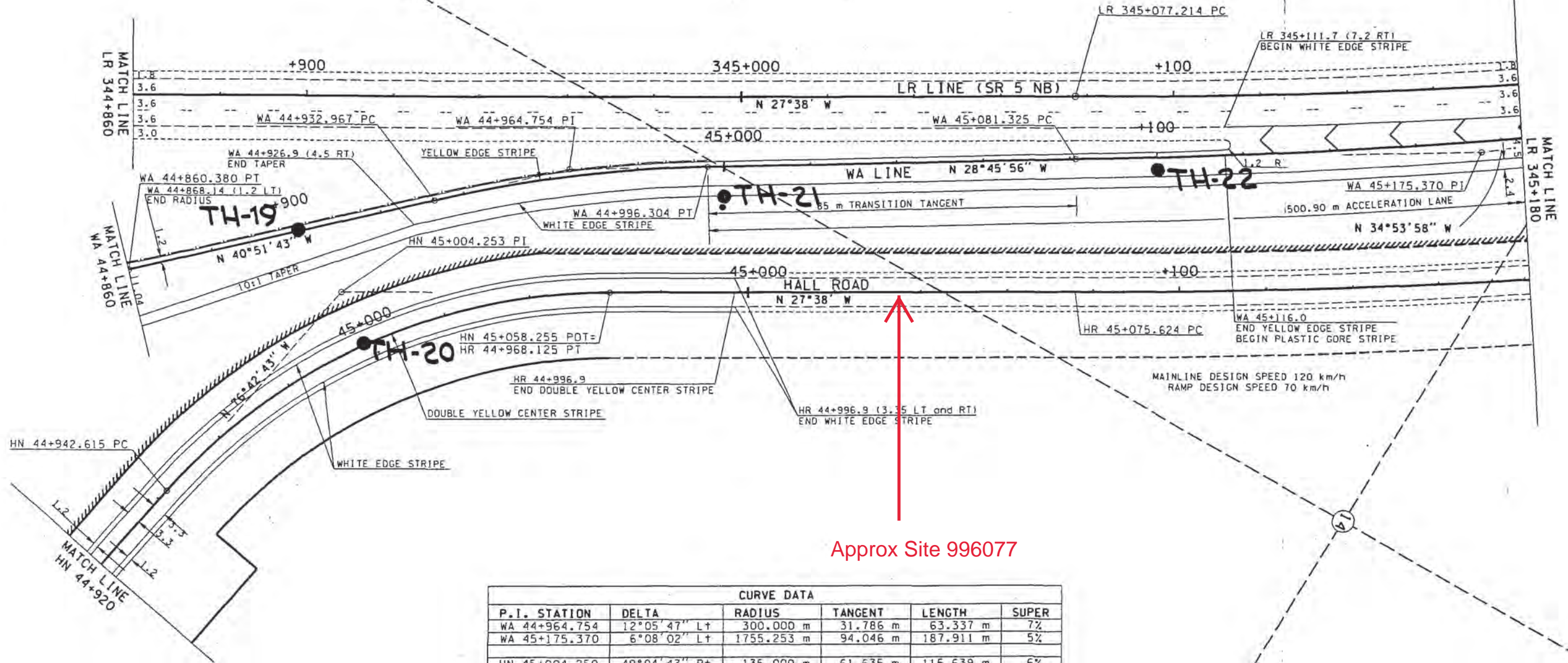
PROP. CHANNELIZATION/ALIGNMENT

CH3

SHEET
3
OF
7
SHEETS

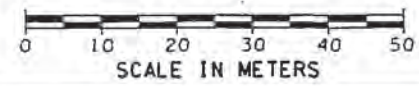
plans
c:\dgn\1602\moistudy.dgn
12 FEB 97
PLOT4

T. 32N. R. 4E. W.M.



CURVE DATA					
P.I. STATION	DELTA	RADIUS	TANGENT	LENGTH	SUPER
WA 44+964.754	12°05'47" Lt	300.000 m	31.786 m	63.337 m	7%
WA 45+175.370	6°08'02" Lt	1755.253 m	94.046 m	187.911 m	5%
HN 45+004.250	49°04'43" Rt	135.000 m	61.635 m	115.639 m	6%

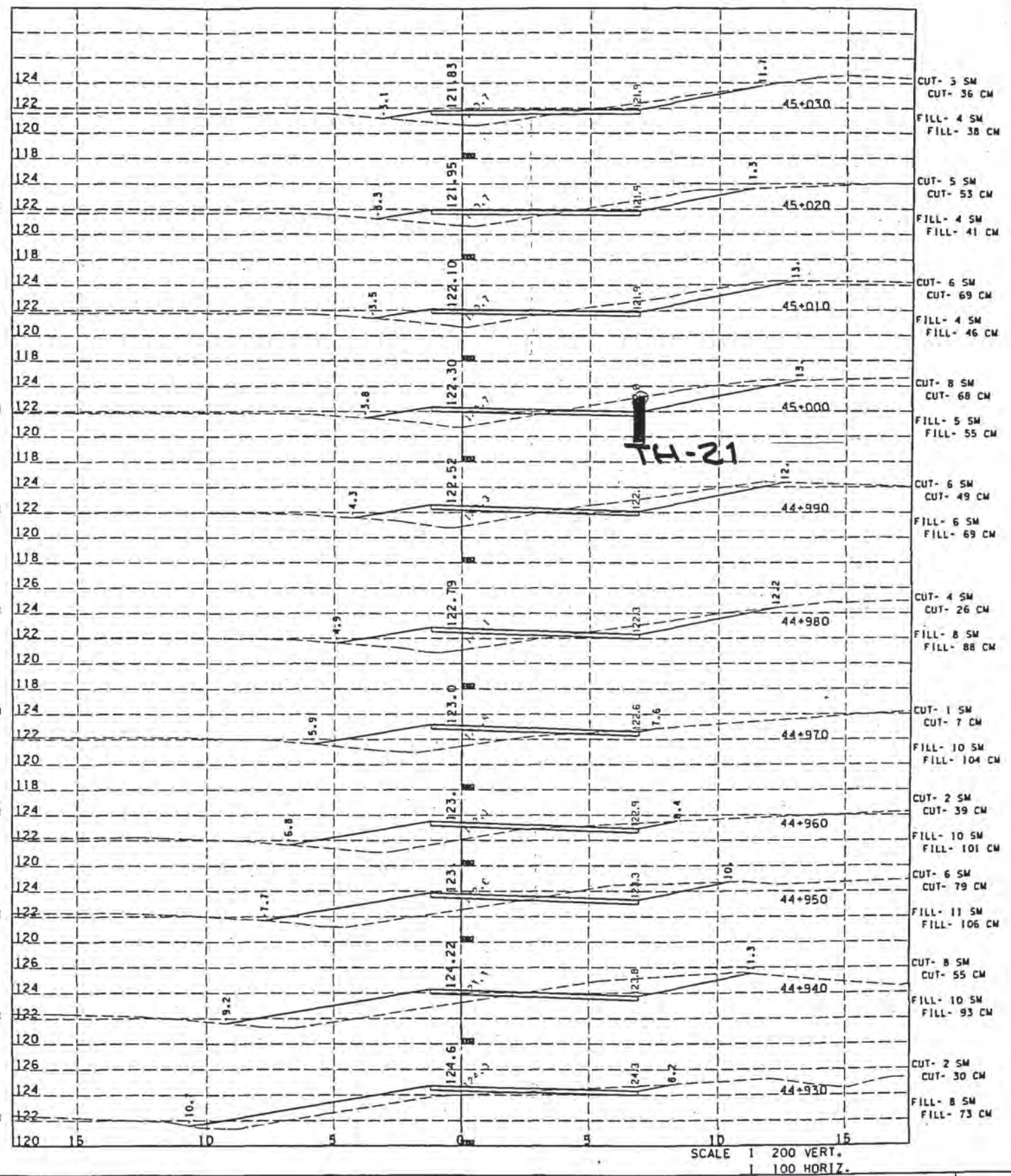
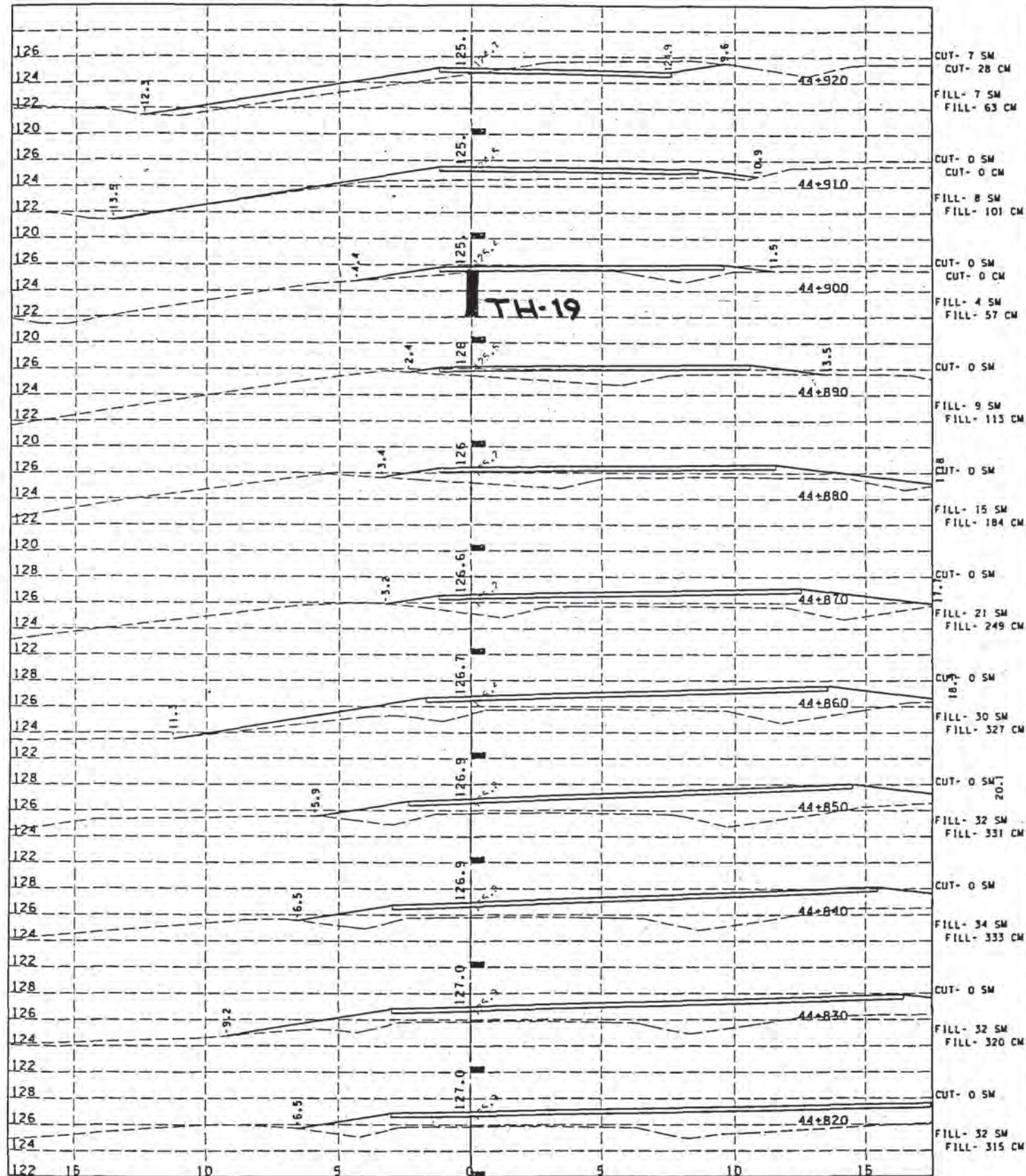
NOTE: ALL FIGURES ARE IN METERS UNLESS OTHERWISE NOTED



DESIGNED BY M. SINDEN	12 JAN 97	REGION NO. 2710	STATE WASH	FED. AID PROJ. NO.	ENVIRONMENTAL AND ENGINEERING SERVICE CENTER		SR 5 STANWOOD/BRYANT VICINITY NORTHBOUND WEIGH STATION	CH4
ENTERED BY M. SINDEN	12 JAN 97	JOB NUMBER	OL-1602					
CHECKED BY M. BRITTON		CONTRACT NO.						
PROJ. ENGR. W. JAMES								
REGIONAL ADM. J. OKAMOTO							PROP. CHANNELIZATION/ALIGNMENT	SHEET 4 OF 7 SHEETS

WA LINE STA 44+820 TO 45+030

13



DESIGNED BY	M. SINDEN	22 JAN 97	REGION NO.	10	STATE	WASH	FED.AID PROJ.NO.	
ENTERED BY	M. SINDEN	22 JAN 97	JOB NUMBER	OL-1602				
CHECKED BY	M. BRITTON		CONTRACT NO.					
PROJ. ENGR.	W. JAMES							
REGIONAL ADM.	J. OKAMOTO							
DATE	DATE	REVISION	BY					

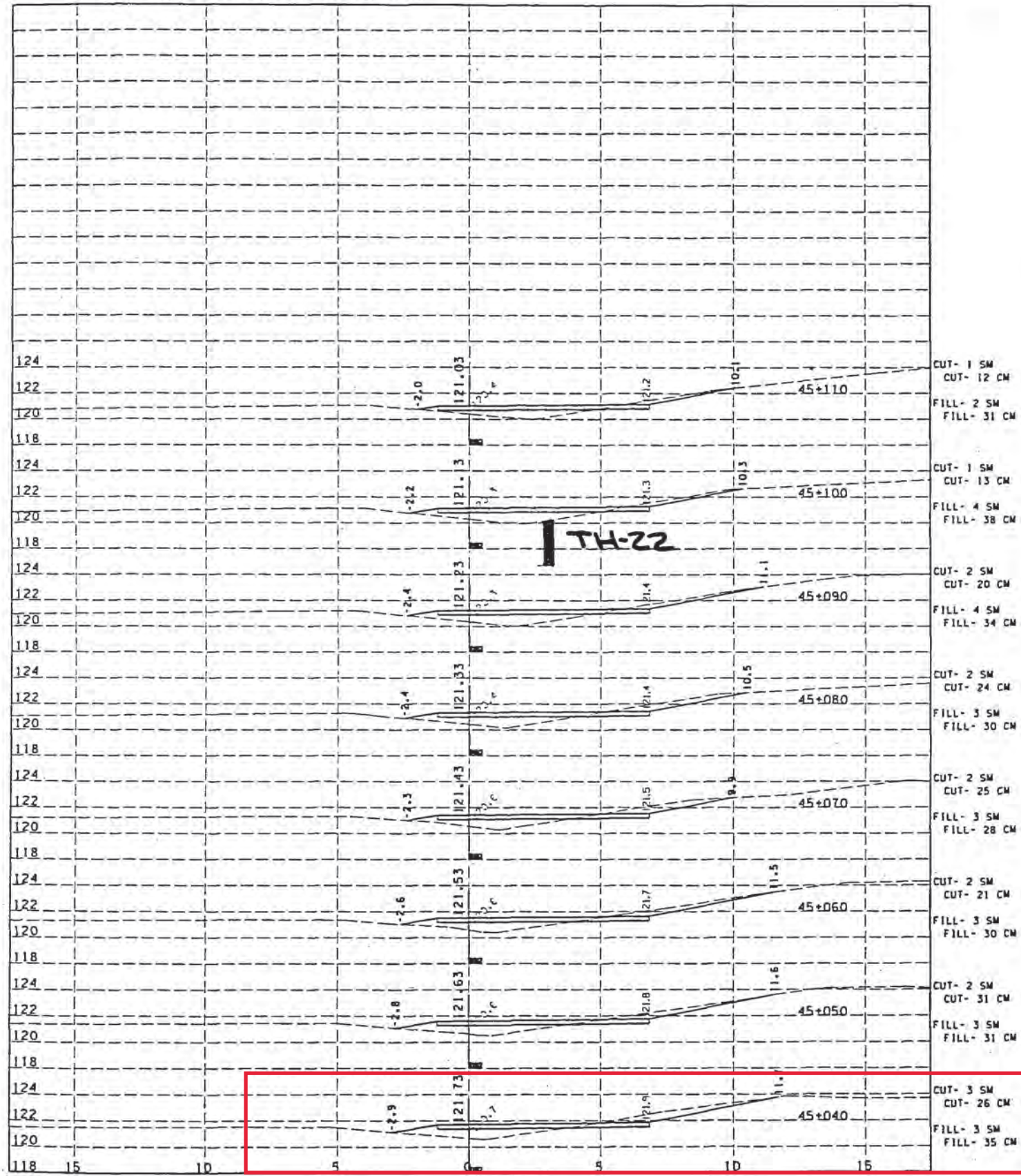
ENVIRONMENTAL AND ENGINEERING
SERVICE CENTERWashington State
Department of TransportationSR 5
STANWOOD/BRYANT VICINITY
NORTHBOUND WEIGH STATION

WA LINE CROSS-SECTIONS

SHEET
OF
SHEETS

WA LINE STA 45+040 TO 45+110

14



Approx Site 996077

SCALE 1 200 VERT.
1 100 HORIZ.

DESIGNED BY	M. SINDEN	22 JAN 97	REGION NO.	10	STATE	WASH	FED.AID PROJ.NO.	
ENTERED BY	M. SINDEN	22 JAN 97	JOB NUMBER	OL-1602				
CHECKED BY	M. BRITTON		CONTRACT NO.					
PROJ. ENGR.	W. JAMES							
REGIONAL ADM.	J. OKAMOTO							
DATE	DATE	REVISION	BY					

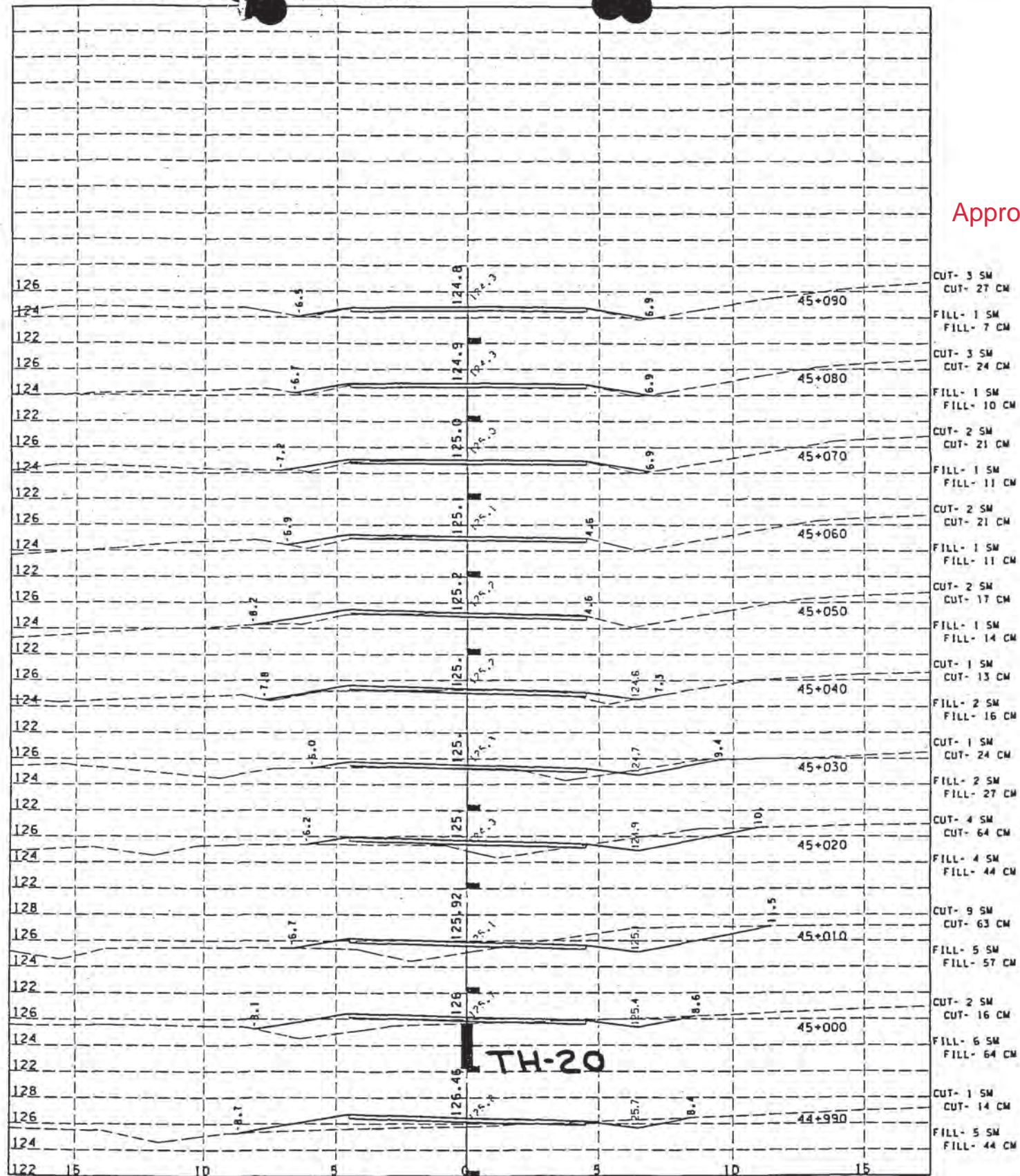
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SERVICE CENTERWashington State
Department of TransportationSR 5
STANWOOD/BRYANT VICINITY
NORTHBOUND WEIGH STATION

WA LINE CROSS-SECTIONS

SHEET
OF
SHEETS

HN LINE STA 44+990 TO 45+090

4

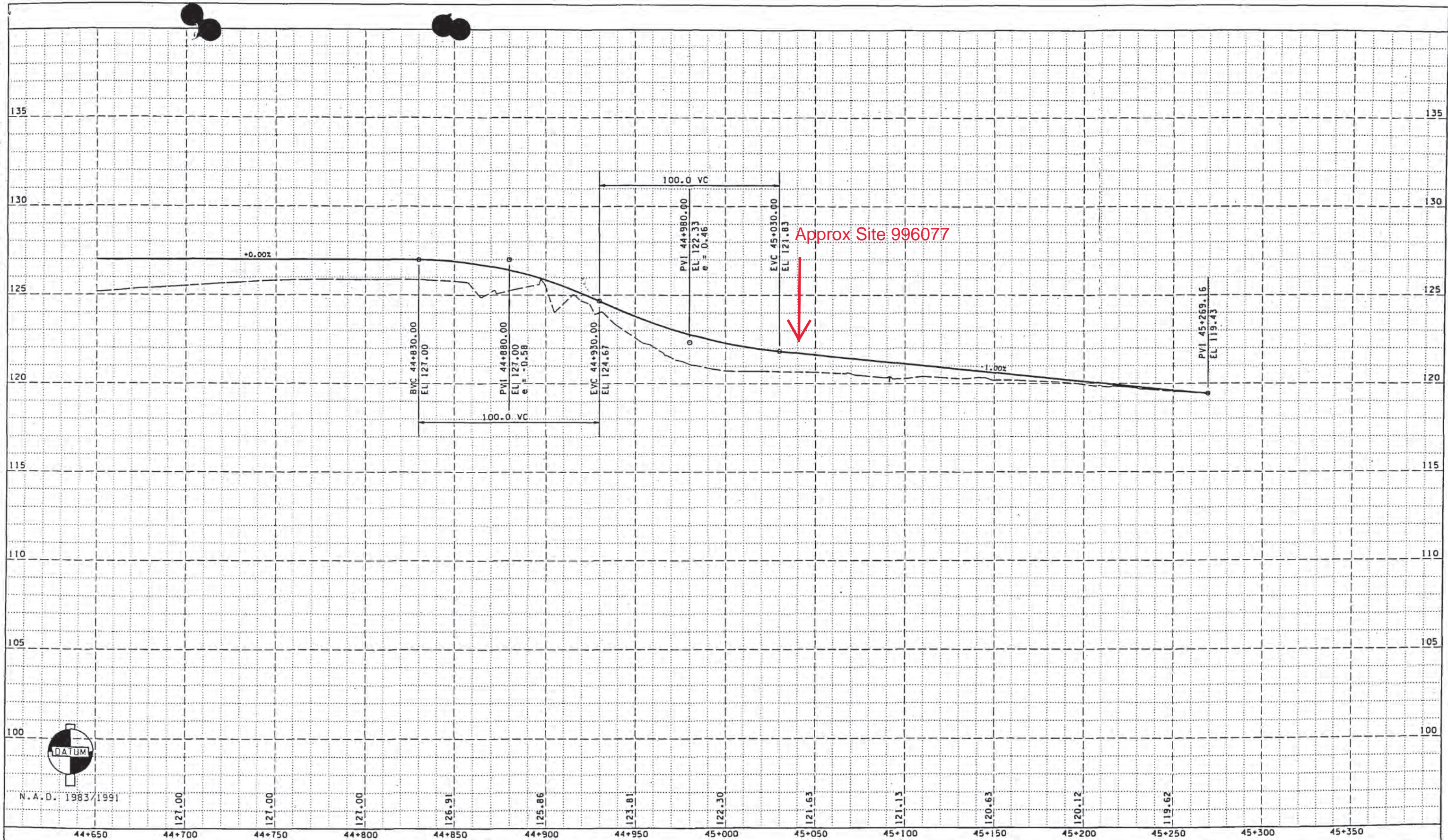
SCALE 1 200 VERT.
1 100 HORIZ.

DESIGNED BY	M. SINDEN	22 JAN 97	REGION NO.	10	STATE	WASH	FED.AID PROJ.NO.	
ENTERED BY	M. SINDEN	22 JAN 97	JOB NUMBER	OL-1602				
CHECKED BY	M. BIRTON		CONTRACT NO.					
PROJ. ENGR.	W. JAMES							
REGIONAL ADM.	J. OKAMOTO							
DATE	DATE	REVISION	BY					

ENVIRONMENTAL AND ENGINEERING
SERVICE CENTERWashington State
Department of TransportationSR 5
STANWOOD/BRYANT VICINITY
NORTHBOUND WEIGH STATION

HN LINE CROSS-SECTIONS

SHEET
OF
SHEETS



N.A.D. 1983/1991

DESIGNED BY	M. SINDEN	12 JAN 97
ENTERED BY	M. SINDEN	12 JAN 97
CHECKED BY	M. BRITTON	
PROJ. ENGR.	W. JAMES	
REGIONAL ADM.	J. OKAMOTO	

DATE	DATE	REVISION	BY
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REGION NO.	STATE	FED. AID PROJ. NO.
10	WASH	
JOB NUMBER		
OL-1602		
CONTRACT NO.		

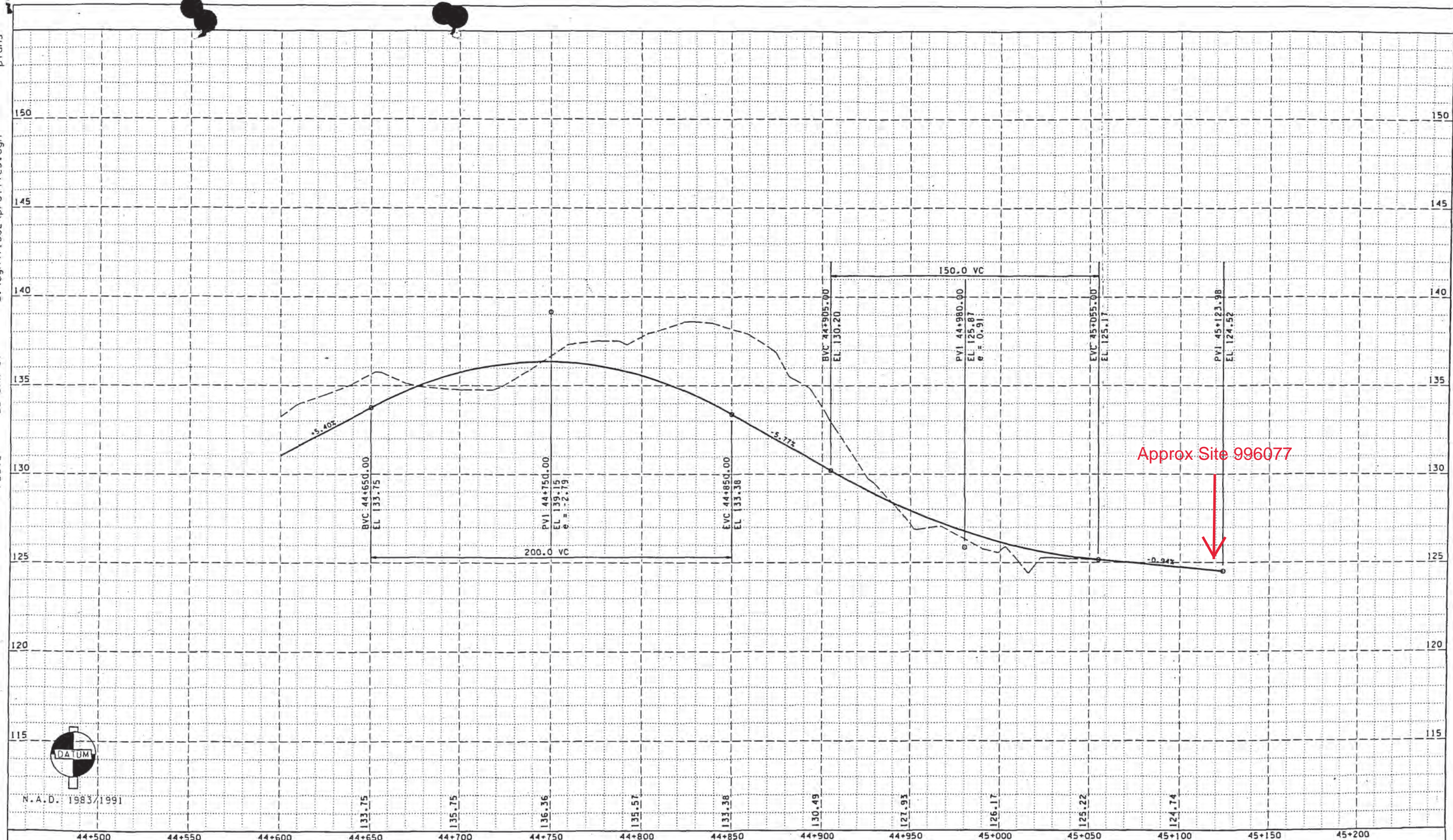
ENVIRONMENTAL AND ENGINEERING
SERVICE CENTERWashington State
Department of TransportationSR 5
STANWOOD/BRYANT VICINITY
NORTHBOUND WEIGH STATION


WA LINE PROFILES

PR2

SHEET
2
OF
6
SHEETS

plans
c:\dgn\11602\profiles.dgn
22 JAN 97
PLOT6



					REGION NO.	STATE	FED.AID PROJ.NO.	ENVIRONMENTAL AND ENGINEERING SERVICE CENTER	 Washington State Department of Transportation	SR 5 STANWOOD/BRYANT VICINITY NORTHBOUND WEIGH STATION		PR6
DESIGNED BY	M. SINDEN	12 JAN 97			10	WASH				HN LINE PROFILES		
ENTERED BY	M. SINDEN	12 JAN 97										
CHECKED BY	M. BRITTON				JOB NUMBER							
PROJ. ENGR.	W. JAMES				0L-1602							
REGIONAL ADM.	J. OKAMOTO				CONTRACT NO.							
		DATE	DATE	REVISION	BY							

HN LINE PROFILES

SHEET 6 OF 6 SHEETS

S.H. _____ S.R. i-5 SECTION STANWOOD/BRYANT Job No. OL-1602Hole No. TH#20 Sub Section WEIGH STATION Cont. Sec. _____Station HN45 + 000 Offset CENTER LINE Ground El. 125.7M

NO FREE

Type Of Boring CME-850 Casing AUGERS W.T. El. WATERInspector Vernon F. Williams Date 3/26/97 Sheet 1 Of 1

DEPTH	BLOWS / FT.	PROFILE	SAMPLE #s	DESCRIPTION OF MATERIAL
0				
5	D-1			
	89		12/39/50	very dense, reddish brow, moist, SP/SM, poorly graded, fine, SAND, WITH
				SILT, and some silt lenses, and oxidation, RECOVERY, 1.4'
10	D-2			
	50/2"		25/50/2"	very dense, grey, moist, SP/SM, poorly graded, fine, SAND, with
				silt, RECOVERY, 8"
				END OF BORING AT MINUS 10'8"
15				NO FREE WATER
20				

organic's silt's sand's gravel's



DOT

Original to Materials Engineer

Copy to Bridge Engineer

Copy to District Administrator

S.H. _____ S.R. I-5 SECTION STANWOOD/BRYANT Job No. OL-1602Hole No. TH#21 Sub Section _____ WEIGH STATION _____ Cont. Sec. _____Station WA 45+00 Offset 7 METERS RIGHT Ground El. 122MType Of Boring CME-850 Casing AUGERS W.T. El. NO FREE WATERInspector Vernon F. Williams Date 3/20/97 Sheet 1 Of 1

DEPTH	BLOWS / FT.	PROFILE	SAMPLE #'s	DESCRIPTION OF MATERIAL
0				
5	D-1			
	11		01219	medium dense,reddish brown,moist,SP/SM,poorly graded,fine,SAND, with silt and some silt lenses,with some oxidation,RECOVERY1.5'
10	D-2			
	65\10"		9\25\50\4"	medium dense,reddish brown,moist,SP/SM,poorly graded,fine,SAND, with silt and some silt lenses,with some oxidation,with grey fine sand in tip of sampler,RECOVERY,1.5'
15				END OF BORING AT MINUS 11'4"
				NO FREE WATER
20				

organic's silt's sand's gravel's

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DOT

Original to Materials Engineer
Copy to Bridge Engineer
Copy to District Administrator

S.H. _____ S.R. I-5 SECTION STANWOOD/BRYANT Job No: OL-1602Hole No. TH#22 Sub Section _____ WEIGH STATION Cont. Sec. _____Station WA45+100 Offset 3 METERS RIGHT Ground El. 120MType Of Boring CME-850 Casing AUGERS W.T. El. NO FREE WATERInspector Vernon F. Williams Date 3/19/97 Sheet 1 Of 1

DEPTH	BLOWS / FT.	PROFILE	SAMPLE #*	DESCRIPTION OF MATERIAL
0				
5	D-1			
	40		14\18\22	dense,brown,moist,GW/GM,well graded,fine to coarse,sub-rounded,GRAVEL, with silt and sand,RECOVERY,0.8'
10	D-2			
	50\6"		22\50	dense,brown,moist,GW/GM,well graded,fine to coarse,sub-rounded,GRAVEL, with silt and sand,RECOVERY,0.8'
				END OF BORING AT MINUS 11.0'
15				NO FREE WATER
20				

organic's silt's sand's gravel's

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Original to Materials Engineer

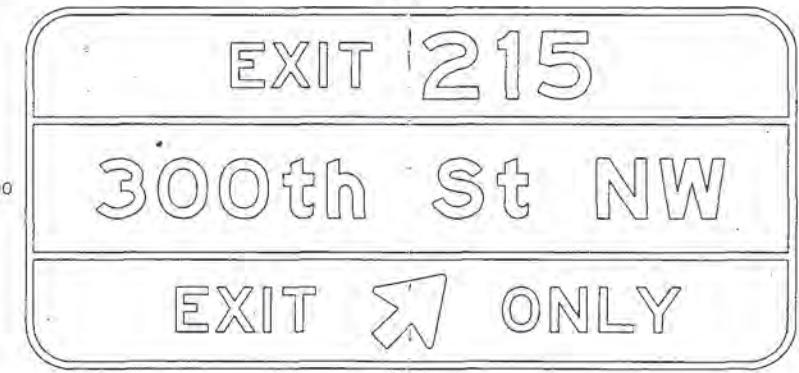
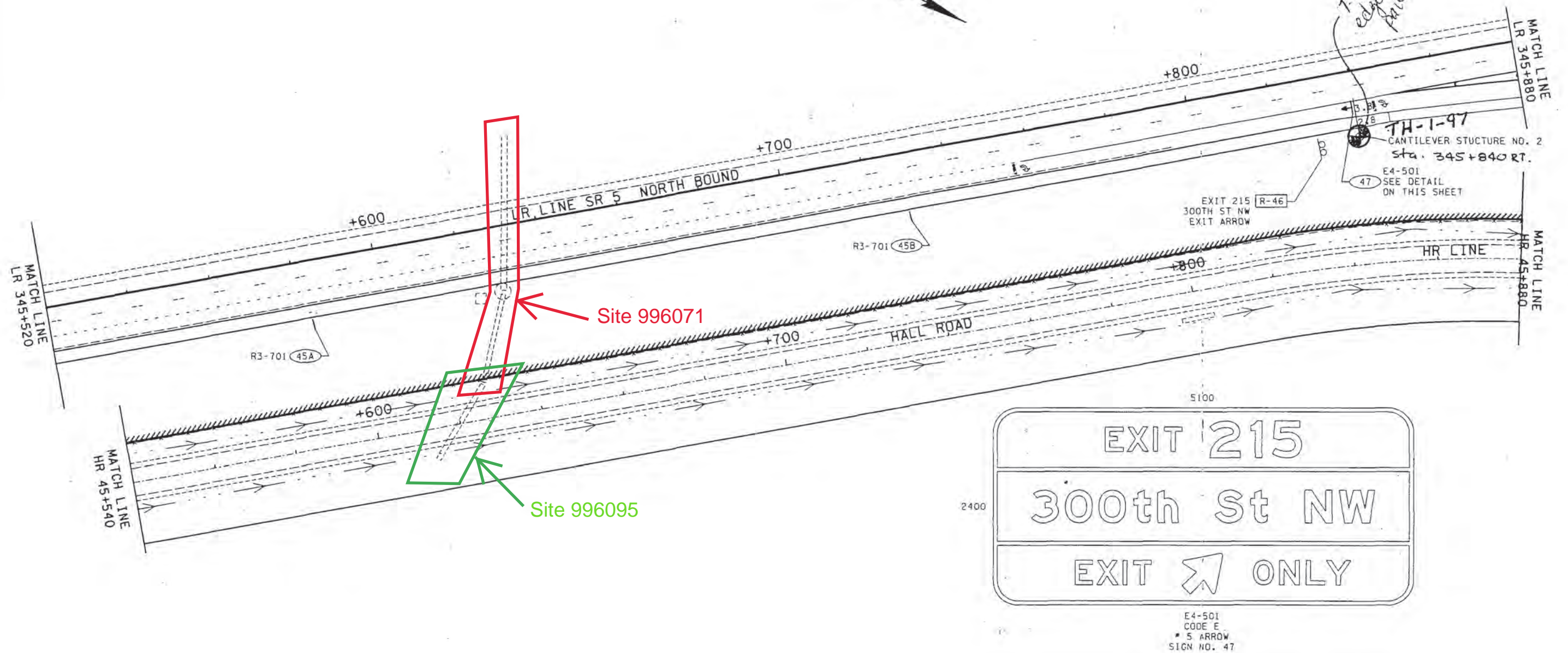
Copy to Bridge Engineer

Copy to District Administrator

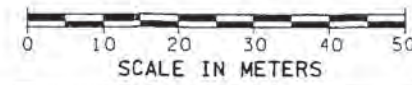
**I-5 Stanwood/Bryant Vicinity
Weigh Station MP 214 Sign Structures
Job No. 0L-1602
WSDOT (1997)**

c:\p1602\sr 5 - stanwood weigh station\1602.ssm.dgn
PLOT6

T 32N. R. 4E. W.M.

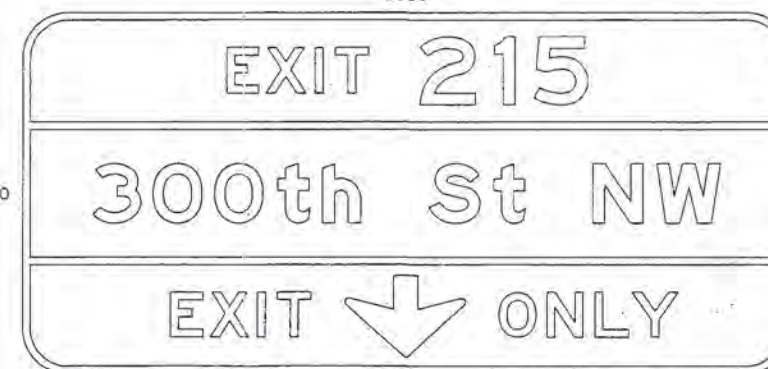
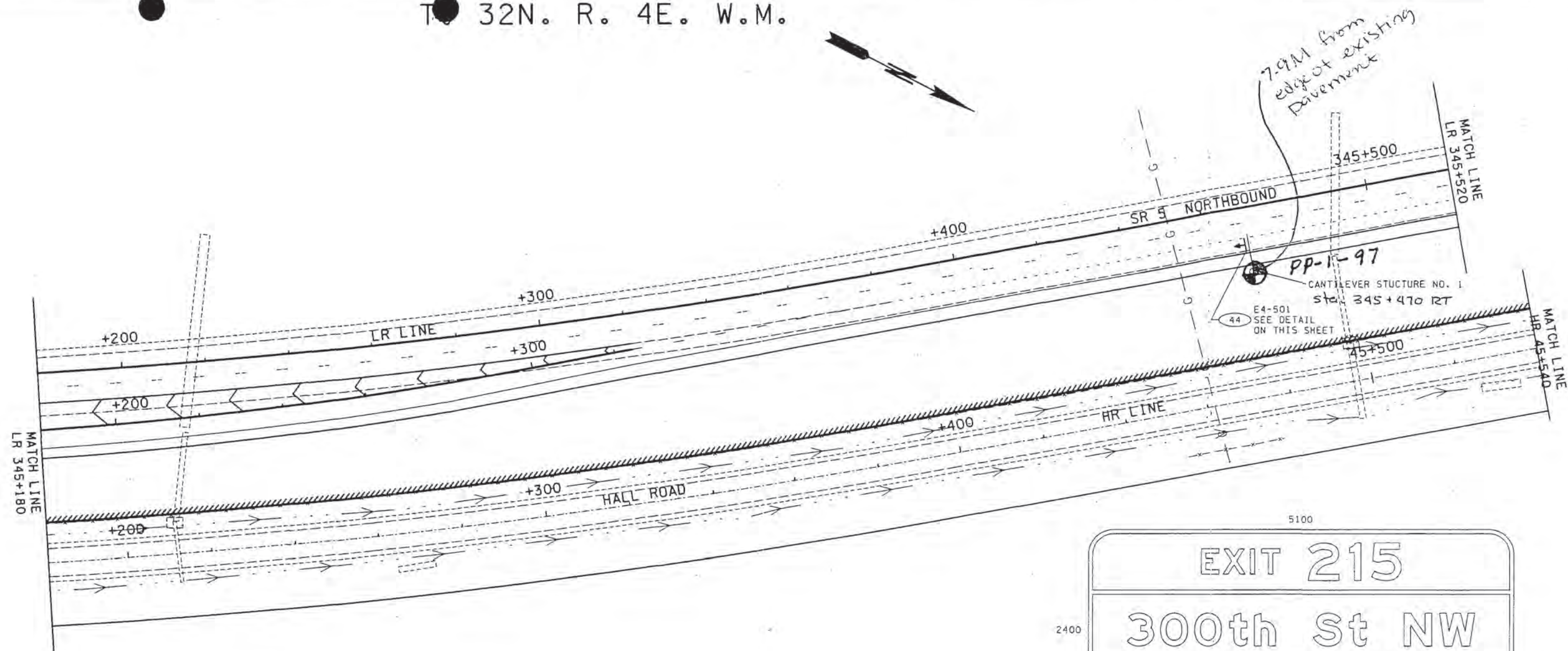


LEGEND	
	SIGN NOTE
	SIGN REMOVAL NOTE
	NEW LOCATION
	SIGN RELOCATION NOTE
	EXISTING LOCATION
	EXISTING SIGN & POST
	EXISTING SIGN ON LIGHT STANDARD
	NEW SIGN ON LIGHT STANDARD
	NEW CANTILEVER
	NEW OVERHEAD SIGN
	NEW SIGN & POST OR RELOCATED SIGN AND/OR POST

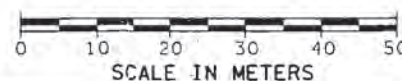













DESIGNED BY L. ANGLIN 10/97				REGION NO. 10		STATE WASH	FED. AID PROJ. NO.		ENVIRONMENTAL AND ENGINEERING SERVICE CENTER		Washington State Department of Transportation		SR 5 STANWOOD/BRYANT VICINITY NORTHBOUND WEIGH STATION		S10	
ENTERED BY L. ANGLIN 10/97				JOB NUMBER		OL-1602									SHEET 5 OF 9 SHEETS	
CHECKED BY D.J. LINER 10/97				CONTRACT NO.												
PROJ. ENGR. W. JAMES 10/97																
REGIONAL ADM. J. OKAMOTO 10/97																
DATE DATE REVISION BY															SIGNING PLAN	


T 32N. R. 4E. W.M.



E4-501
CODE E
SIGN NO. 448



LEGEND			
	SIGN NOTE		EXISTING SIGN ON LIGHT STANDARD
	SIGN REMOVAL NOTE		NEW SIGN ON LIGHT STANDARD
	NEW LOCATION		NEW CANTILEVER
	SIGN RELOCATION NOTE		NEW OVERHEAD SIGN
	EXISTING LOCATION		NEW SIGN & POST OR RELOCATED SIGN AND/OR POST
	EXISTING SIGN & POST		

				REGION NO.	STATE	FED.AID PROJ.NO.	ENVIRONMENTAL AND ENGINEERING SERVICE CENTER	 Washington State Department of Transportation	SR 5 STANWOOD/BRYANT VICINITY NORTHBOUND WEIGH STATION	SIGNING PLAN
DESIGNED BY	L. ANGLIN	10/97		10	WASH					
ENTERED BY	L. ANGLIN	10/97								
CHECKED BY	D.J. LINER	10/97		JOB NUMBER						
PROJ. ENGR.	W. JAMES	10/97		01-1602						
REGIONAL ADM.	J. OKAMOTO	10/97		CONTRACT NO.						
	DATE	DATE	REVISION	BY						

LOG OF TEST BORING

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

S.R. 5 Section SR-5 Stanwood/Bryant Vicinity North bound Weight Station Job No. OL-1602

Hole No. PP-1-97 For Sign Standard Cont. Sec. _____

Station 345 + 470 Offset 15 M Right Approx. _____

Type Of Boring Portable Penetrometer Equipment Hand Tools Ground El. Same as C/L

Inspector Brian M. Breck Starting date 11/10/97 Sheet 1 of 1

W.T. El. Water

DEPTH	LOWS / FT	PROFILE	SAMPLE#	DESCRIPTION OF MATERIAL
0				- 0.0' to - 0.2' - Sod
	D - 1		13/30/25	Silty SAND with Rounded and sub-rounded gravel ,
	27			Dense ,Brown ,Moist ,Homogeneous.
	D - 2		20/27/33	Silty SAND with Rounded and sub-rounded gravel ,
5	30			Dense ,Brown ,Moist ,Homogeneous.
				End of Test Boring elevation = - 4.5'
				No Free Water
				Blows Per Foot are Equivalent to Standard Penetrometer Values.
10				Samples were Retained at Penetrometer depths
15				
20				

organic's silt's sand's gravel's



DOT

NW Region Form

Original to Materials Engineer

Copy to Bridge Engineer

Copy to District Administrator

Copy to _____

LOG OF TEST BORING

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

S.R. 5 Section SR-5 Stanwood/Bryant Vicinity Northbound Weight Station Job No. OL-1602Hole No. TH-1-97 For Cantilever Sign Cont. Sec. Station 345 + 840 Offset 15m Right Approx. Ground El. Same as C/LType Of Boring Rotary Drill D - 25 Casing HW Advancer W.T. El. - 8.0'Inspector Brian M. Breck Starting date 11/17/97 Sheet 1 of 1











DEPTH	BLOWS / FT	PROFILE	SAMPLE#	DESCRIPTION OF MATERIAL
0				
	D - 1		31117/21	Silty SAND with rounded and sub-rounded gravel ,Dense ,Brown ,Moist ,
	38			Homogeneous. Recovered 0.8' Retained 0.8'
5	D - 2		8117/20	Sandy SILT with embedded rounded and sub-rounded gravel ,Dense ,
	37			Light brown ,Moist ,Homogeneous. Recovered 0.6' Retained 0.6'
10	D - 3		8112/13	Silty SAND with embedded rounded and sub-rounded gravel ,Dense ,Gray ,
	25			Wet ,Homogeneous. Recovered 0.7' Retained 0.7'
15				
20				









organic's silt's sand's gravel's





DOT
NW Region Form

Original to Materials Engineer
Copy to Bridge Engineer
Copy to District Administrator
Copy to _____

















Appendix B: Test Boring Logs

In Situ Sample and Test Symbols	
	Standard Penetration Test
	Non-standard Penetration Test
	Shelby Tube
	Piston Sampler
	WSDOT Undisturbed Sampler
	Core Sample
	Grab Sample
	California Sampler
	Vane Shear Test
	Pressuremeter Test

Backfill and Instrument Symbols	
	Cement Surface Seal
	Bentonite Chips
	Bentonite Cement Grout (BCM)
	Sand Filter Pack
	Slough (Hole Collapse)
	Pipe (Piezometer or Instrument) in BCM
	Well Screen in Sand Filter Pack
	Vibrating Wire Piezometer in BCM

Water Level Symbols	
	Water Level During Drilling
	Water Range in Piezometer
	Transducer Depth
	Water is Below Transducer

Laboratory Testing Codes	
AL	Atterberg Limits Test
CD	Consolidated Drained Triaxial Test
CN	1-Dimensional Consolidation Test
CSS	Cyclic Simple Shear Test
CU	Consolidated Undrained Triaxial Test
DG	Degradation Test
DN	Density Test
DS	Direct Shear Test
DSS	Direct Simple Shear Test
GS	Grain Size Distribution Test
HC	Hydraulic Conductivity Test
HT	Hydrometer Test
JS	Jar Slake Test
LA	LA Abrasion Test
LOI	Loss on Ignition Test
MC	Moisture Content Test
PH	pH Test
PT	Point Load Compressive Test
RES	Resistivity Test
RS	Torsional Ring Shear Test
SG	Specific Gravity Test
SL	Slake Durability Test
UC	Unconfined Compression Test
UU	Unconsolidated Undrained Triaxial Test

Soil Stratigraphy Symbols			
COARSE GRAINED		FINE GRAINED & ORGANIC	
	GW: Well-graded Gravel		CL: Lean Clay
	GP: Poorly graded Gravel		ML: Silt
	GM: Silty Gravel		CH: Fat Clay
	GC: Clayey Gravel		MH: Elastic Silt
	SW: Well-graded Sand		OL: Organic Silt
	SP: Poorly graded Sand		OH: Organic Clay
	SM: Silty Sand		CL-ML: Silty Clay (dual symbol)
	SC: Clayey Sand		PT: Peat or Highly Organic Soil
Soil classification is per Chapter 4.2 of the WSDOT Geotechnical Design Manual (GDM). The soil groups above contain less than 15% of other constituents. When more than 15% other constituents are observed, the soil group names are modified (e.g. Silty Gravel with Sand; Sandy, Elastic Silt with Gravel) per ASTM 2488. For dual classifications, a split symbol is used (e.g. CL-ML above). Refer to the Material Description column on the log for a complete description of the observed soil conditions.			

Soil Density/Consistency				WSDOT GDM 4.2.5
COHESIONLESS SOILS		COHESIVE SOILS		
Blows/Ft	Density Term	Blows/Ft	Consistency Term	
< 5	Very Loose	< 2	Very Soft	
5 - 10	Loose	2 - 4	Soft	
11 - 24	Medium Dense	5 - 8	Medium Stiff	
25 - 50	Dense	9 - 15	Stiff	
> 50	Very Dense	16 - 30	Very Stiff	
(REF) is indicated on the log for any soil type when the penetration resistance exceeded 100 blows per foot (refusal conditions).		31 - 60	Hard	
		> 60	Very Hard	

Soil Angularity		WSDOT GDM 4.2.4
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces	
Subangular	Particles are similar to angular description but have rounded edges	
Subrounded	Particles have nearly plane sides but have well rounded corners and edges	
Rounded	Particles have smoothly curved sides and no edges	

Soil Moisture		WSDOT GDM 4.2.7
Dry	Absence of moisture, dusty, dry to touch	
Moist	Damp but no visible water	
Wet	Visible Free Water	

Soil Structure		WSDOT GDM 4.2.8
Stratified	Alternating layers of varying material or color with layers at least 0.25 inch thick	
Laminated	Alternating layers of varying material or color with layers less than 0.25 inch thick	
Fissured	Breaks along definite planes of fracture with little resistance to fracturing	
Slickensided	Fracture planes appear polished or glossy, sometimes striated	
Blocky	Cohesive soil that can be broken down into smaller angular lumps which resists further breakdown	
Disrupted	Soil structure is broken and mixed. Infers that material has moved substantially - landslide debris	
Homogeneous	Same color and appearance throughout	
Cemented	Particles are held together by a binding agent	



















Rock Grain Size WSDOT GDM 4.3.1.5		
TERM	GRAIN SIZE	DESCRIPTION
Fine Grained	Less than 0.04 inch	Few crystal boundaries/grains distinguishable with the aid of a hand lens
Medium Grained	0.04 to 0.2 inch	Most crystal boundaries/grains distinguishable with the aid of a hand lens
Coarse Grained	Greater than 0.2 inch	Most crystal boundaries/grains distinguishable with the naked eye

Rock Weathered State WSDOT GDM 4.3.1.6		
TERM	DESCRIPTION	GRADE
Fresh	No visible signs of rock material weathering; perhaps slight discoloration in major discontinuity surfaces.	I
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering, and may be somewhat weaker externally than in its fresh condition.	II
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as corestones.	III
Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as discontinuous framework or as corestone.	IV
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V
Residual Soil	All rock material is converted to soil. The mass structure and material fabric is destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

Relative Rock Strength WSDOT GDM 4.3.1.6			
TERM	DESCRIPTION	GRADE	UCS (ksi)
Extremely Weak	Specimen can be indented by thumbnail.	R0	0.04 - 0.14
Very Weak	Specimen crumbles under sharp blow with point of geological hammer, and can be cut with a pocket knife.	R1	0.15 - 3.6
Moderately Weak	Shallow cuts or scrapes can be made in a specimen with a pocket knife. Geological hammer point indents deeply with firm blow.	R2	3.6 - 7.3
Moderately Strong	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer point.	R3	7.3 - 15
Strong	Specimen breaks with one firm blow from the hammer end of a geological hammer.	R4	15 - 29
Very Strong	Specimen requires many blows of a geological hammer to break intact sample.	R5	> 29

Rock Discontinuity Spacing GDM 4.3.2.1	
TERM	SPACING
Very Widely	Greater than 10 feet
Widely	3 feet to 10 feet
Moderately	1 foot to 3 feet
Closely	2 inches to 12 inches
Very Closely	Less than 2 inches

Rock Discontinuity Condition WSDOT GDM 4.3.2.2	
TERM	DESCRIPTION
Excellent Condition	Very rough surfaces, no separation, hard discontinuity wall
Good Condition	Slightly rough surfaces, separation less than 0.05 inch, hard discontinuity wall
Fair Condition	Slightly rough surface, separation greater than 0.05 inch, soft discontinuity wall
Poor Condition	Slickensided surfaces, or soft gouge less than 0.2 inch thick, or open discontinuities 0.05 to 0.2 inch
Very Poor Condition	Soft gouge greater than 0.2 inch, or open discontinuities greater than 0.2 inch

Rock Lithology Symbols			
	Andesite		Limestone
	Basalt		Phyllite
	Breccia		Quartzite
	Claystone		Rhyolite
	Coal		Sandstone
	Conglomerate		Shale
	Diorite		Siltstone
	Gneiss		Tuff
	Granite		Volcaniclastic

Other Rock Terms and Abbreviations		
TERM	ABBREV.	DEFINITION
Core Recovery	REC (%)	$\frac{100 \times \text{Length of Core Recovered}}{\text{Length of Core Run}}$
Rock Quality Designation	RQD (%)	$\frac{100 \times \text{Length of Core in Pieces} > 4 \text{ inches}}{\text{Length of Core Barrel}}$
Fracture Frequency	FF (#/Ft)	Number of natural fractures per unit length of core recovered. Mechanical breaks ignored.

ABBREVIATIONS: ksi = kips per square inch; UCS = Uniaxial Compressive Strength

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary
to West Fork Church Creek (Freedom Creek) -996077-

Job Number: XL5949 Route & MP Range: SR 005 MP 214.36 - 214.38

Northing: 462,847.8 feet Latitude: 48.260042 deg.

Driller/Inspector: Peterson, Trevor (#3008) / Henderson, Danny (#2742)

Easting: 1,293,028.1 feet Longitude: -122.259552 deg.

Start Card: RE20719 Well Tag: BMM377 Instrument: 1" PVC

Elevation: 397.5 feet Collector: Region Survey

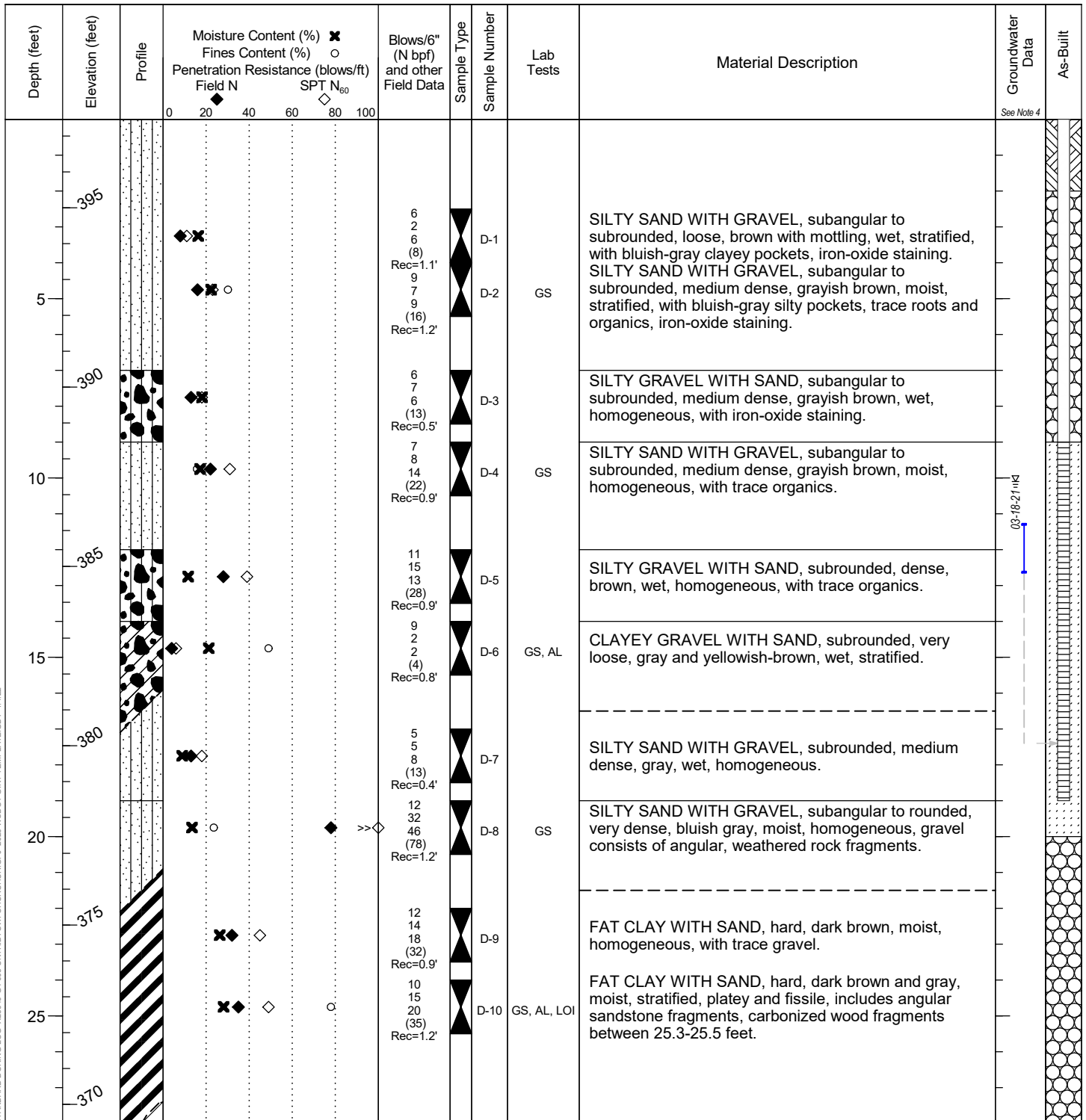
Drilling Method: Casing Advancer Hole Diam.: 4 in

Horizontal/Vertical Datum: NAD 83 HARN, SPN / NAVD88

Equipment: CME 850 (ID:9C2-5) Rod Type: HQ

Started: March 17, 2021 Completed: March 18, 2021

Hammer Type: Autohammer Historic Efficiency: 84.5%



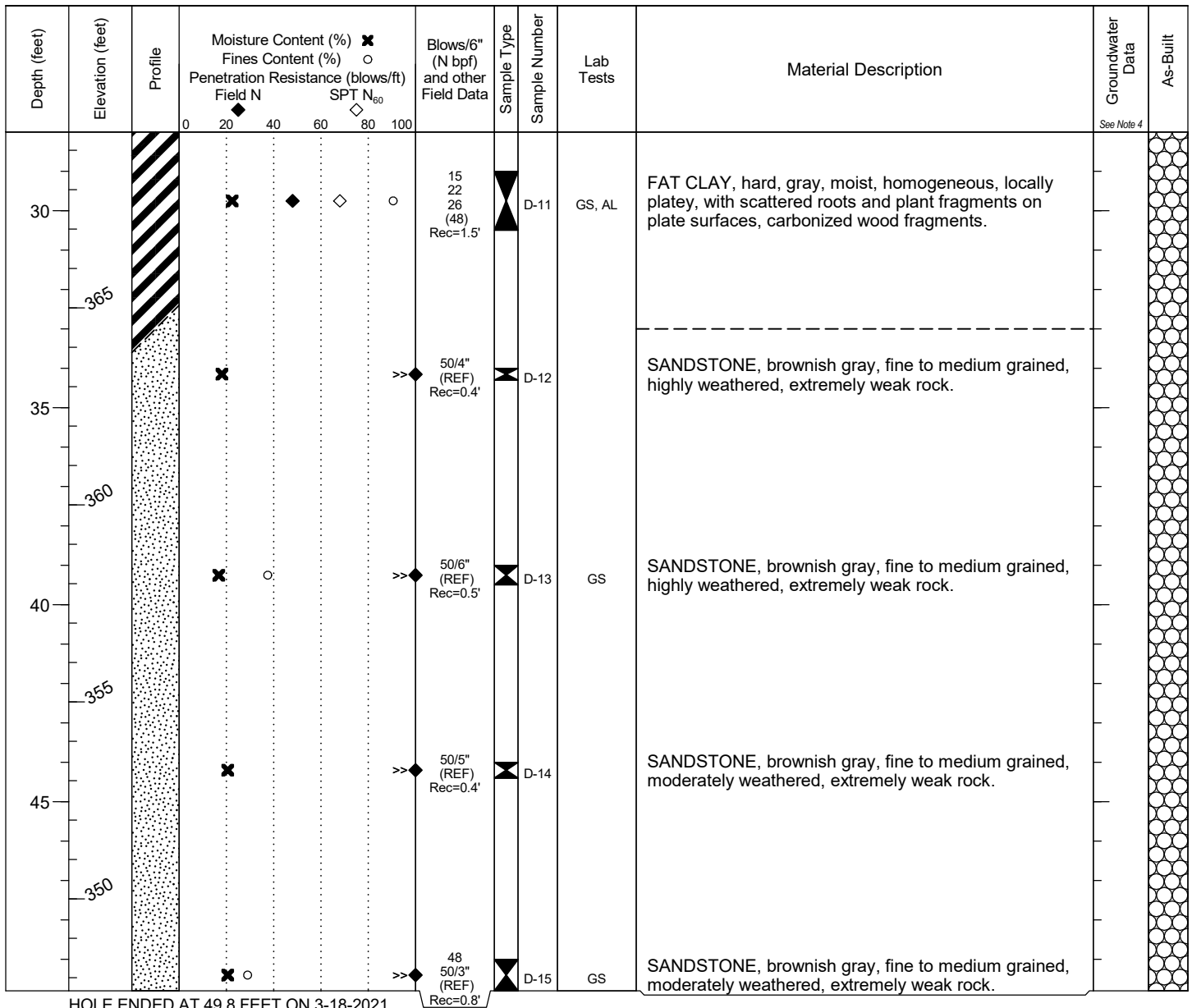
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 VERSION 1
FINAL

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary
to West Fork Church Creek (Freedom Creek) -996077-

Job Number: XL5949

Route & MP Range: SR 005 MP 214.36 - 214.38


NOTES:

- This is a summary log of the boring. Soil/rock descriptions are derived from visual field identifications and laboratory test data (where tested). See exploration log legend for explanation of graphics and abbreviations.
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- Where oversized samplers were used, a correction was made to the N-value per the AASHTO Manual on Subsurface Investigations, 1988. Blow counts per 6-inch increment have not been corrected.
- The groundwater level range shown on this log represents data collected between 4/21/2021 and 9/15/2021. The line between the minimum and maximum values represents the data points, typically collected at 6-hour intervals.

BAIL-RECHARGE TEST RESULTS:

Test Date: March 18, 2021
Hole Depth / Casing Depth: 49.8 feet / 49.0 feet
Water Depth Before Bailing: 7.0 feet

ELAPSED TIME (minutes)	WATER DEPTH (feet)
0	33.4
1	32.5
2	31.4
3	30.3
4	29.1
5	28.2
10	26.5
15	24.3
20	22.4
25	20.2
30	20.2
35	20.2

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary to West Fork Church Creek (Freedom Creek) -996077-

Job Number: XL5949 Route & MP Range: SR 005 MP 214.36 - 214.38

Northing: 462,810.7 feet Latitude: 48.259935 deg.

Driller/Inspector: Peterson, Trevor (#3008) / Harvey, Thomas (#2599)

Easting: 1,292,924.4 feet Longitude: -122.259975 deg.

Start Card: RE20719 Well Tag: BMM378 Instrument: 1" PVC

Elevation: 391.8 feet Collector: Region Survey

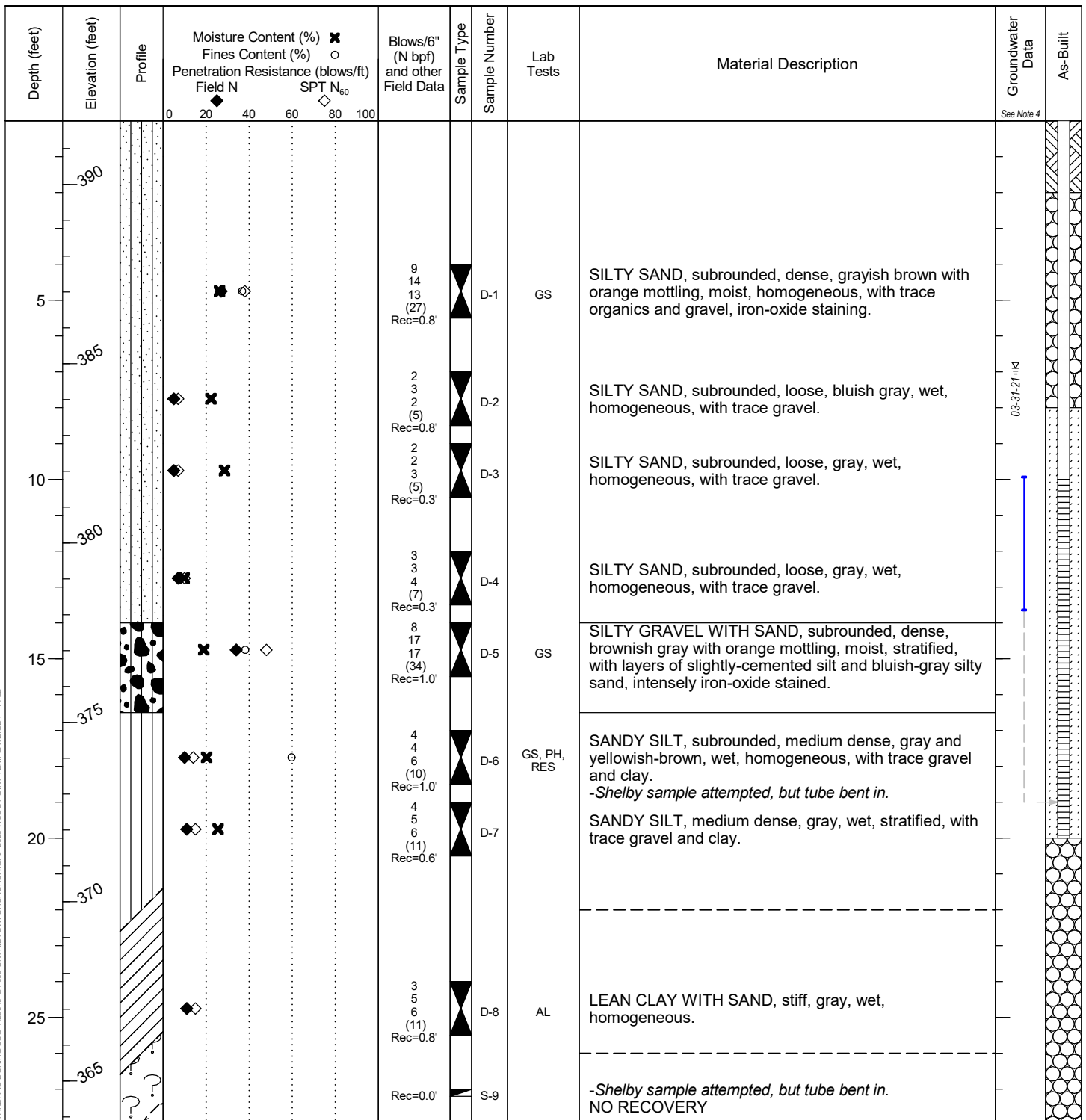
Drilling Method: Casing Advancer Hole Diam.: 6 in

Horizontal/Vertical Datum: NAD 83 HARN, SPN / NAVD88

Equipment: CME 850 (ID:9C2-5) Rod Type: HWT

Started: March 31, 2021 Completed: March 31, 2021

Hammer Type: Autohammer Historic Efficiency: 84.5%



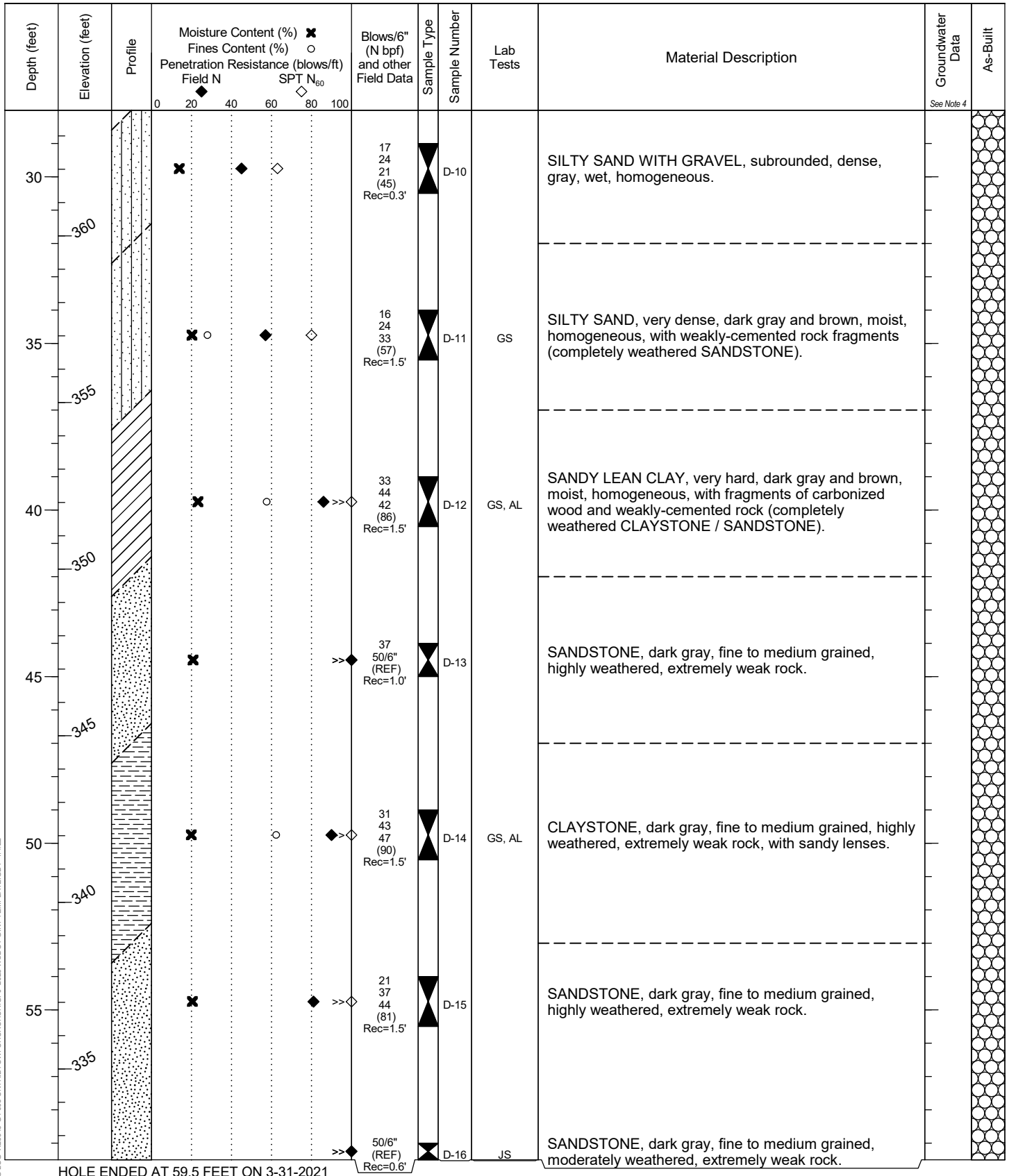
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VERSION 1
FINAL

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary to West Fork Church Creek (Freedom Creek) -996077-

Job Number: XL5949

Route & MP Range: SR 005 MP 214.36 - 214.38



NOTES:

BAIL-RECHARGE TEST RESULTS:

CONTINUED NEXT PAGE (see last page for notes)

VERSION 1
FINAL

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary
to West Fork Church Creek (Freedom Creek) -996077-

Job Number: XL5949

Route & MP Range: SR 005 MP 214.36 - 214.38

Depth (feet)	Elevation (feet)	Profile	Moisture Content (%)	Fines Content (%)	Penetration Resistance (blows/ft)	Field N	SPT N ₆₀	Blows/6" (N bpf) and other Field Data	Sample Type	Sample Number	Lab Tests	Material Description	Groundwater Data	As-Built
			0	20	40	60	80	100						

See Note 4

1. This is a summary log of the boring. Soil/rock descriptions are derived from visual field identifications and laboratory test data (where tested). See exploration log legend for explanation of graphics and abbreviations.
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3. Where oversized samplers were used, a correction was made to the N-value per the AASHTO Manual on Subsurface Investigations, 1988. Blow counts per 6-inch increment have not been corrected.
4. The groundwater level range shown on this log represents data collected between 4/21/2021 and 9/15/2021. The line between the minimum and maximum values represents the data points, typically collected at 6-hour intervals.

Test Date: March 31, 2021

Hole Depth / Casing Depth: 59.5 feet / 59.0 feet

Water Depth Before Bailing: 6.9 feet

ELAPSED TIME (minutes)	WATER DEPTH (feet)
0	15.4
5	9.0
10	7.9
15	7.2
20	7.2
30	7.2

Project: Advanced Work on Fish Barriers: I-5/ WF Church Creek
(Freedom Creek) -996073-

Job Number: XL5949 Route & MP Range: SR 005 MP 214.74 - 214.74

Northing: 463,886.7 feet Latitude: 48.262826 deg.

Driller/Inspector: Peterson, Trevor (#3008) / Harvey, Thomas (#2599)

Easting: 1,291,785.4 feet Longitude: -122.264732 deg.

Start Card: RE20720 Well Tag: BMM379 Instrument: 1" PVC

Elevation: 367.4 feet Collector: Region Survey

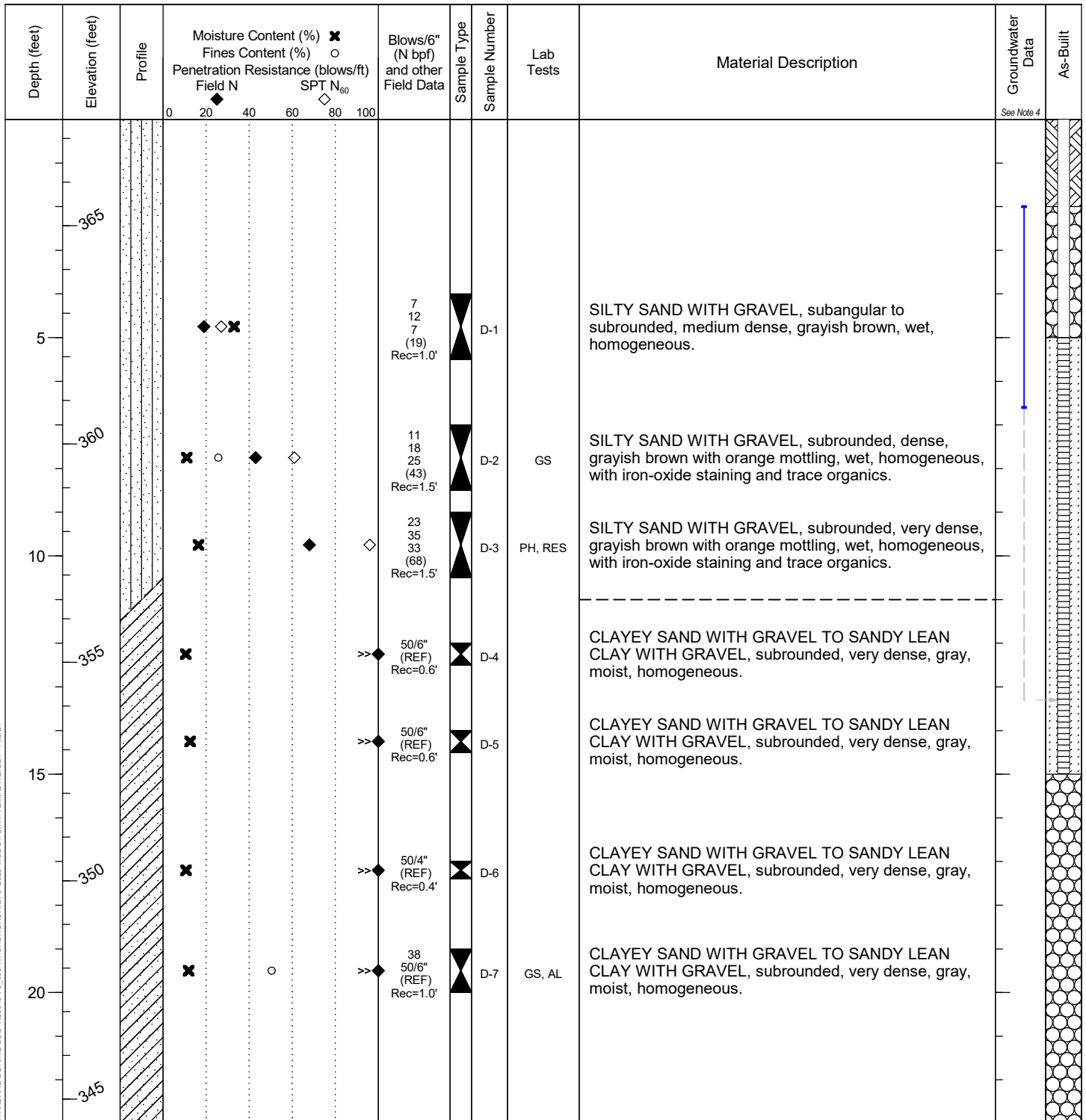
Drilling Method: Casing Advancer Hole Diam.: 6 in

Horizontal/Vertical Datum: NAD 83 HARN, SPN / NAVD88

Equipment: CME 850 (ID:9C2-5) Rod Type: HWT

Started: April 1, 2021 Completed: April 1, 2021

Hammer Type: Autohammer Historic Efficiency: 84.5%



CONTINUED NEXT PAGE (see last page for notes)

VERSION 1
FINAL

Project: Advanced Work on Fish Barriers: I-5/ WF Church Creek
(Freedom Creek) -996073-

Job Number: XL5949 Route & MP Range: SR 005 MP 214.74 - 214.74

Depth (feet)	Elevation (feet)	Profile	Moisture Content (%) Fines Content (%) Penetration Resistance (blows/ft) Field N	Blows/6" (N bpf) and other Field Data	Sample Type Sample Number	Lab Tests	Material Description	Groundwater Data <small>See Note 4</small>	As-Built
25	340		✕	>> 50/6" (REF) Rec=0.6'	D-8		CLAYEY SAND WITH GRAVEL TO SANDY LEAN CLAY WITH GRAVEL, subrounded, very dense, gray, moist, homogeneous.		
30	335		✕	>> 27 50/6" (REF) Rec=1.0'	D-9	GS	SANDY SILT, subrounded, very dense, gray, moist, homogeneous, with trace gravel.		
35	330		✕	>> 41 50/6" (REF) Rec=1.0'	D-10	GS	SANDY SILT, subrounded, very dense, gray, moist, homogeneous, with trace gravel.		
40	325		✕	>> 50/4" (REF) Rec=0.3'	D-11		SANDY SILT, subrounded, very dense, gray, moist, homogeneous, with trace gravel.		
45	320		✕	>> 50/6" (REF) Rec=0.4'	D-12		SANDY SILT, subrounded, very dense, gray, moist, homogeneous, with trace gravel.		
50			✕	>> 50/6" (REF) Rec=0.6'	D-13		SILTY SAND WITH GRAVEL, subrounded, very dense, gray, moist, homogeneous.		

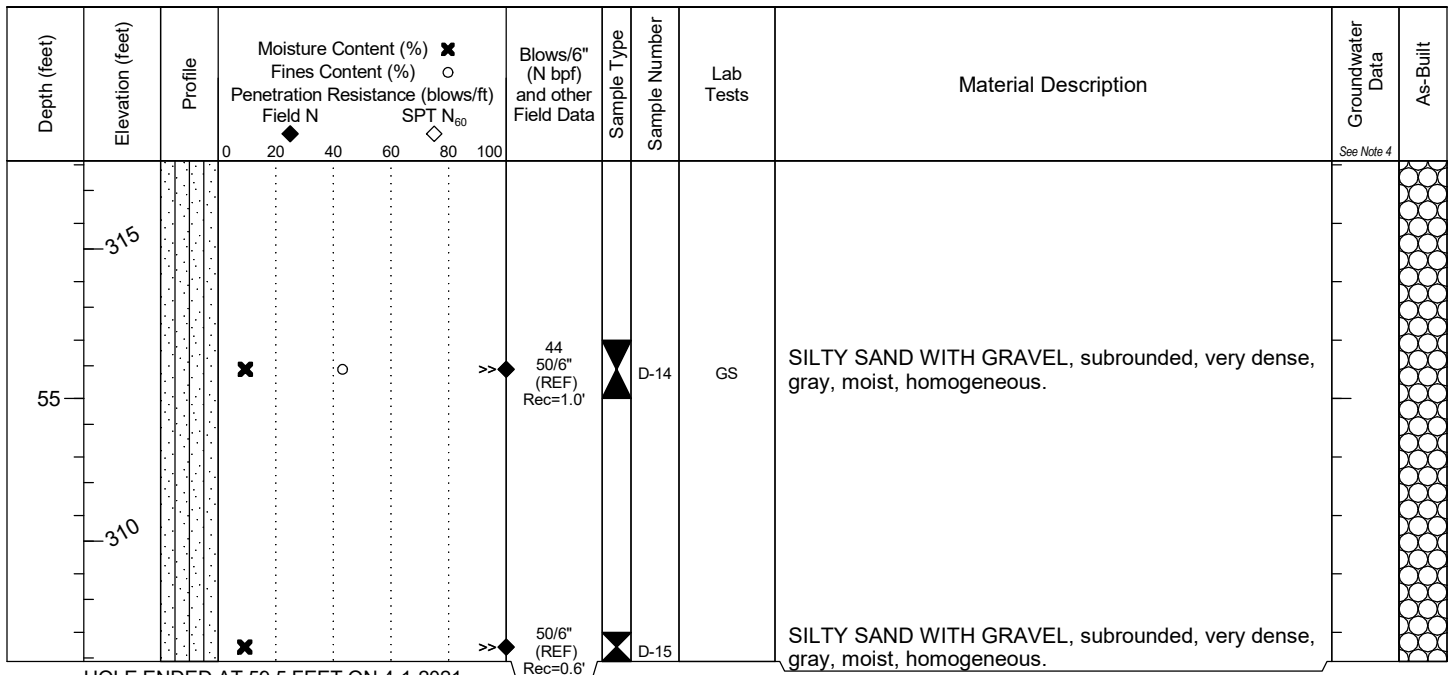
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 VERSION 1
FINAL

Project: Advanced Work on Fish Barriers: I-5/ WF Church Creek
(Freedom Creek) -996073-

Job Number: XL5949

Route & MP Range: SR 005 MP 214.74 - 214.74


NOTES:

1. This is a summary log of the boring. Soil/rock descriptions are derived from visual field identifications and laboratory test data (where tested). See exploration log legend for explanation of graphics and abbreviations.
2. The implied accuracy of the location information displayed on this log is typically sub-meter(X,Y) when collected using GPS methods by the Geotechnical Office and sub-centimeter (X,Y,Z) when collected by the Region survey crew.
3. Where oversized samplers were used, a correction was made to the N-value per the AASHTO Manual on Subsurface Investigations, 1988. Blow counts per 6-inch increment have not been corrected.
4. The groundwater level range shown on this log represents data collected between 4/21/2021 and 9/15/2021. The line between the minimum and maximum values represents the data points, typically collected at 6-hour intervals.

BAIL-RECHARGE TEST RESULTS:

Test Date: April 1, 2021
Hole Depth / Casing Depth: 59.5 feet / 39.0 feet
Water Depth Before Bailing: 1.4 feet

ELAPSED TIME (minutes)	WATER DEPTH (feet)
0	14.2
5	9.0
10	6.9
15	6.5
20	6.5
30	6.5

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary to West Fork Church Creek (Freedom Creek) -996071-

Job Number: XL5949 Route & MP Range: SR 005 MP 214.73 - 214.73

Northing: ~464,311 feet Latitude: ~48.26400 deg.

Driller/Inspector: Peterson, Trevor (#3008) / Harvey, Thomas (#2599)

Easting: ~1,292,018 feet Longitude: ~-122.26381 deg.

Start Card: RE20720 Well Tag: BMM380 Instrument: 1" PVC

Elevation: ~378 feet Collector: Geotech Office GPS

Drilling Method: Casing Advancer/Coring Hole Diam.: 4 in

Horizontal/Vertical Datum: NAD 83 HARN, SPN / NAVD88

Equipment: CME 850 (ID:9C2-5) Rod Type: HQ

Started: March 24, 2021 Completed: March 25, 2021

Hammer Type: Autohammer Historic Efficiency: 84.5%

Depth (feet)	Approximate Elevation (feet)	Profile	Moisture Content (%) Fines Content (%) Penetration Resistance (blows/ft) Field N	SPT N ₆₀	Blows/6" (N bpf) and other Field Data	Sample Type	Sample Number	Lab Tests	Material Description	Groundwater Data	As-Built
										See Note 4	
5	375		✕	◇	8 6 15 (21) Rec=1.0'	D-1			SILTY SAND WITH GRAVEL, subrounded, medium dense, yellowish brown and gray with mottling, moist, stratified, with clay pockets and trace organics, jumbled texture, iron-oxide staining.		
	370		✕	◇	2 3 3 (6) Rec=1.0'	D-2		GS	SILTY SAND WITH GRAVEL, subrounded, loose, brownish gray with mottling, wet, homogeneous, with trace pine needles, roots, and fine organics, iron-oxide staining.		
10			✕	◇	2 3 2 (5) Rec=1.0'	D-3		GS, PH, RES	SILTY SAND WITH GRAVEL, subrounded, loose, brown and gray, wet, homogeneous, with trace roots and fine organics.		
	365		✕	◇	8 12 11 (23) Rec=0.6'	D-4			SILTY GRAVEL WITH SAND, subangular to subrounded, medium dense, olive gray, wet, homogeneous, with trace organics.		
15			✕	◇	9 16 13 (29) Rec=1.0'	D-5		GS	SILTY GRAVEL WITH SAND, subrounded, dense, grayish brown, wet, stratified, slight iron-oxide staining.		
	360		✕	◇	14 16 15 (31) Rec=0.2'	D-6			WELL-GRADED GRAVEL WITH SAND, subrounded, dense, grayish brown, wet, homogeneous, fines washed out during sampling.		
20			✕	◇	11 14 17 (31) Rec=1.0'	D-7			SILTY SAND WITH GRAVEL, subrounded, dense, gray, moist, homogeneous.		

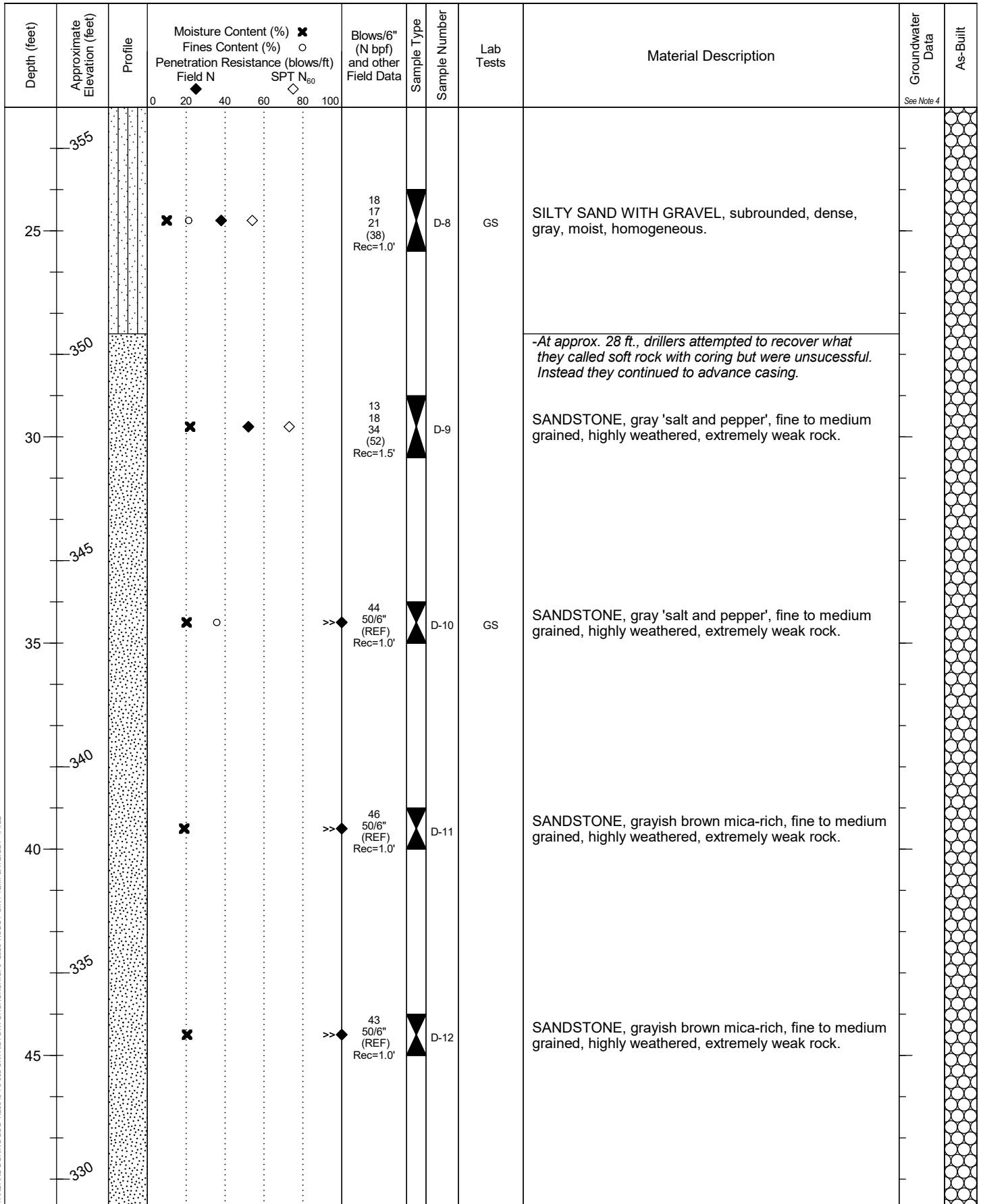
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 VERSION 1
FINAL

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary
to West Fork Church Creek (Freedom Creek) -996071-

Job Number: XL5949

Route & MP Range: SR 005 MP 214.73 - 214.73



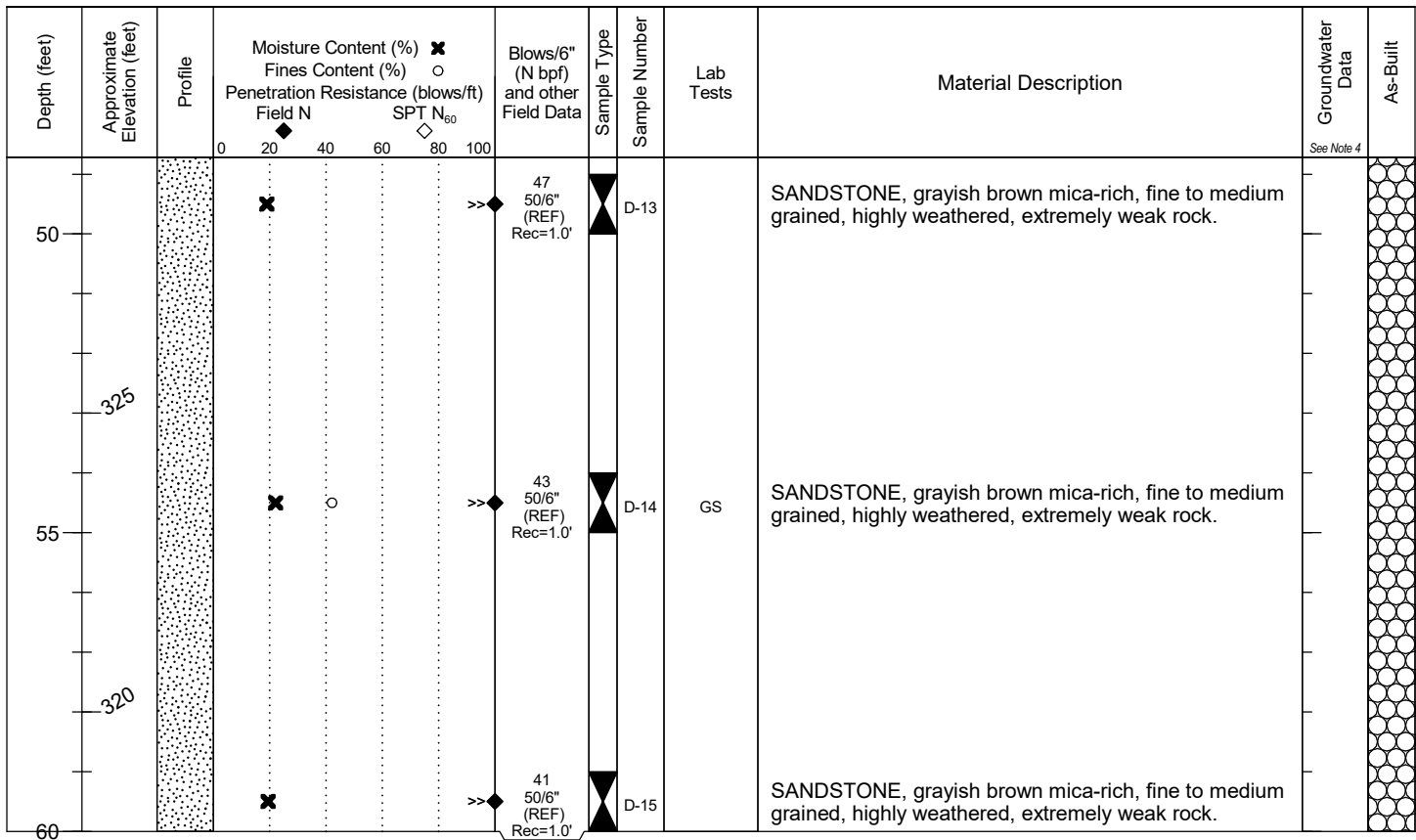
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VERSION 1
FINAL

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary
to West Fork Church Creek (Freedom Creek) -996071-

Job Number: XL5949

Route & MP Range: SR 005 MP 214.73 - 214.73



NOTES:

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- Where oversized samplers were used, a correction was made to the N-value per the AASHTO Manual on Subsurface Investigations, 1988. Blow counts per 6-inch increment have not been corrected.
- The groundwater level range shown on this log represents data collected between 4/21/2021 and 9/15/2021. The line between the minimum and maximum values represents the data points, typically collected at 6-hour intervals.

BAIL-RECHARGE TEST RESULTS:

Test Date: March 25, 2021
Hole Depth / Casing Depth: 60.0 feet / 49.0 feet
Water Depth Before Bailing: 6.1 feet

ELAPSED TIME (minutes)	WATER DEPTH (feet)
0	18.3
1	11.0
5	8.7
10	7.5
15	5.4
20	5.4
30	5.4

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary to West Fork Church Creek (Freedom Creek) -996071-

Job Number: XL5949 Route & MP Range: SR 005 MP 214.73 - 214.73

Northing: 464,268.0 feet Latitude: 48.263878 deg.

Driller/Inspector: Peterson, Trevor (#3008) / Harvey, Thomas (#2599)

Easting: 1,291,921.2 feet Longitude: -122.264204 deg.

Start Card: RE20720 Well Tag: BMM381 Instrument: 1" PVC

Elevation: 378.5 feet Collector: Region Survey

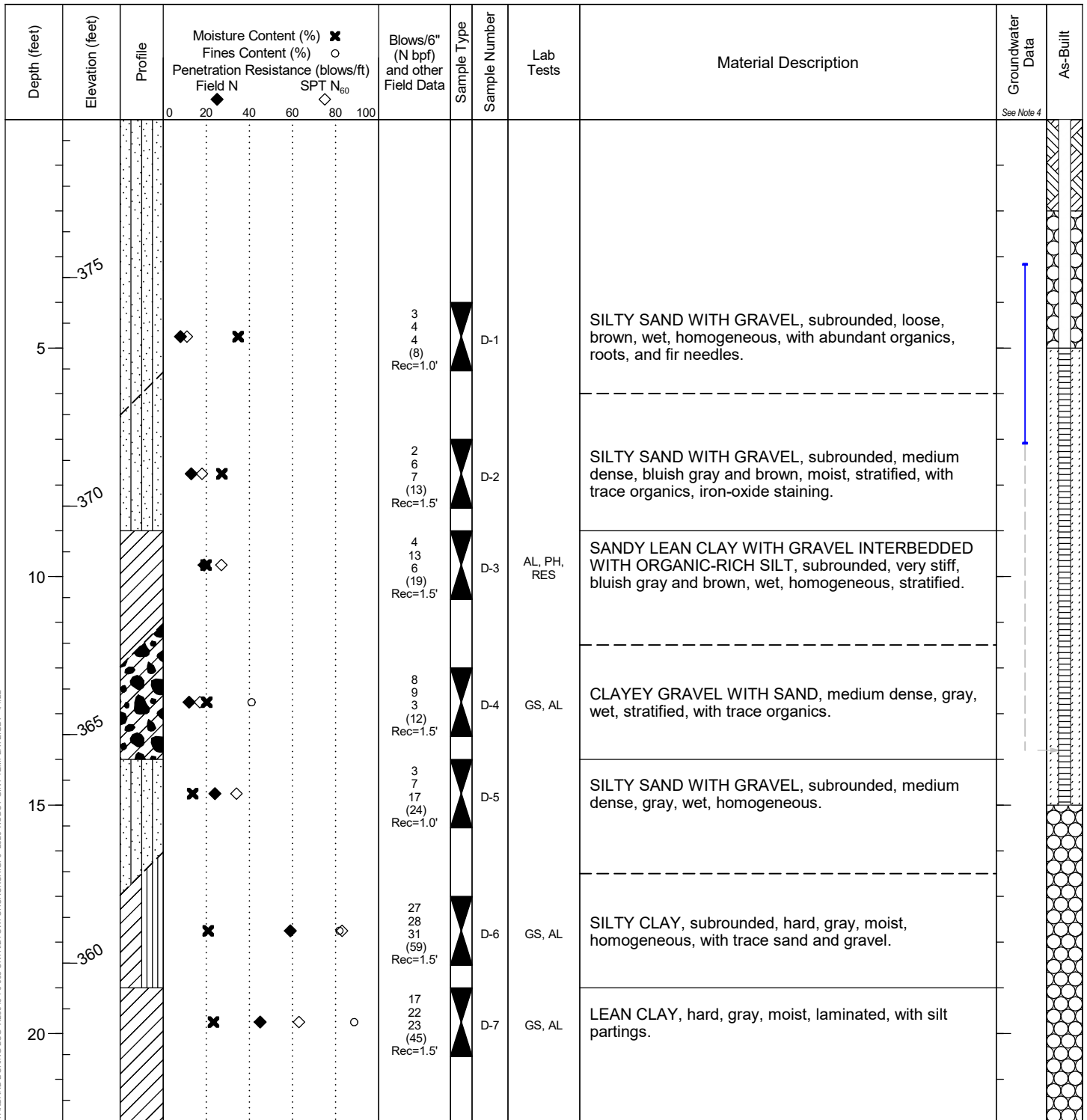
Drilling Method: Casing Advancer Hole Diam.: 6 in

Horizontal/Vertical Datum: NAD 83 HARN, SPN / NAVD88

Equipment: CME 850 (ID:9C2-5) Rod Type: HWT

Started: March 29, 2021 Completed: March 30, 2021

Hammer Type: Autohammer Historic Efficiency: 84.5%



CONTINUED NEXT PAGE (see last page for notes)

VERSION 1
FINAL

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary
to West Fork Church Creek (Freedom Creek) -996071-

Job Number: XL5949

Route & MP Range: SR 005 MP 214.73 - 214.73

Depth (feet)	Elevation (feet)	Profile	Moisture Content (%) Fines Content (%) Penetration Resistance (blows/ft) Field N	Blows/6" (N bpf) and other Field Data	Sample Type	Sample Number	Lab Tests	Material Description	Groundwater Data	As-Built
			0 20 40 60 80 100 x o SPT N ₆₀						See Note 4	
25	355		x	>> 50/6" (REF) Rec=0.4'	D-8		GS	SILTY SAND WITH GRAVEL, subangular, very dense, gray, moist, homogeneous.		
30	350		x	>> 31 50/6" (REF) Rec=1.0'	D-9			SANDSTONE, dark yellowish brown, fine to medium grained, highly weathered, extremely weak rock.		
35	345		x	>> 50/6" (REF) Rec=0.6'	D-10			SANDSTONE, dark yellowish brown, fine to medium grained, highly weathered, extremely weak rock.		
40	340		x o	>> 47 50/6" (REF) Rec=1.0'	D-11		GS	SANDSTONE, dark yellowish brown, fine to medium grained, highly weathered, extremely weak rock.		
45	335		x	>> 43 50/6" (REF) Rec=1.0'	D-12			SANDSTONE, dark yellowish brown, fine to medium grained, highly weathered, extremely weak rock.		
	330									

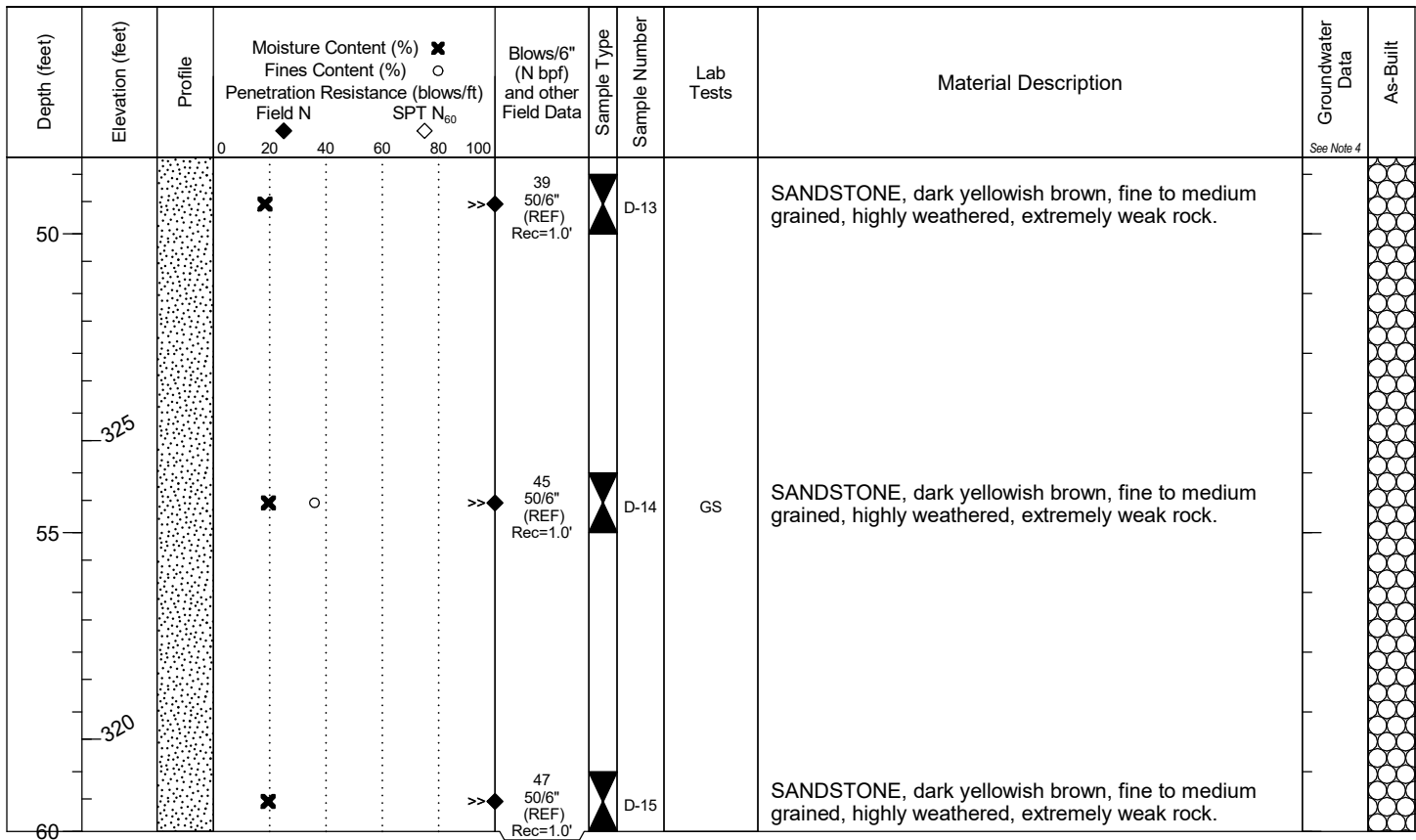
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 VERSION 1
FINAL

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary
to West Fork Church Creek (Freedom Creek) -996071-

Job Number: XL5949

Route & MP Range: SR 005 MP 214.73 - 214.73


NOTES:

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- Where oversized samplers were used, a correction was made to the N-value per the AASHTO Manual on Subsurface Investigations, 1988. Blow counts per 6-inch increment have not been corrected.
- The groundwater level range shown on this log represents data collected between 4/21/2021 and 9/15/2021. The line between the minimum and maximum values represents the data points, typically collected at 6-hour intervals.

BAIL-RECHARGE TEST RESULTS:

Test Date: March 30, 2021
Hole Depth / Casing Depth: 60.0 feet / 59.0 feet
Water Depth Before Bailing: 3.0 feet

ELAPSED TIME (minutes)	WATER DEPTH (feet)
0	16.1
5	10.3
10	7.1
15	6.1
20	5.0
25	4.8
30	4.8

Advanced Work on Fish Barriers: I-5/ UNT to Fisher Creek (Unnamed Trib to Milltown Creek) -995242 and 03.0183 1.20-

Project:

Job Number: XL5949 Route & MP Range: SR 005 MP 218.44 - 218.56

Northing: 479,977.1 feet Latitude: 48.306308 deg.

Driller/Inspector: Gordon, Sebastian (#3313T) / Haller, Robert (#2779)

Easting: 1,279,868.8 feet Longitude: -122.314919 deg.

Start Card: RE-20851 Well Tag: BNQ-823 Instrument: 1" PVC

Elevation: 230.7 feet Collector: Region Survey

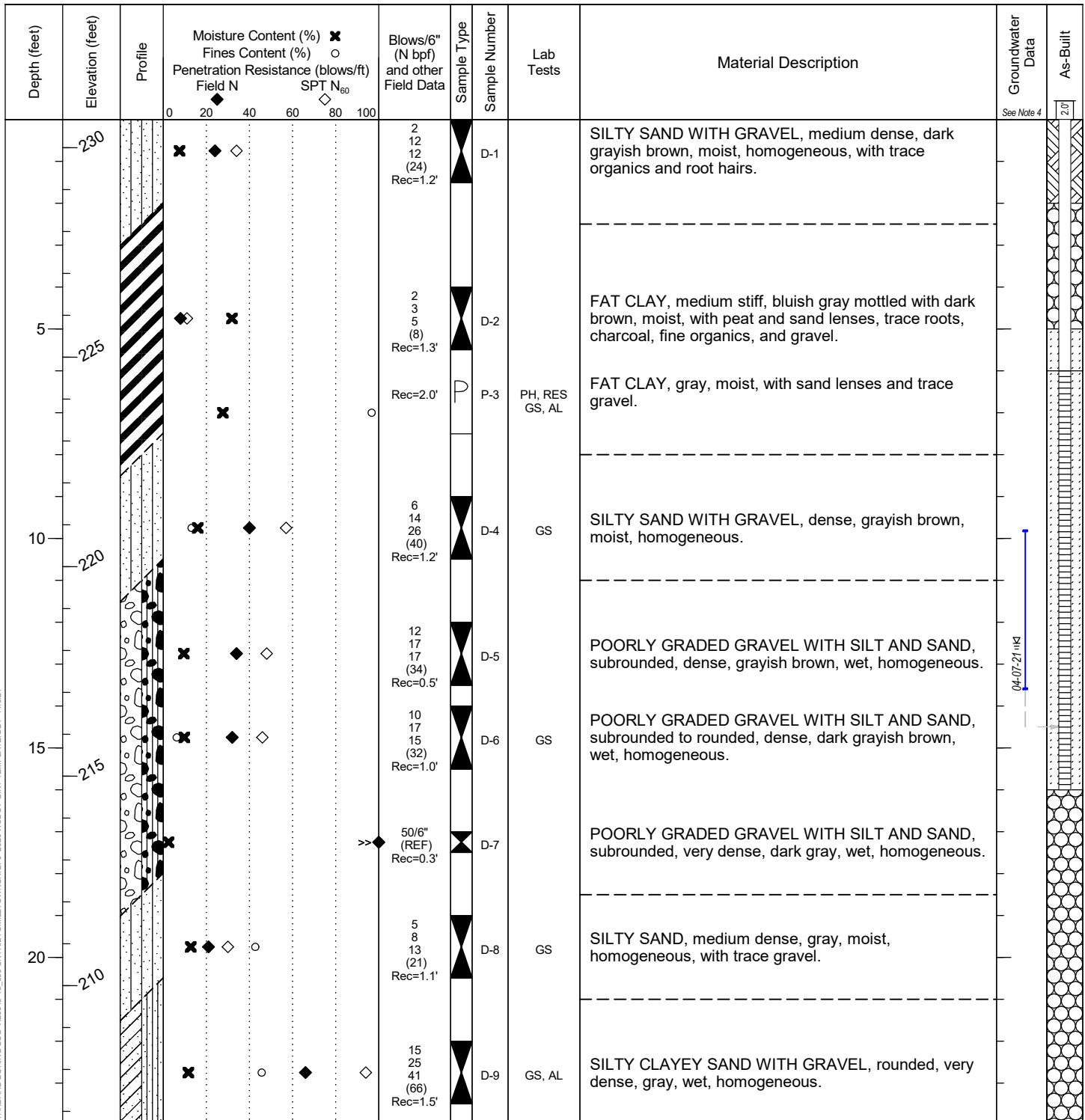
Drilling Method: Casing Advancer Hole Diam.: 4 in

Horizontal/Vertical Datum: NAD 83 HARN, SPN / NAVD88

Equipment: CME 850 (ID:9C2-4) Rod Type: HQ

Started: April 6, 2021 Completed: April 7, 2021

Hammer Type: Autohammer Historic Efficiency: 85.4%

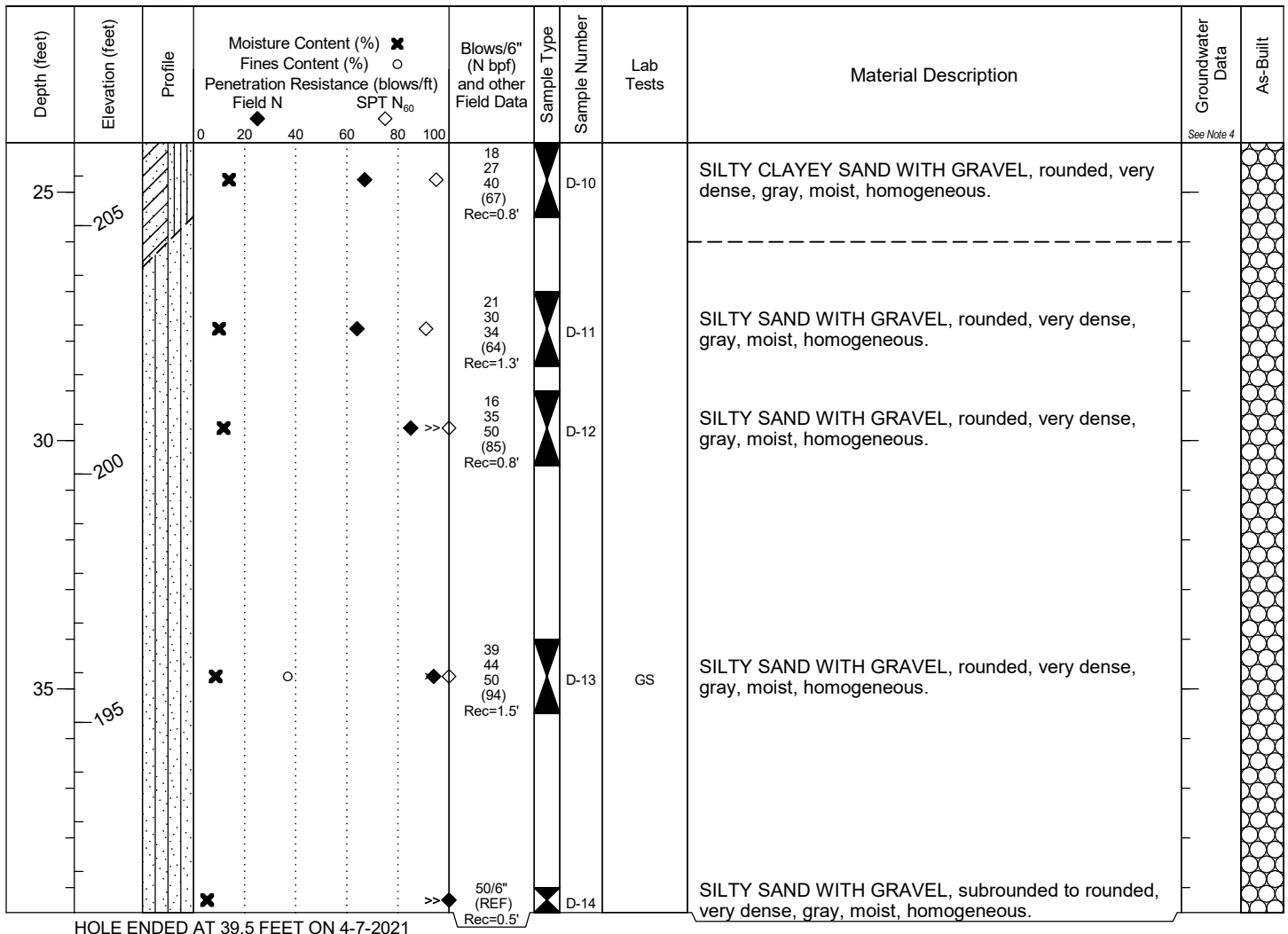


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 VERSION 1
FINAL

Advanced Work on Fish Barriers: I-5/ UNT to Fisher
 Creek (Unnamed Trib to Milltown Creek) -995242 and
 Project: 03.0183 1.20-

Job Number: XL5949 Route & MP Range: SR 005 MP 218.44 - 218.56


NOTES:

- This is a summary log of the boring. Soil/rock descriptions are derived from visual field identifications and laboratory test data (where tested). See exploration log legend for explanation of graphics and abbreviations.
- The implied accuracy of the location information displayed on this log is typically sub-meter(X,Y) when collected using GPS methods by the Geotechnical Office and sub-centimeter (X,Y,Z) when collected by the Region survey crew.
- Where oversized samplers were used, a correction was made to the N-value per the AASHTO Manual on Subsurface Investigations, 1988. Blow counts per 6-inch increment have not been corrected.
- The groundwater level range shown on this log represents data collected between 4/21/2021 and 9/15/2021. The line between the minimum and maximum values represents the data points, typically collected at 6-hour intervals.

BAIL-RECHARGE TEST RESULTS:

Test Date: April 6, 2021
 Hole Depth / Casing Depth: 39.5 feet / 39.0 feet
 Water Depth Before Bailing: 4.9 feet
 Note: Took out 7 bails with 10ft bailer

ELAPSED TIME (minutes)	WATER DEPTH (feet)
0	24.9
1	22.9
2	21.4
3	20.3
4	19.4
5	18.5
10	15.8
15	14.4
20	13.4
25	12.9
30	12.6
990	12.5

Project: Advanced Work on Fish Barriers: I-5/ UNT to Fisher Creek (Unnamed Trib to Milltown Creek) -995242 and 03.0183 1.20-

Job Number: XL5949 Route & MP Range: SR 005 MP 218.44 - 218.56

Northing: 480,053.1 feet Latitude: 48.306534 deg.

Driller/Inspector: Gordon, Sebastian (#3313T) / Haller, Robert (#2779)

Easting: 1,280,205.6 feet Longitude: -122.313541 deg.

Start Card: RE-20851 Well Tag: BNQ-824 Instrument: 1" PVC

Elevation: 239.5 feet Collector: Region Survey

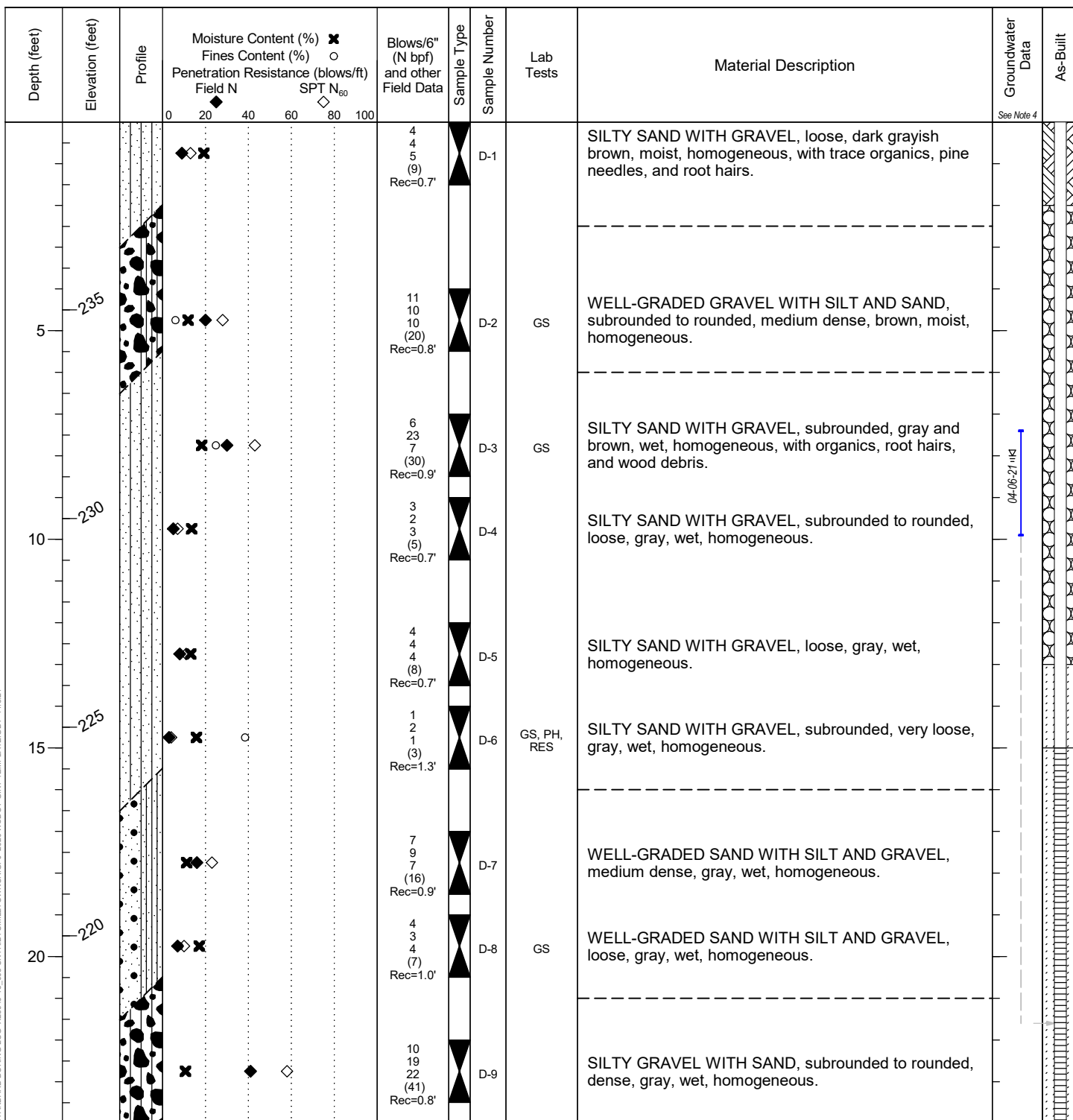
Drilling Method: Casing Advancer Hole Diam.: 4 in

Horizontal/Vertical Datum: NAD 83 HARN, SPN / NAVD88

Equipment: CME 850 (ID:9C2-4) Rod Type: HQ

Started: April 1, 2021 Completed: April 6, 2021

Hammer Type: Autohammer Historic Efficiency: 85.4%

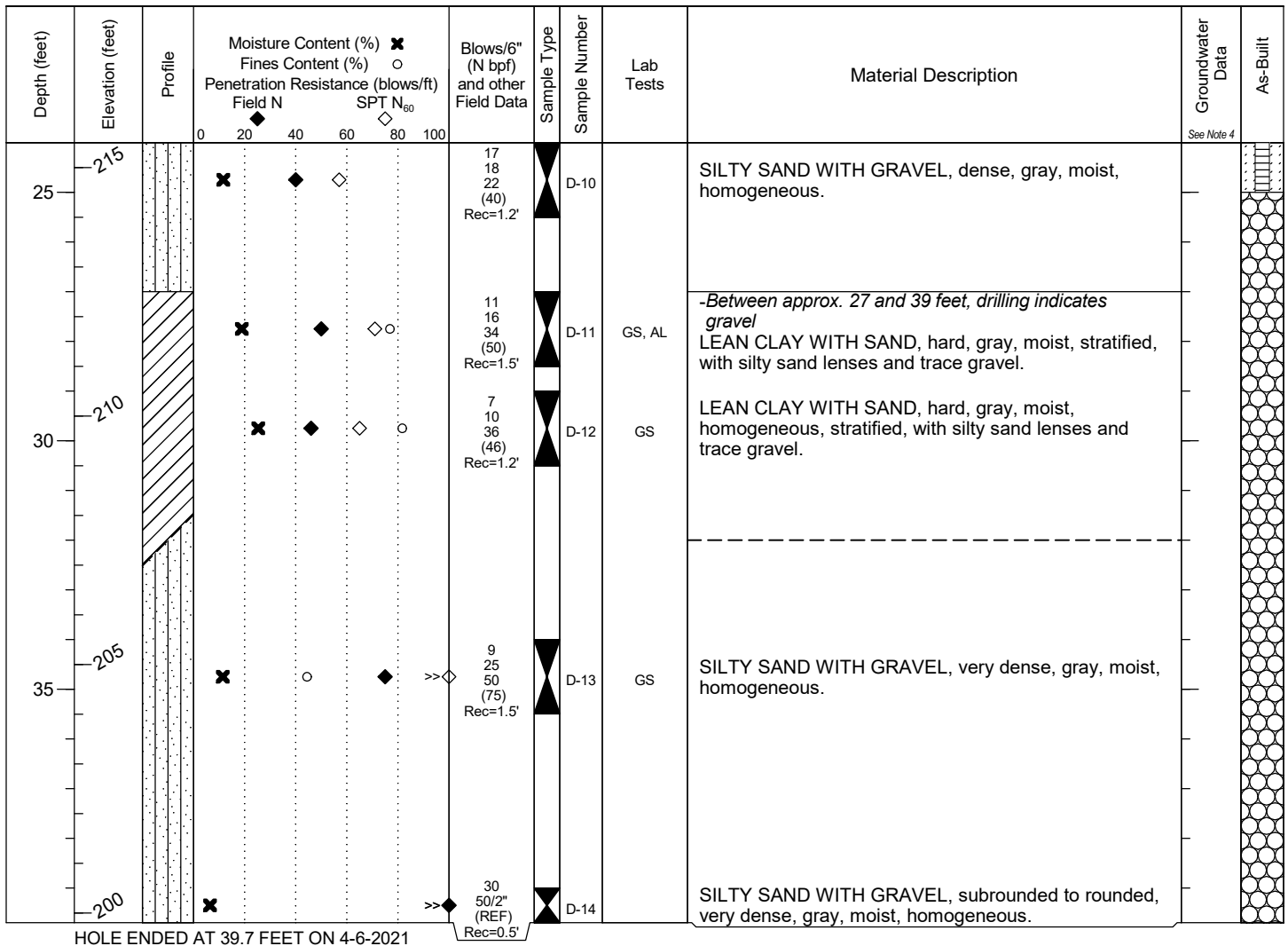


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 VERSION 1
FINAL

Project: Advanced Work on Fish Barriers: I-5/ UNT to Fisher Creek (Unnamed Trib to Milltown Creek) -995242 and 03.0183 1.20-

Job Number: XL5949 Route & MP Range: SR 005 MP 218.44 - 218.56


NOTES:

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- Where oversized samplers were used, a correction was made to the N-value per the AASHTO Manual on Subsurface Investigations, 1988. Blow counts per 6-inch increment have not been corrected.
- The groundwater level range shown on this log represents data collected between 4/21/2021 and 9/15/2021. The line between the minimum and maximum values represents the data points, typically collected at 6-hour intervals.

BAIL-RECHARGE TEST RESULTS:

Test Date: April 5, 2021
 Hole Depth / Casing Depth: 39.7 feet / 39.0 feet
 Water Depth Before Bailing: 8.8 feet
 Note: Took out 11 bails with 10ft bailer

ELAPSED TIME (minutes)	WATER DEPTH (feet)
0	28.1
1	24.3
2	20.6
3	19.8
4	17.2
5	16.8
10	11.5
15	10.5
20	9.2
25	8.4
30	8.0
35	8.0
960	8.0

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary to Secret Creek (992175)

Job Number: XL5949 Route & MP Range: SR 005 MP 213.62 - 213.66

Northing: 459,275.0 feet Latitude: 48.250326 deg.

Driller/Inspector: Peterson, Trevor (#3008) / Harvey, Thomas (#2599)

Easting: 1,294,540.9 feet Longitude: -122.253072 deg.

Start Card: RE20976 Well Tag: BNQ912 Instrument: 1" PVC

Elevation: 335.1 feet Collector: Region Survey

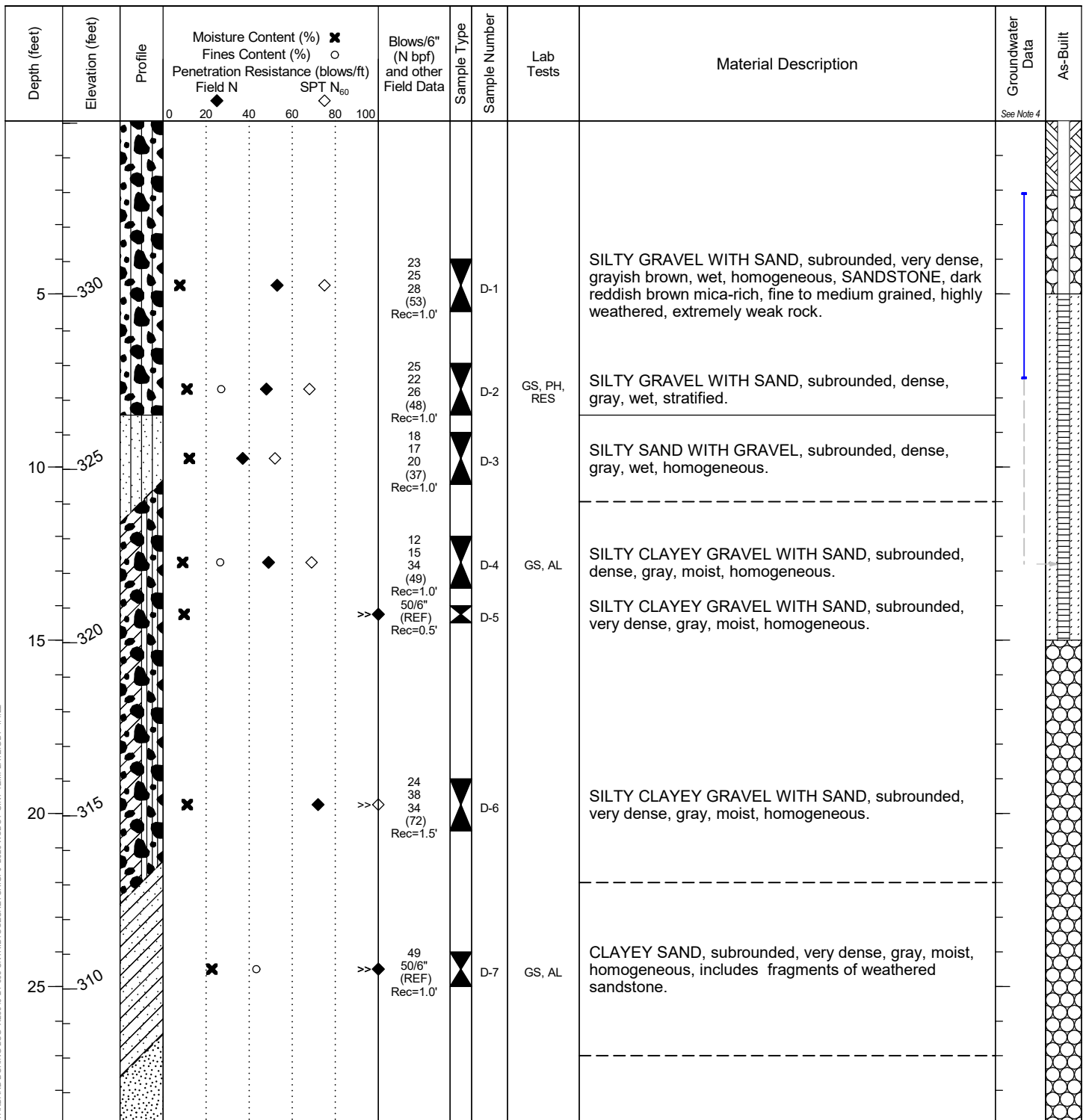
Drilling Method: Casing Advancer Hole Diam.: 6 in

Horizontal/Vertical Datum: NAD 83 HARN, SPN / NAVD88

Equipment: CME 850 (ID:9C2-5) Rod Type: HWT

Started: April 12, 2021 Completed: April 13, 2021

Hammer Type: AutoHammer Historic Efficiency: 84.5%



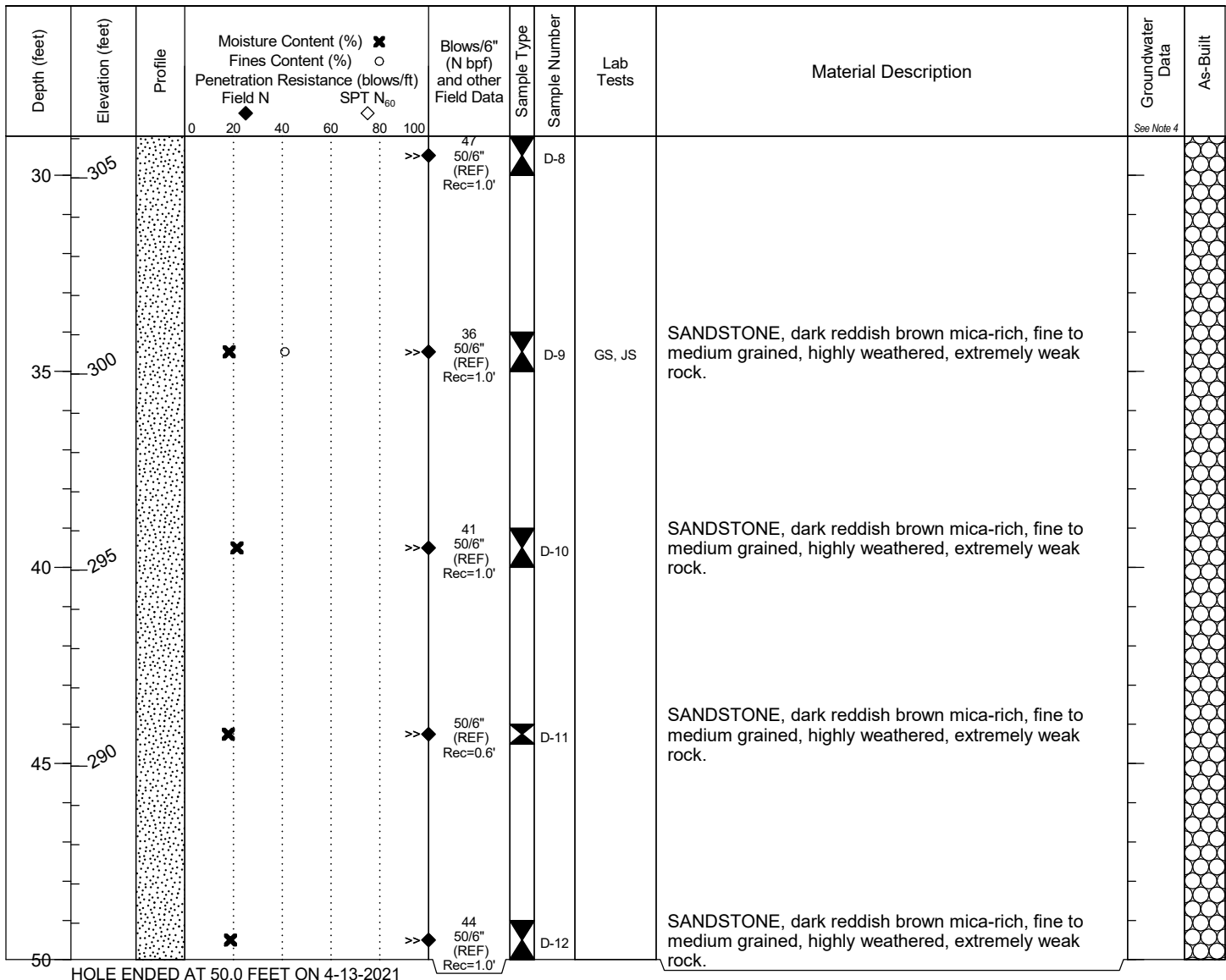
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VERSION 1
FINAL

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary
to Secret Creek (992175)

Job Number: XL5949

Route & MP Range: SR 005 MP 213.62 - 213.66


NOTES:

- This is a summary log of the boring. Soil/rock descriptions are derived from visual field identifications and laboratory test data (where tested). See exploration log legend for explanation of graphics and abbreviations.
- The implied accuracy of the location information displayed on this log is typically sub-meter(X,Y) when collected using GPS methods by the Geotechnical Office and sub-centimeter (X,Y,Z) when collected by the Region survey crew.
- Where oversized samplers were used, a correction was made to the N-value per the AASHTO Manual on Subsurface Investigations, 1988. Blow counts per 6-inch increment have not been corrected.
- The groundwater level range shown on this log represents data collected between 4/21/2021 and 9/15/2021. The line between the minimum and maximum values represents the data points, typically collected at 6-hour intervals.

BAIL-RECHARGE TEST RESULTS:

Test Date: April 13, 2021
Hole Depth / Casing Depth: 50.0 feet / 49.0 feet
Water Depth Before Bailing: 3.4 feet

ELAPSED TIME (minutes)	WATER DEPTH (feet)
0	16.5
1	11.9
5	8.6
10	6.7
15	6.6
20	6.6
30	6.6

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary to Secret Creek (992175)

Job Number: XL5949 Route & MP Range: SR 005 MP 213.62 - 213.66

Northing: 459,212.4 feet Latitude: 48.250150 deg.

Driller/Inspector: Peterson, Trevor (#3008) / Harvey, Thomas (#2599)

Easting: 1,294,460.6 feet Longitude: -122.253397 deg.

Start Card: RE20976 Well Tag: BNQ913 Instrument: 1" PVC

Elevation: 333.8 feet Collector: Region Survey

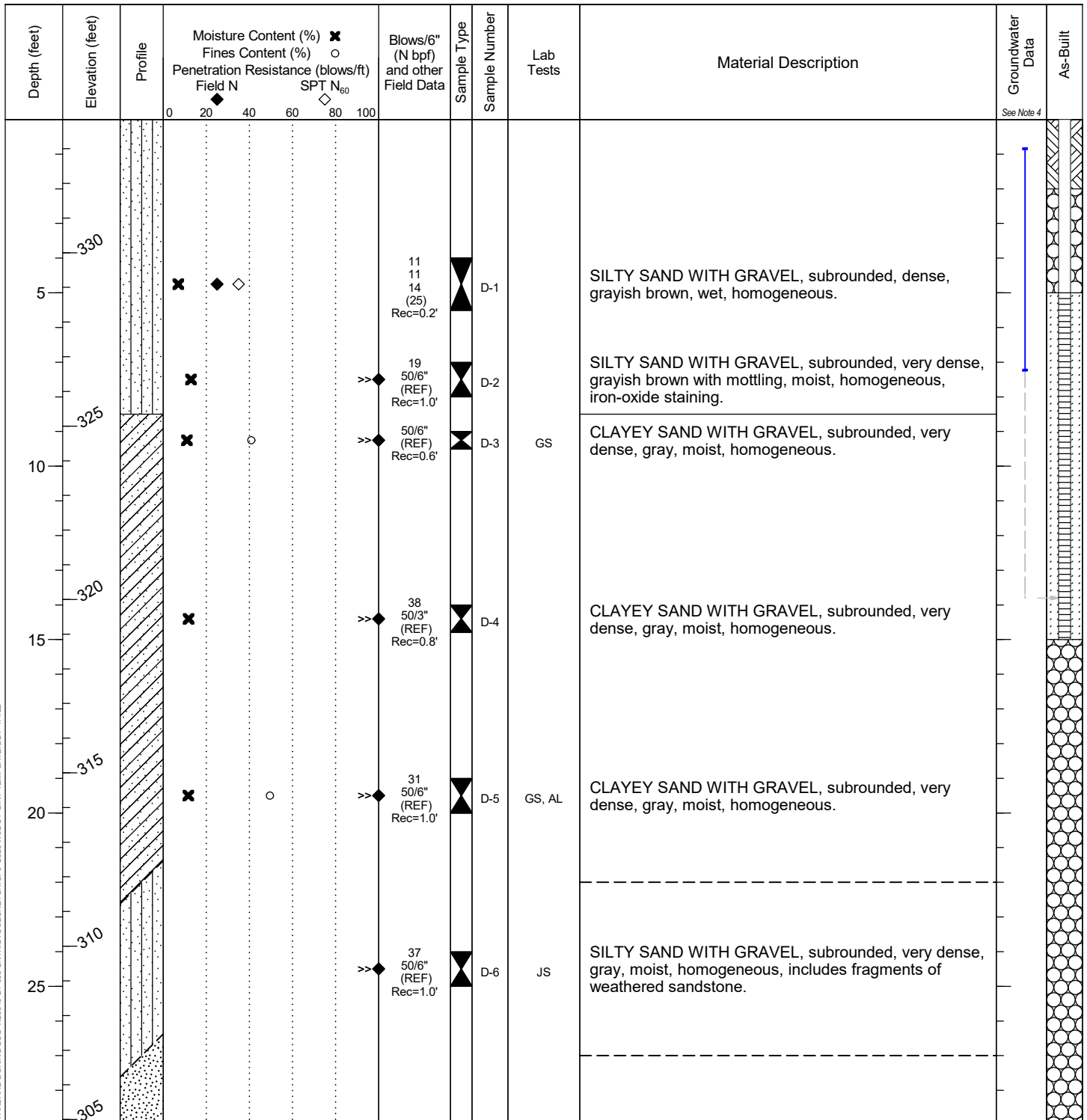
Drilling Method: Casing Advancer Hole Diam.: 6 in

Horizontal/Vertical Datum: NAD 83 HARN, SPN / NAVD88

Equipment: CME 850 (ID:9C2-5) Rod Type: HWT

Started: April 13, 2021 Completed: April 14, 2021

Hammer Type: Autohammer Historic Efficiency: 84.5%



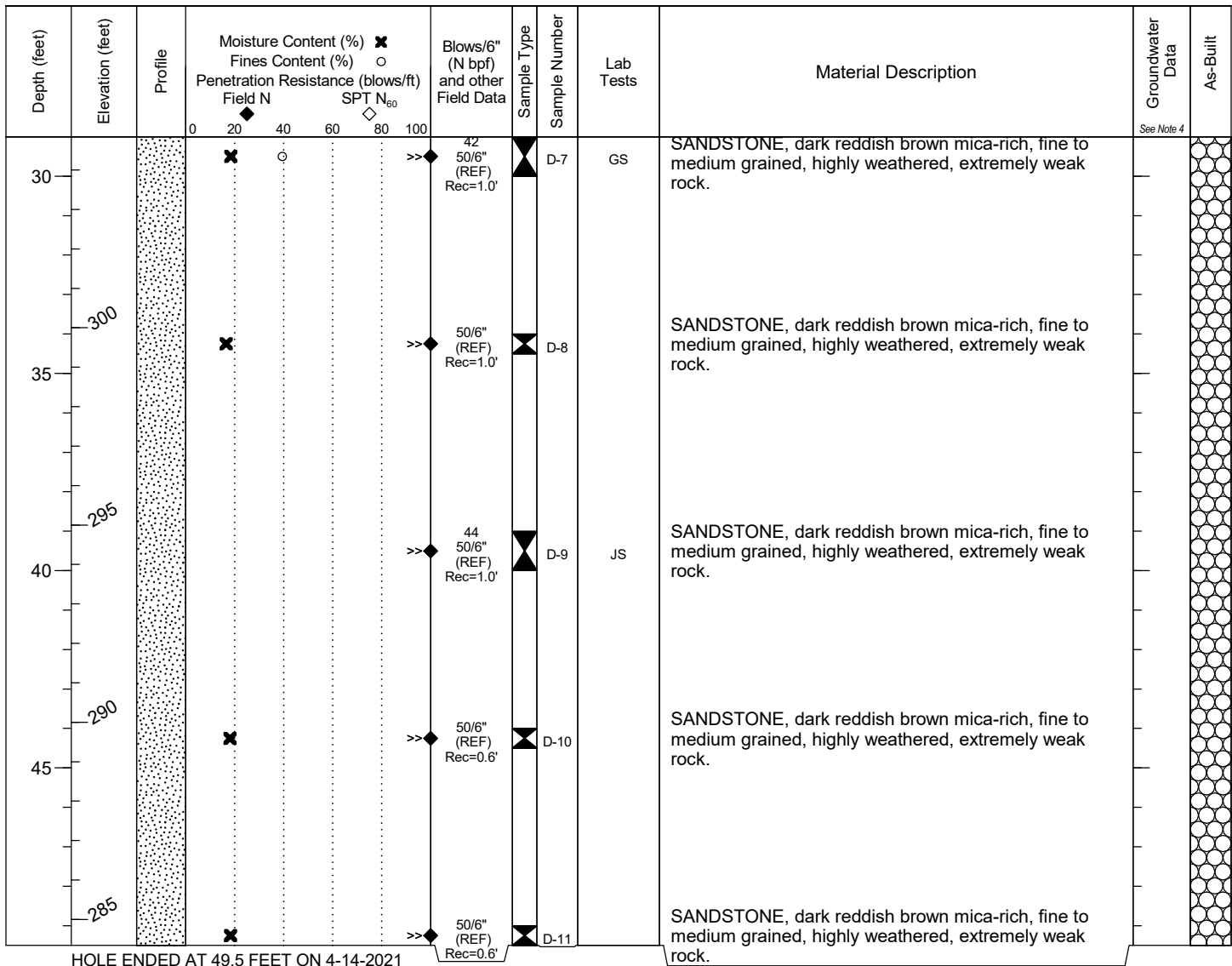
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VERSION 1
FINAL

Project: Advanced Work on Fish Barriers: I-5/Unnamed Tributary
to Secret Creek (992175)

Job Number: XL5949

Route & MP Range: SR 005 MP 213.62 - 213.66


NOTES:

- This is a summary log of the boring. Soil/rock descriptions are derived from visual field identifications and laboratory test data (where tested). See exploration log legend for explanation of graphics and abbreviations.
- The implied accuracy of the location information displayed on this log is typically sub-meter(X,Y) when collected using GPS methods by the Geotechnical Office and sub-centimeter (X,Y,Z) when collected by the Region survey crew.
- Where oversized samplers were used, a correction was made to the N-value per the AASHTO Manual on Subsurface Investigations, 1988. Blow counts per 6-inch increment have not been corrected.
- The groundwater level range shown on this log represents data collected between 4/21/2021 and 9/15/2021. The line between the minimum and maximum values represents the data points, typically collected at 6-hour intervals.

BAIL-RECHARGE TEST RESULTS:

Test Date: April 14, 2021
Hole Depth / Casing Depth: 49.5 feet / 49.0 feet
Water Depth Before Bailing: 3.5 feet

ELAPSED TIME (minutes)	WATER DEPTH (feet)
0	11.1
5	6.1
10	6.0
15	5.9
20	5.9
30	5.9

Advanced Work on Fish Barriers: I-5/ UNT to Fisher Creek (Unnamed Trib to Milltown Creek) -995242 and 03.0183 1.20-

Project: _____

 Job Number: XL5949 Route & MP Range: SR 005 MP 218.44 - 218.56

 Northing: 480,283.8 feet Latitude: 48.307106 deg.

 Driller/Inspector: Peterson, Trevor (#3008) / Harvey, Thomas (#2599)

 Easting: 1,279,057.9 feet Longitude: -122.318274 deg.

 Start Card: SE77795
AE66389

 Elevation: 234.7 feet Collector: Region Survey

 Drilling Method: Casing Advancer Hole Diam.: 6 in

 Horizontal/Vertical Datum: NAD 83 HARN, SPN / NAVD88

 Equipment: CME 850 (ID:9C2-5) Rod Type: HWT

 Started: April 27, 2021 Completed: April 28, 2021

 Hammer Type: Autohammer Historic Efficiency: 84.5%

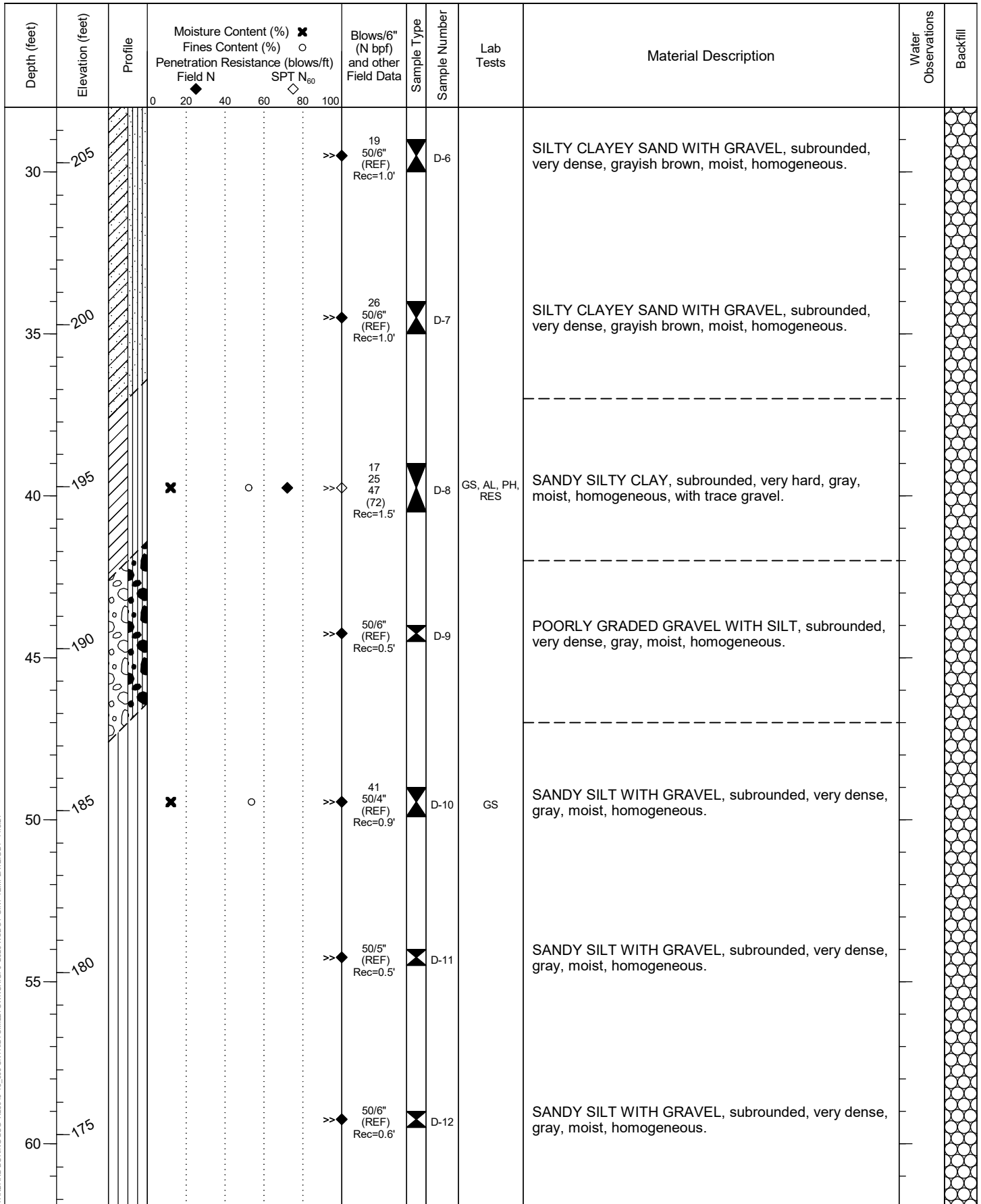
Depth (feet)	Elevation (feet)	Profile	Moisture Content (%) Fines Content (%) Penetration Resistance (blows/ft) Field N	Blows/6" (N bpf) and other Field Data	Sample Type	Sample Number	Lab Tests	Material Description	Water Observations	Backfill
			0 20 40 60 80 100 SPT N ₆₀							
5	230		✕ ◆ ◇ 7 11 12 (23) Rec=1.5'		D-1		PH, RES	SILTY SAND WITH GRAVEL, subrounded, medium dense, grayish brown, moist, homogeneous.		
10	225		✕ ◆ ◇ 13 12 22 (34) Rec=1.5'		D-2		GS, AL	SILTY SAND WITH GRAVEL, subrounded, dense, grayish brown, moist, homogeneous.		
15	220		◆ ◇ 8 7 9 (16) Rec=0.8'		D-3			SILTY SAND WITH GRAVEL, subrounded, medium dense, gray, moist, homogeneous, with trace clay.		
20	215		✕ ◆ ◇ 11 13 10 (23) Rec=1.5'		D-4		GS, AL	SILTY SAND WITH GRAVEL, subrounded, medium dense, gray, moist, homogeneous, with trace clay.		
25	210		◆ ◇ 7 13 12 (25) Rec=1.5'		D-5			CLAYEY SAND WITH GRAVEL, subrounded, dense, bluish gray, moist, homogeneous.		

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 VERSION 1
FINAL

Advanced Work on Fish Barriers: I-5/ UNT to Fisher
 Creek (Unnamed Trib to Milltown Creek) -995242 and
 Project: 03.0183 1.20-

Job Number: XL5949 Route & MP Range: SR 005 MP 218.44 - 218.56



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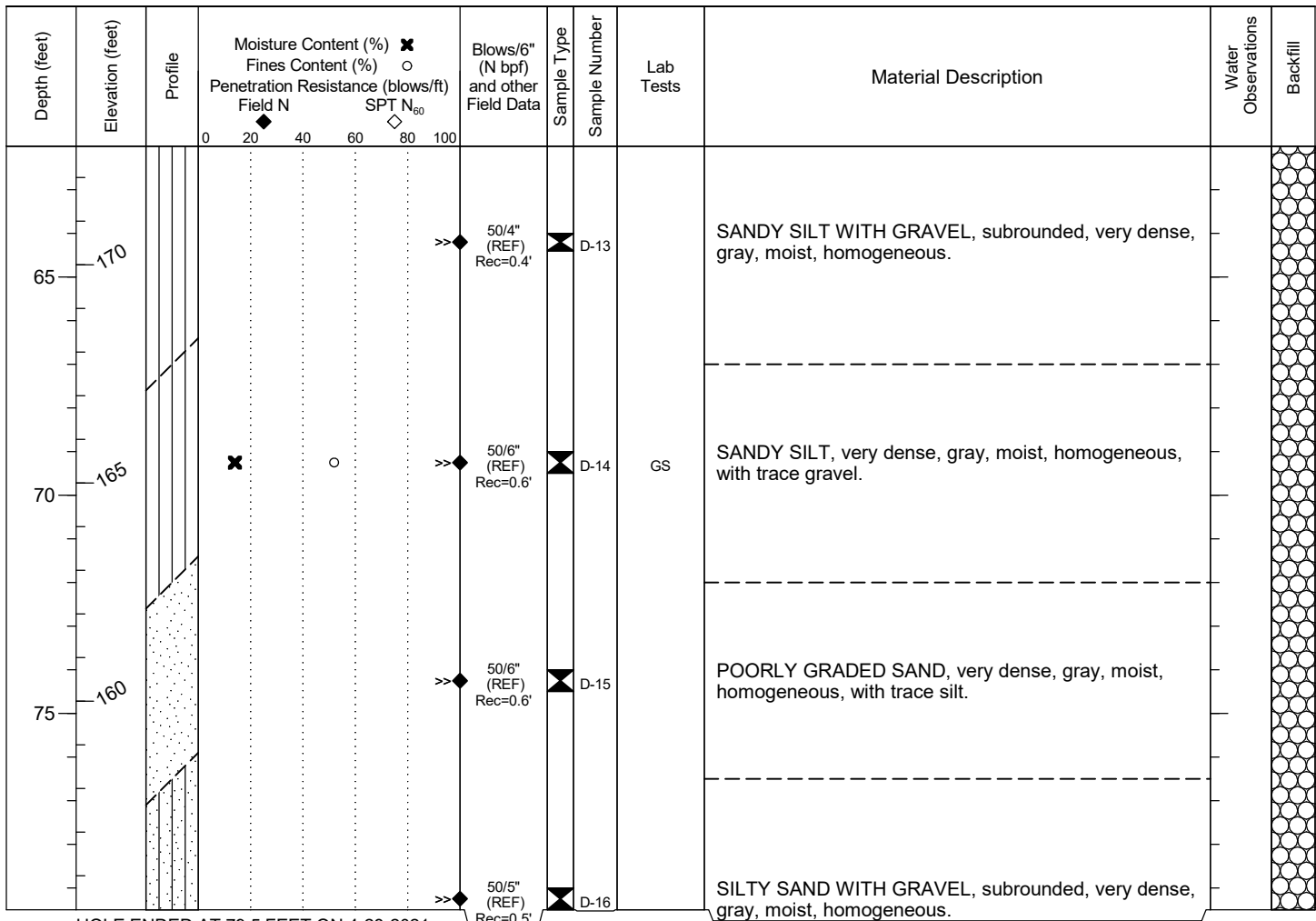
 VERSION 1
FINAL

Advanced Work on Fish Barriers: I-5/ UNT to Fisher
 Creek (Unnamed Trib to Milltown Creek) -995242 and
 03.0183 1.20-

Project:

Job Number: XL5949

Route & MP Range: SR 005 MP 218.44 - 218.56


NOTES:

- This is a summary log of the boring. Soil/rock descriptions are derived from visual field identifications and laboratory test data (where tested). See exploration log legend for explanation of graphics and abbreviations.
- The implied accuracy of the location information displayed on this log is typically sub-meter (X,Y) when collected using GPS methods by the Geotechnical Office and sub-centimeter (X,Y,Z) when collected by the Region survey crew.
- Where oversized samplers were used, a correction was made to the N-value per the AASHTO Manual on Subsurface Investigations, 1988. Blow counts per 6-inch increment have not been corrected.
- The groundwater level(s), if shown, represents observations made during drilling and/or stabilized water measured during a bail test. The groundwater level should be considered approximate and will vary based on seasonal and other effects.

BAIL-RECHARGE TEST RESULTS:

 Test Date: April 28, 2021
 Hole Depth / Casing Depth: 79.5 feet / 79.0 feet
 Water Depth Before Bailing: 7.5 feet
 Note: Bailed to 51.4 feet. No recharge.

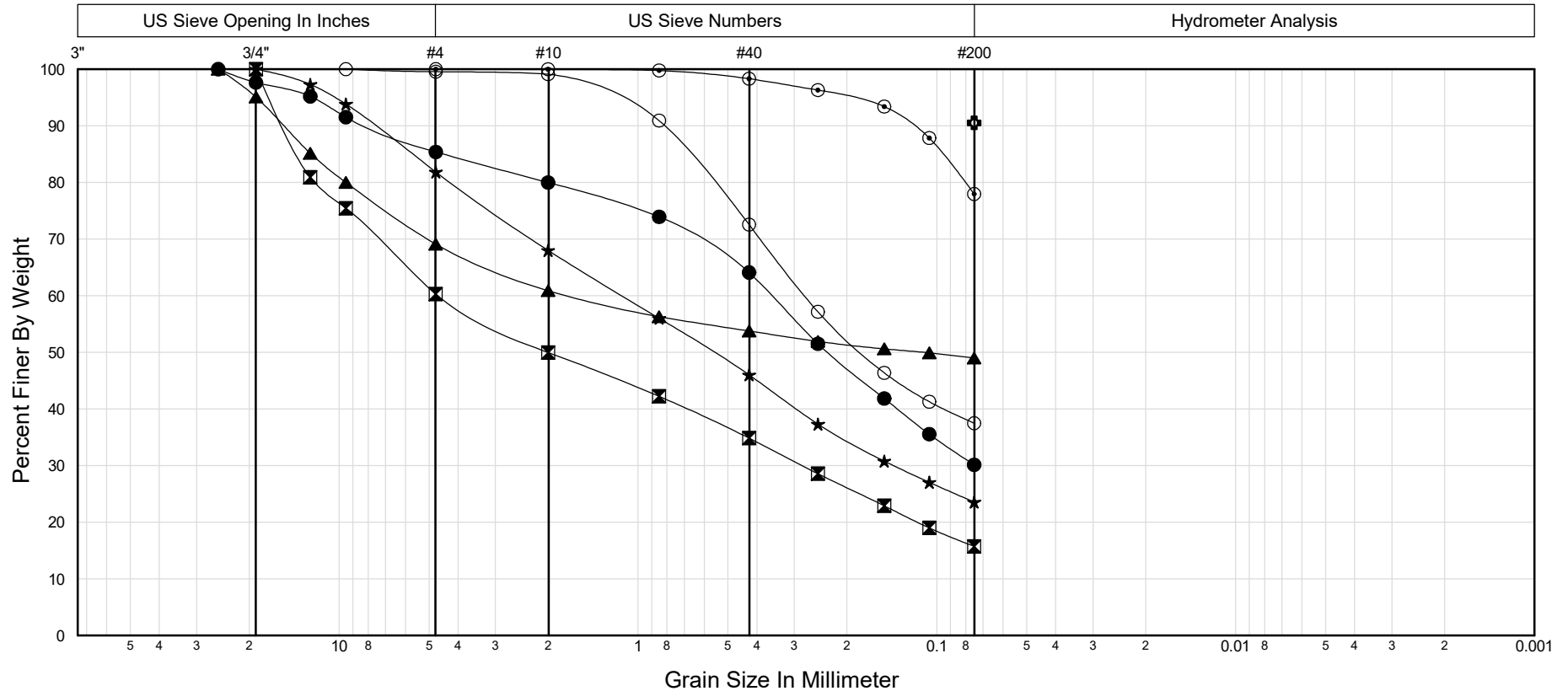
ELAPSED TIME (minutes)	WATER DEPTH (feet)
0	51.4
60	51.4

Appendix C: Laboratory Test Results

Job No: **XL5949**

Project: **Advanced Work on Fish Barriers: I-5/Unnamed Tributary to West Fork Church Creek (Freedom Creek) -996077-**

Symbol	Depth (feet)	Sample No.	USCS	Description	Test Date	MC (%)	LL	PL	PI	Moist Density (lbs/ft ³)	Specific Gravity	Gravel (%)	Sand (%)	Fines (%)	C _c	C _u	D ₆₀ (mm)	D ₅₀ (mm)	D ₃₀ (mm)	D ₂₀ (mm)	D ₁₀ (mm)
●	4.0	D-2		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	22						14.6	55.2	30.1			0.358	0.231			
⊠	9.0	D-4		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	17						39.7	44.6	15.7			4.637	2.005	0.282	0.116	
▲	14.0	D-6	GC	CLAYEY GRAVEL with SAND	4-30-21	21	35	21	14			30.9	20.1	49.0			1.699	0.111			
★	19.0	D-8		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	13						18.2	58.3	23.5			1.130	0.560	0.139		
⊙	24.0	D-10	CH	FAT CLAY with SAND	4-30-21	28	59	22	37			0.0	22.0	78.0							
⊕	29.0	D-11	CH	FAT CLAY	4-30-21	22	57	26	31			N/A	N/A	90.5							
○	39.0	D-13		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	17						0.4	62.1	37.5			0.276	0.178			

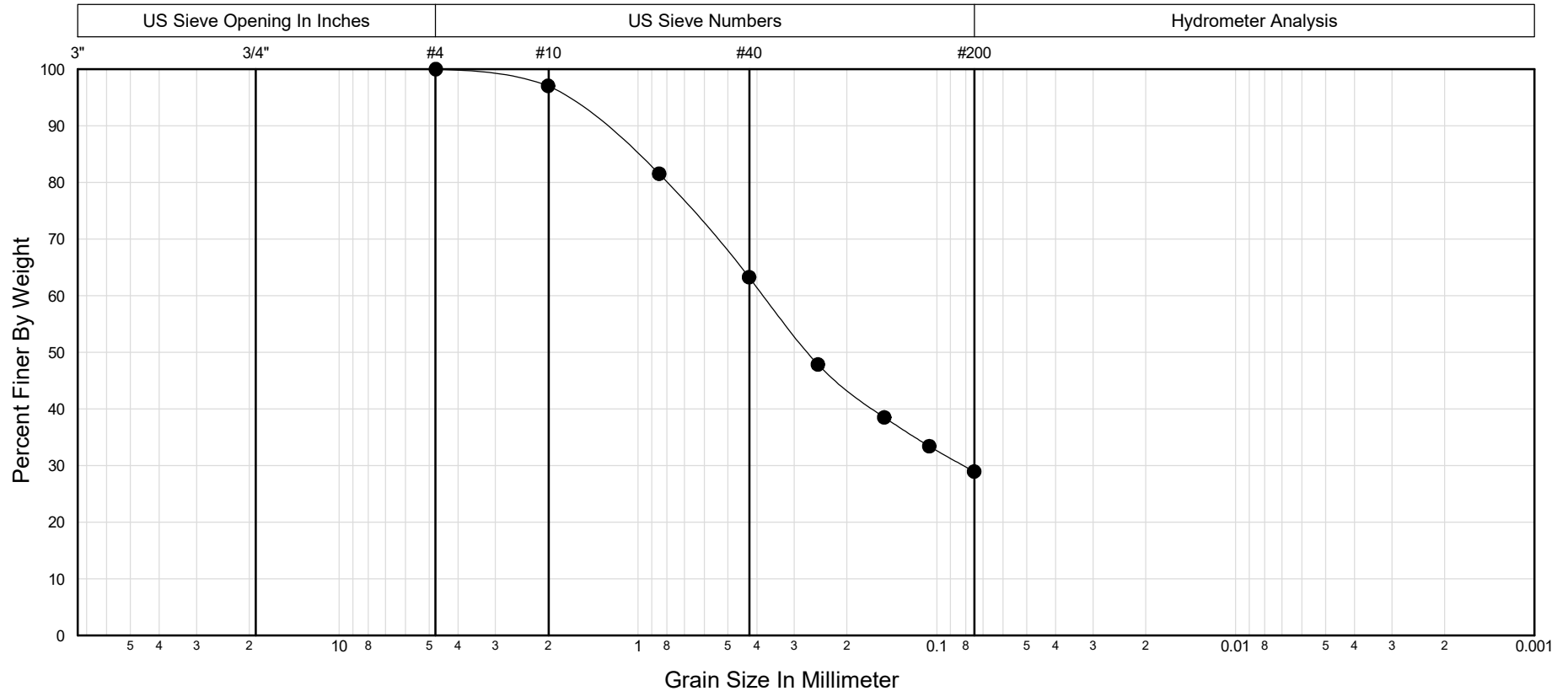


Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		

Job No: **XL5949**

Project: **Advanced Work on Fish Barriers: I-5/Unnamed Tributary to West Fork Church Creek (Freedom Creek) -996077-**

Symbol	Depth (feet)	Sample No.	USCS	Description	Test Date	MC (%)	LL	PL	PI	Moist Density (lbs/ft ³)	Specific Gravity	Gravel (%)	Sand (%)	Fines (%)	C _c	C _u	D ₆₀ (mm)	D ₅₀ (mm)	D ₃₀ (mm)	D ₂₀ (mm)	D ₁₀ (mm)
●	49.0	D-15		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	21						0.0	71.1	28.9			0.380	0.269	0.081		

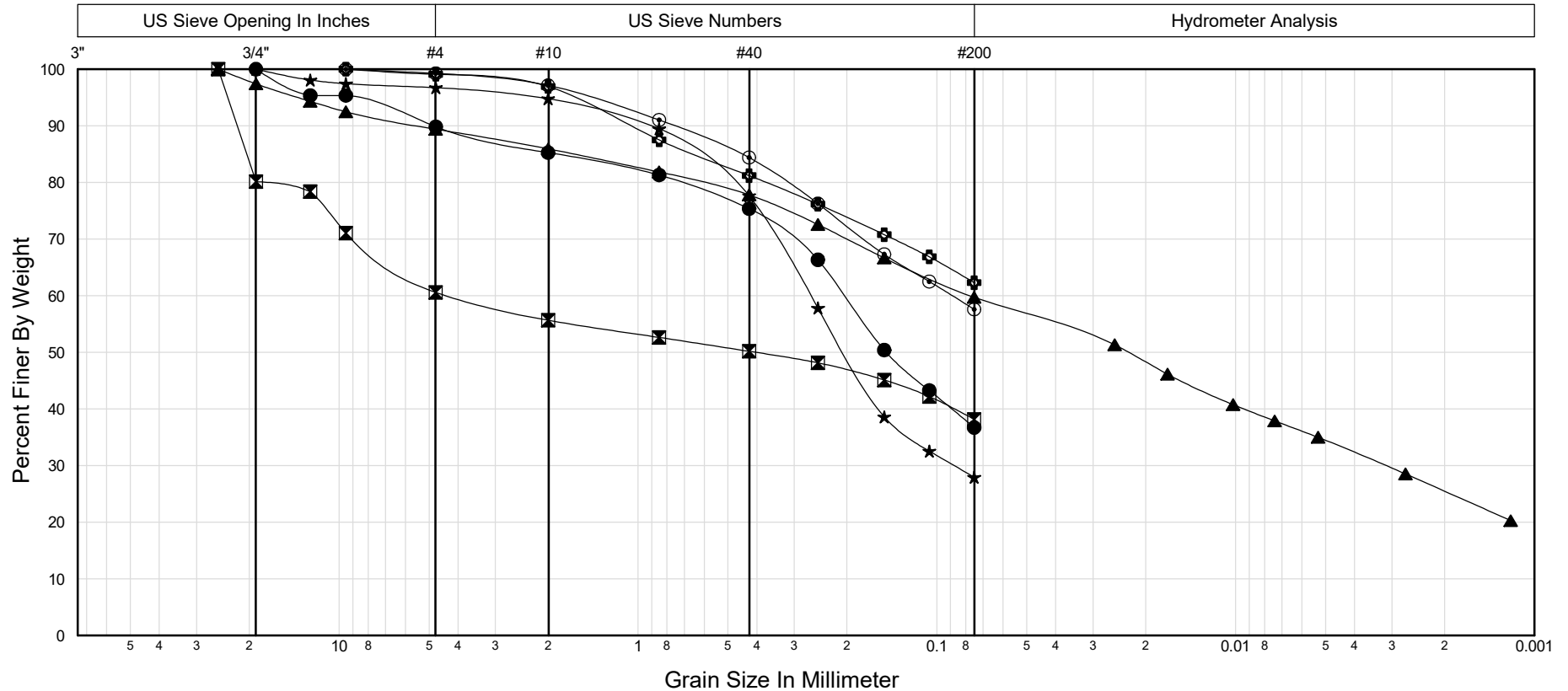


Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		

Job No: **XL5949**

Project: **Advanced Work on Fish Barriers: I-5/Unnamed Tributary to West Fork Church Creek (Freedom Creek) -996077-**

Symbol	Depth (feet)	Sample No.	USCS	Description	Test Date	MC (%)	LL	PL	PI	Moist Density (lbs/ft ³)	Specific Gravity	Gravel (%)	Sand (%)	Fines (%)	C _c	C _u	D ₆₀ (mm)	D ₅₀ (mm)	D ₃₀ (mm)	D ₂₀ (mm)	D ₁₀ (mm)
●	4.0	D-1		Sieve analyses only - no Atterberg Limits: Description not calculated	5-13-21	26						10.2	53.1	36.7			0.204	0.147			
⊠	14.0	D-5		Sieve analyses only - no Atterberg Limits: Description not calculated	5-13-21	19						39.4	22.4	38.2			4.294	0.406			
▲	17.0	D-6		Sieve analyses only - no Atterberg Limits: Description not calculated	5-13-21	20						10.6	29.7	59.7			0.077	0.023	0.003		
★	34.0	D-11		Sieve analyses only - no Atterberg Limits: Description not calculated	5-13-21	20						3.3	68.8	27.9			0.265	0.203	0.087		
⊙	39.0	D-12	CL	SANDY LEAN CLAY	5-13-21	23	47	24	23			0.8	41.7	57.6			0.089				
⊕	49.0	D-14	CH	SANDY FAT CLAY	5-13-21	20	52	19	33			0.9	36.8	62.3							

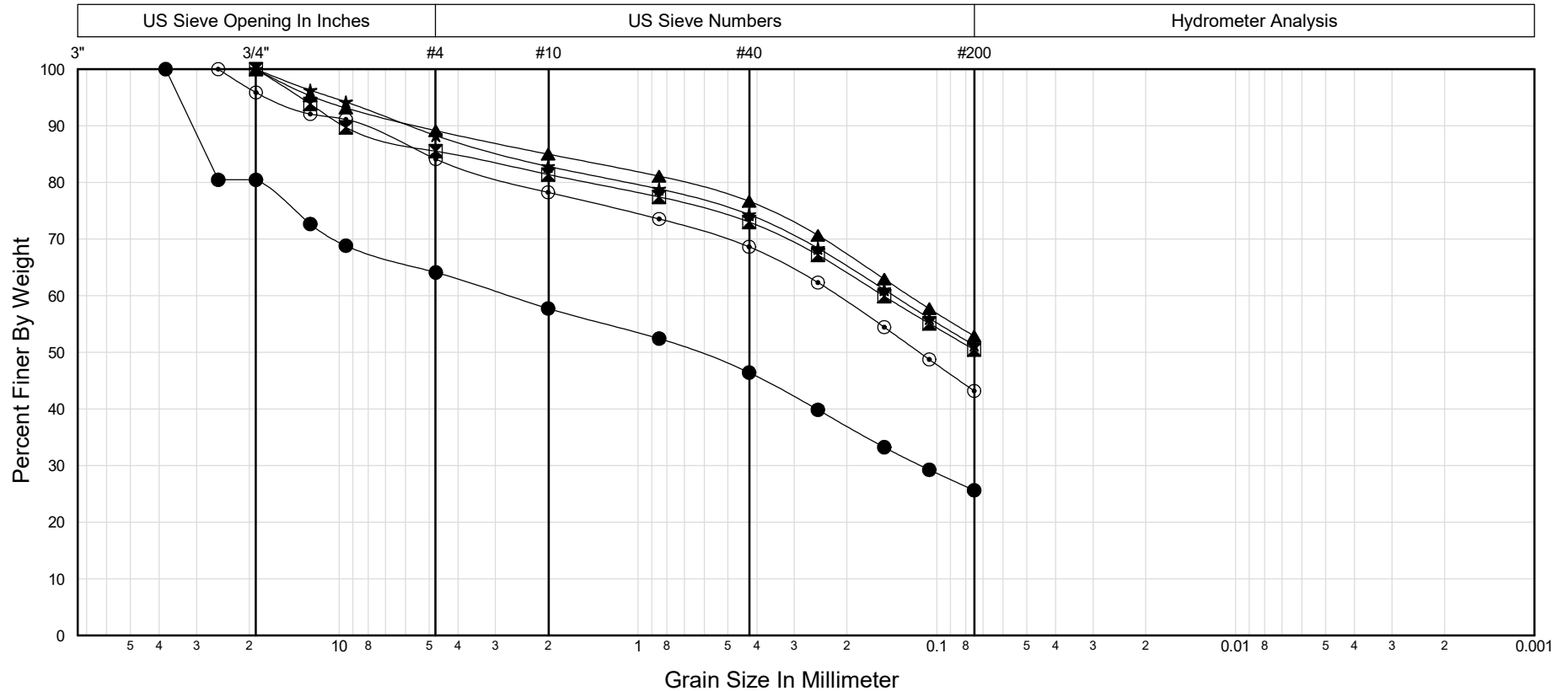


Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		

Job No: **XL5949**

Project: **Advanced Work on Fish Barriers: I-5/ WF Church Creek (Freedom Creek) -996073-**

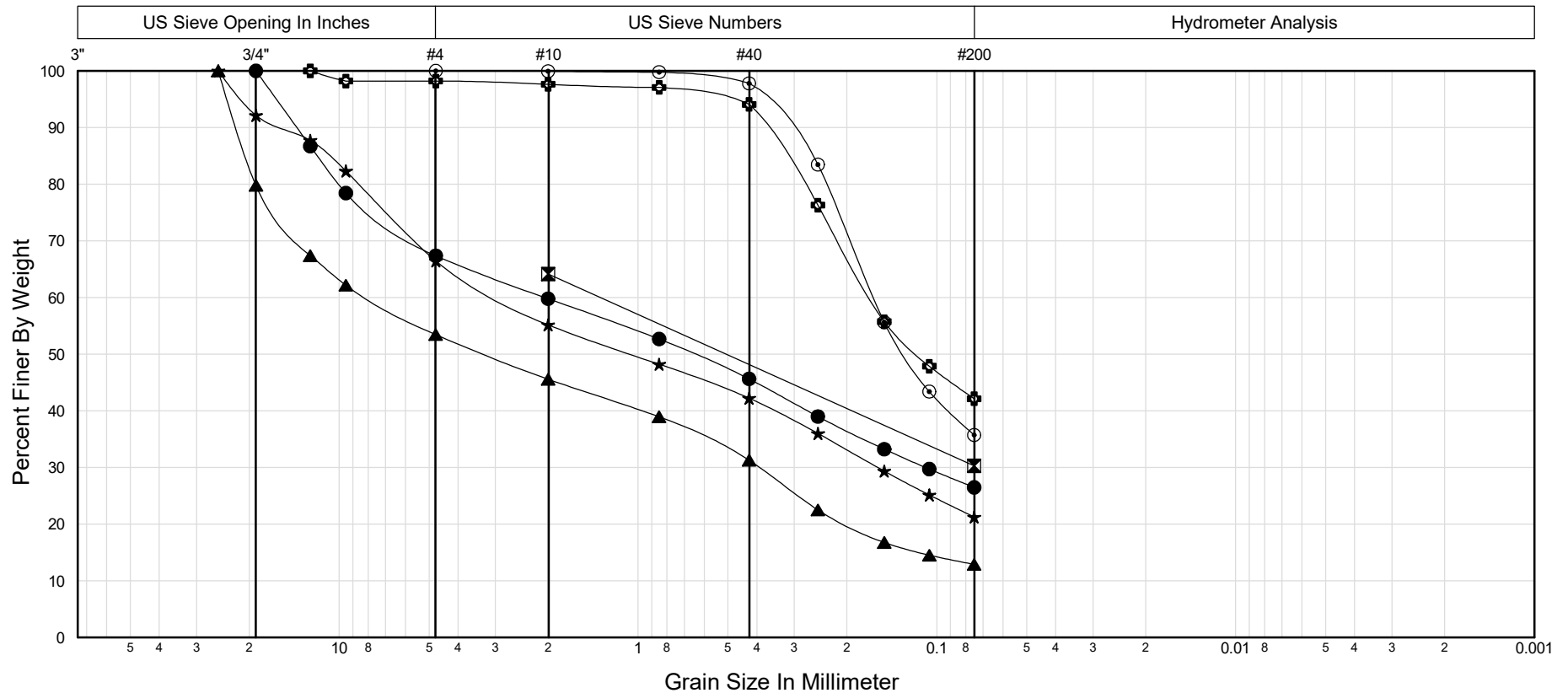
Symbol	Depth (feet)	Sample No.	USCS	Description	Test Date	MC (%)	LL	PL	PI	Moist Density (lbs/ft³)	Specific Gravity	Gravel (%)	Sand (%)	Fines (%)	C _c	C _u	D ₆₀ (mm)	D ₅₀ (mm)	D ₃₀ (mm)	D ₂₀ (mm)	D ₁₀ (mm)
●	7.0	D-2		Sieve analyses only - no Atterberg Limits: Description not calculated	5-14-21	11						35.9	38.5	25.6			2.721	0.642	0.113		
⊠	19.0	D-7	CL	SANDY LEAN CLAY	5-14-21	12	24	14	10			14.5	35.0	50.5			0.151				
▲	29.0	D-9		Sieve analyses only - no Atterberg Limits: Description not calculated	5-14-21	10						10.9	36.3	52.9			0.123				
★	34.0	D-10		Sieve analyses only - no Atterberg Limits: Description not calculated	5-14-21	10						11.7	37.0	51.3			0.139				
⊙	54.0	D-14		Sieve analyses only - no Atterberg Limits: Description not calculated	5-14-21	9						15.9	40.9	43.2			0.215	0.114			



Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		

Job No: **XL5949**

Project: **Advanced Work on Fish Barriers: I-5/Unnamed Tributary to West Fork Church Creek (Freedom Creek) -996071-**

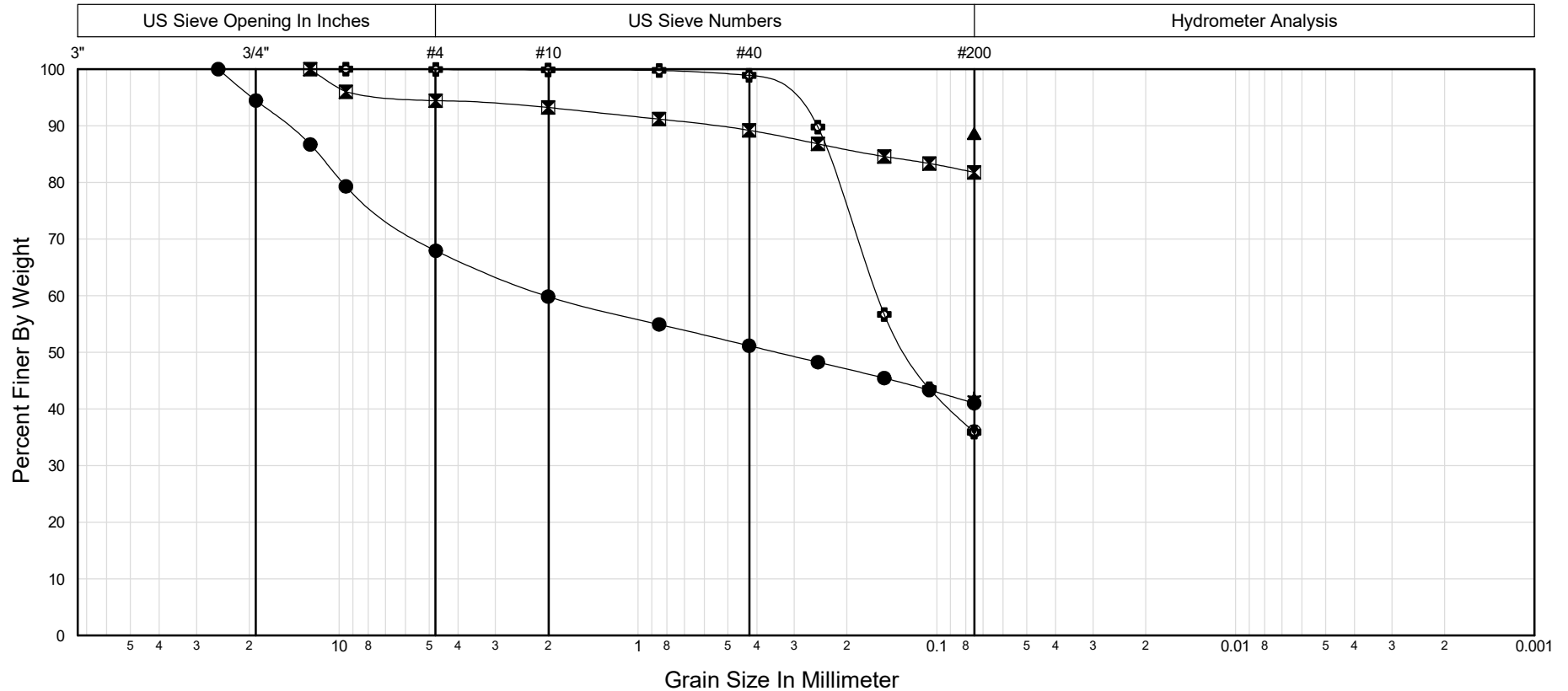
[illegible]

Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		

Job No: **XL5949**

Project: **Advanced Work on Fish Barriers: I-5/Unnamed Tributary to West Fork Church Creek (Freedom Creek) -996071-**

Symbol	Depth (feet)	Sample No.	USCS	Description	Test Date	MC (%)	LL	PL	PI	Moist Density (lbs/ft ³)	Specific Gravity	Gravel (%)	Sand (%)	Fines (%)	C _c	C _u	D ₆₀ (mm)	D ₅₀ (mm)	D ₃₀ (mm)	D ₂₀ (mm)	D ₁₀ (mm)
●	12.0	D-4	GC	CLAYEY GRAVEL with SAND	4-30-21	20	33	18	15			32.1	26.9	41.0			2.036	0.344			
⊠	17.0	D-6	CL-ML	SILTY CLAY with SAND	4-30-21	21	26	20	6			5.6	12.6	81.8							
▲	19.0	D-7	CL	LEAN CLAY	4-30-21	23	30	20	10			N/A	N/A	88.6							
★	24.0	D-8		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	14						N/A	N/A	42.0							
⊙	39.0	D-11		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	20						N/A	N/A	36.1							
⊕	54.0	D-14		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	20						0.1	64.0	35.9			0.158	0.126			

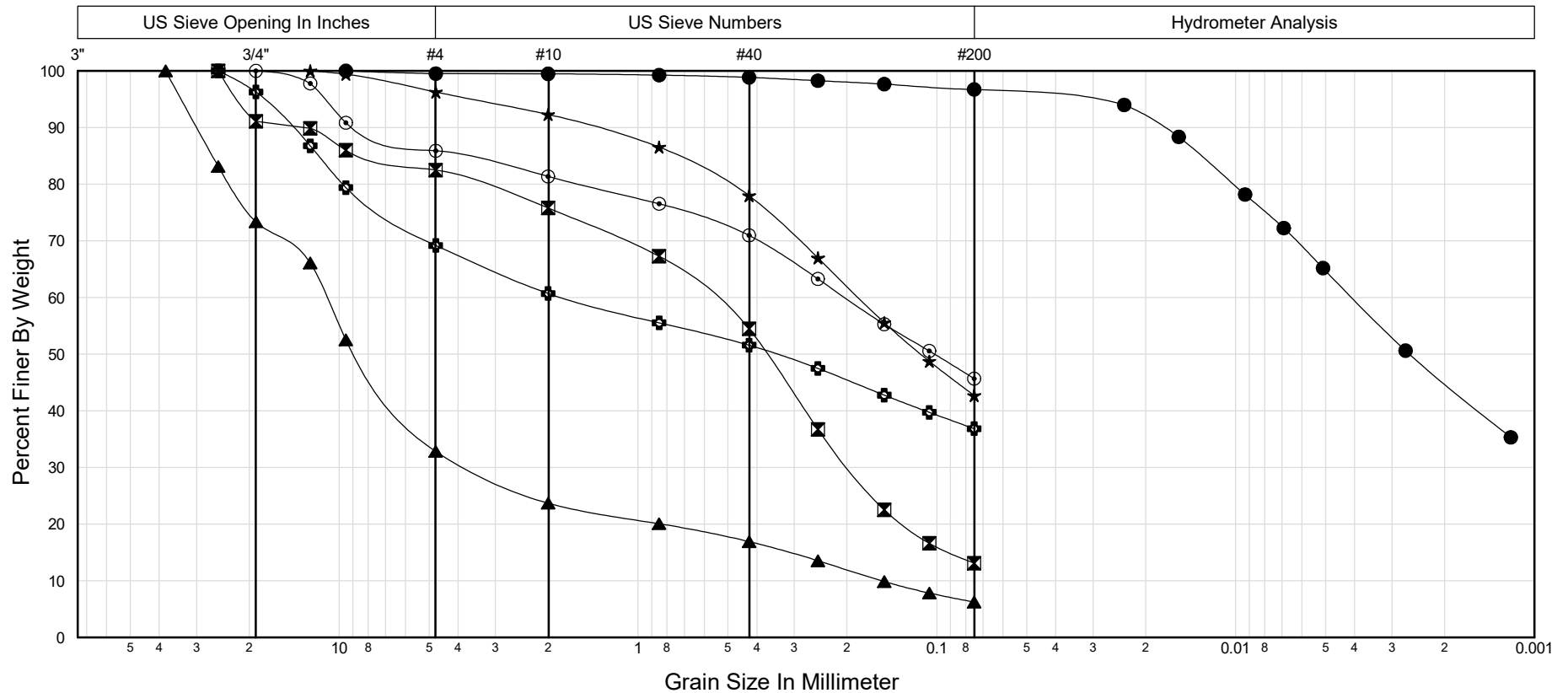


Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		

Job No: **XL5949**

Project: **Advanced Work on Fish Barriers: I-5/ UNT to Fisher Creek (Unnamed Trib to Milltown Creek) -995242 and 03.0183 1.20-**

Symbol	Depth (feet)	Sample No.	USCS	Description	Test Date	MC (%)	LL	PL	PI	Moist Density (lbs/ft ³)	Specific Gravity	Gravel (%)	Sand (%)	Fines (%)	C _c	C _u	D ₆₀ (mm)	D ₅₀ (mm)	D ₃₀ (mm)	D ₂₀ (mm)	D ₁₀ (mm)
●	6.5	P-3	CH	FAT CLAY	4-30-21	28	51	20	31			0.5	2.8	96.7			0.004	0.003			
⊠	9.0	D-4		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	16						17.5	69.4	13.1			0.573	0.372	0.196	0.129	
▲	14.0	D-6		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	10						67.2	26.6	6.2	7.8	72	11.053	8.696	3.633	0.839	0.153
★	19.0	D-8		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	13						3.7	53.6	42.7			0.183	0.113			
⊙	22.0	D-9	SC-SM	SILTY, CLAYEY SAND	4-30-21	12	21	15	6			14.1	40.2	45.7			0.203	0.102			
⊕	34.0	D-13		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	9						30.8	32.3	36.8			1.781	0.346			

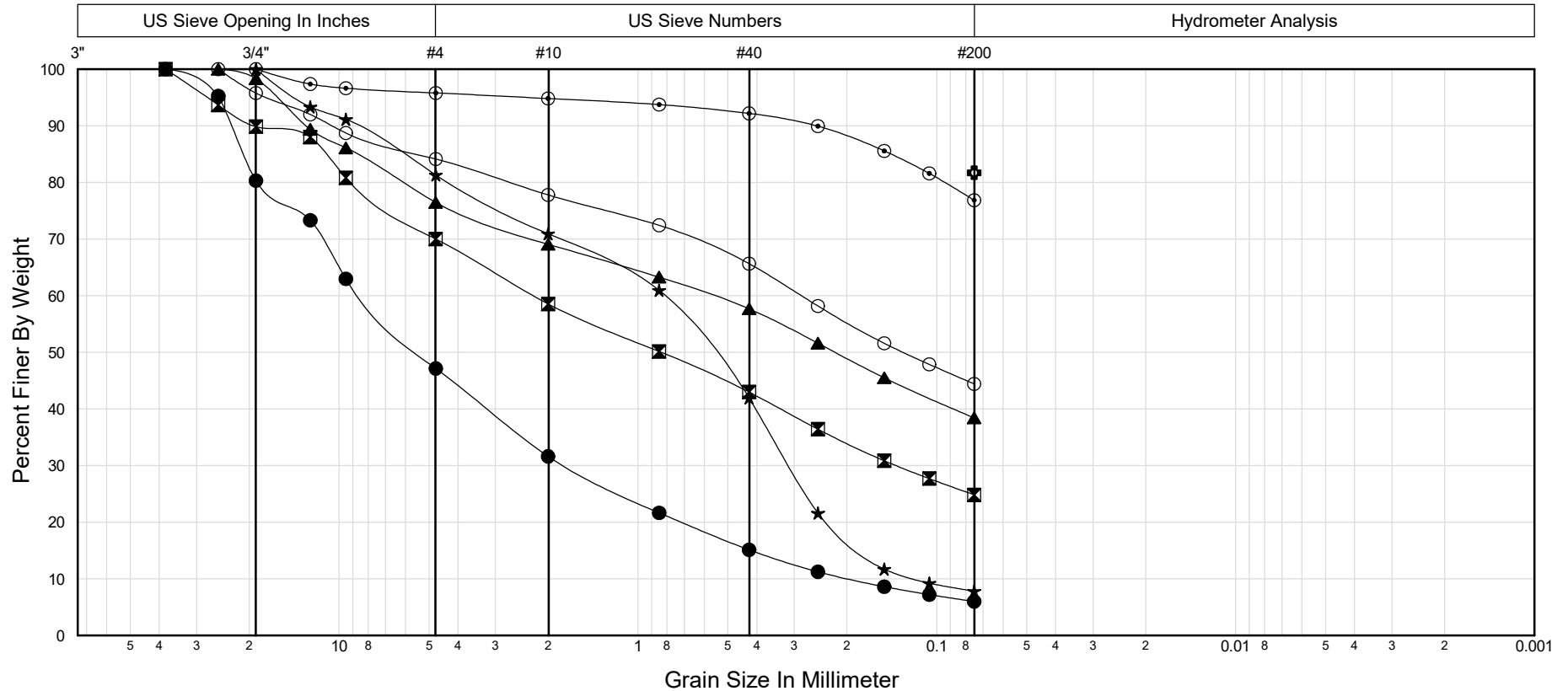


Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		

Job No: **XL5949**

Project: **Advanced Work on Fish Barriers: I-5/ UNT to Fisher Creek (Unnamed Trib to Milltown Creek) -995242 and 03.0183 1.20-**

Symbol	Depth (feet)	Sample No.	USCS	Description	Test Date	MC (%)	LL	PL	PI	Moist Density (lbs/ft ³)	Specific Gravity	Gravel (%)	Sand (%)	Fines (%)	C _c	C _u	D ₆₀ (mm)	D ₅₀ (mm)	D ₃₀ (mm)	D ₂₀ (mm)	D ₁₀ (mm)
●	4.0	D-2		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	12						52.9	41.1	6.0	1.8	42	8.344	5.384	1.741	0.714	0.197
⊠	7.0	D-3		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	18						30.0	45.2	24.8			2.233	0.837	0.137		
▲	14.0	D-6		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	16						23.5	38.0	38.4			0.566	0.219			
★	19.0	D-8		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	17						18.7	73.5	7.8	1.0	7	0.821	0.570	0.311	0.230	0.118
⊙	27.0	D-11	CL	LEAN CLAY with SAND	4-30-21	19	24	16	8			4.2	18.9	76.9							
⊕	29.0	D-12		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	25						N/A	N/A	81.7							
○	34.0	D-13		Sieve analyses only - no Atterberg Limits: Description not calculated	4-30-21	11						15.9	39.7	44.4			0.285	0.129			

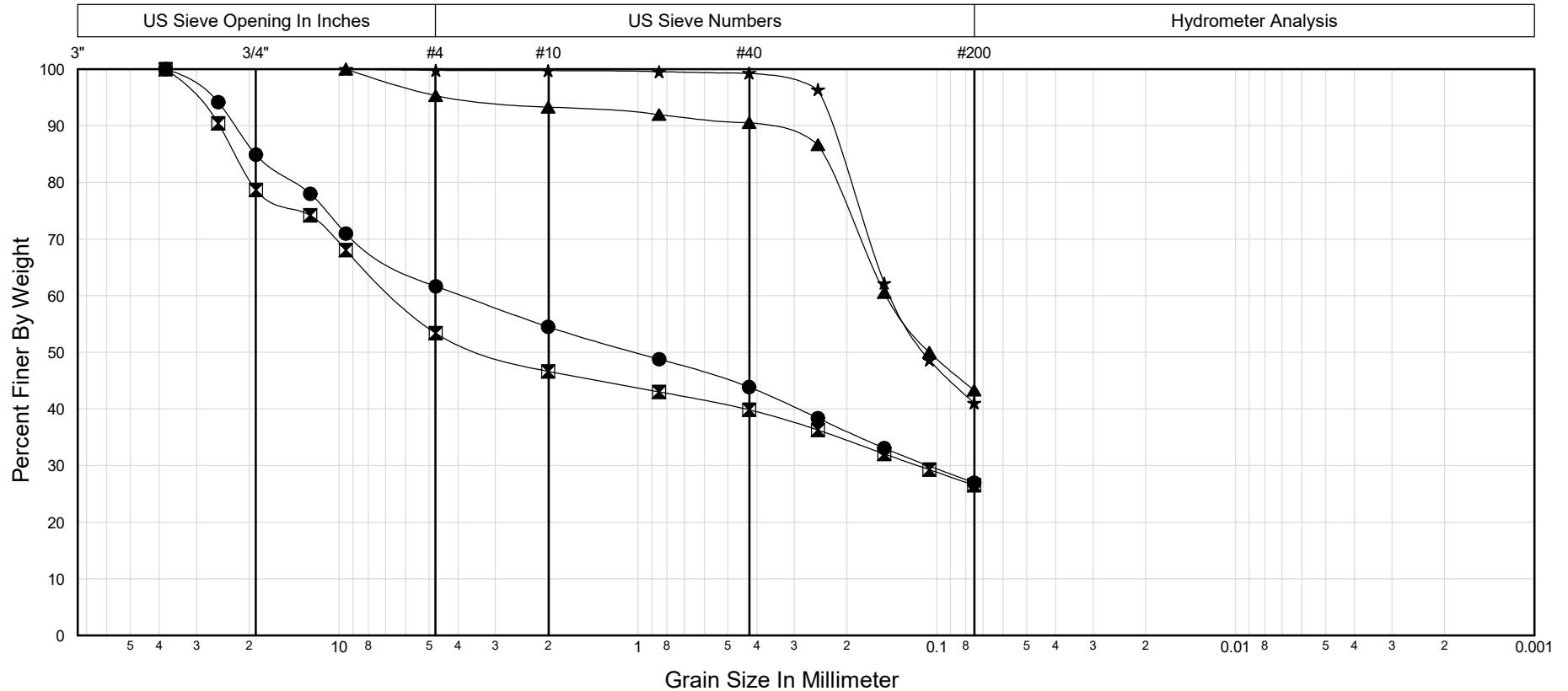


Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		

Job No: **XL5949**

Project: **Advanced Work on Fish Barriers: I-5/Unnamed Tributary to Secret Creek (992175)**

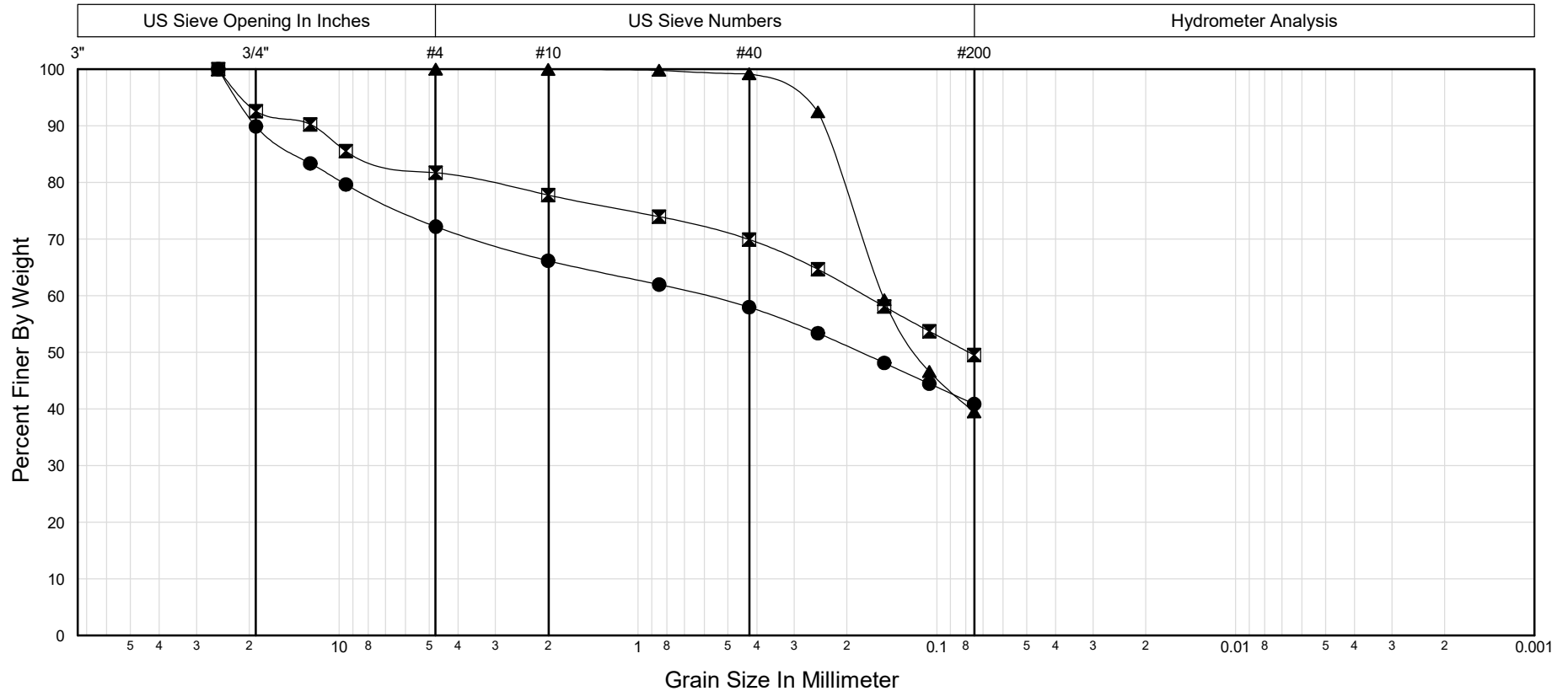
Symbol	Depth (feet)	Sample No.	USCS	Description	Test Date	MC (%)	LL	PL	PI	Moist Density (lbs/ft ³)	Specific Gravity	Gravel (%)	Sand (%)	Fines (%)	C _c	C _u	D ₆₀ (mm)	D ₅₀ (mm)	D ₃₀ (mm)	D ₂₀ (mm)	D ₁₀ (mm)
●	7.0	D-2		Sieve analysis only - no Atterberg Limits: Description not calculated	5-13-21	11						38.4	34.7	27.0			3.891	1.020	0.106		
⊠	12.0	D-4	GC-GM	SILTY, CLAYEY GRAVEL with SAND	5-13-21	9	21	14	7			46.6	26.8	26.5			6.499	3.079	0.116		
▲	24.0	D-7	SC	CLAYEY SAND	5-13-21	23	33	22	11			4.7	52.0	43.3			0.147	0.106			
★	34.0	D-9		Sieve analysis only - no Atterberg Limits: Description not calculated	5-13-21	18						0.2	58.7	41.1			0.142	0.110			



Job No: **XL5949**

Project: **Advanced Work on Fish Barriers: I-5/Unnamed Tributary to Secret Creek (992175)**

Symbol	Depth (feet)	Sample No.	USCS	Description	Test Date	MC (%)	LL	PL	PI	Moist Density (lbs/ft ³)	Specific Gravity	Gravel (%)	Sand (%)	Fines (%)	C _c	C _u	D ₆₀ (mm)	D ₅₀ (mm)	D ₃₀ (mm)	D ₂₀ (mm)	D ₁₀ (mm)
●	9.0	D-3		Sieve analysis only - no Atterberg Limits: Description not calculated	5-14-21	11						27.8	31.3	40.9			0.605	0.180			
⊠	19.0	D-5	SC	CLAYEY SAND with GRAVEL	5-14-21	12	26	14	12			18.3	32.2	49.5			0.174	0.078			
▲	29.0	D-7		Sieve analysis only - no Atterberg Limits: Description not calculated	5-14-21	18						0.0	60.5	39.5			0.152	0.116			

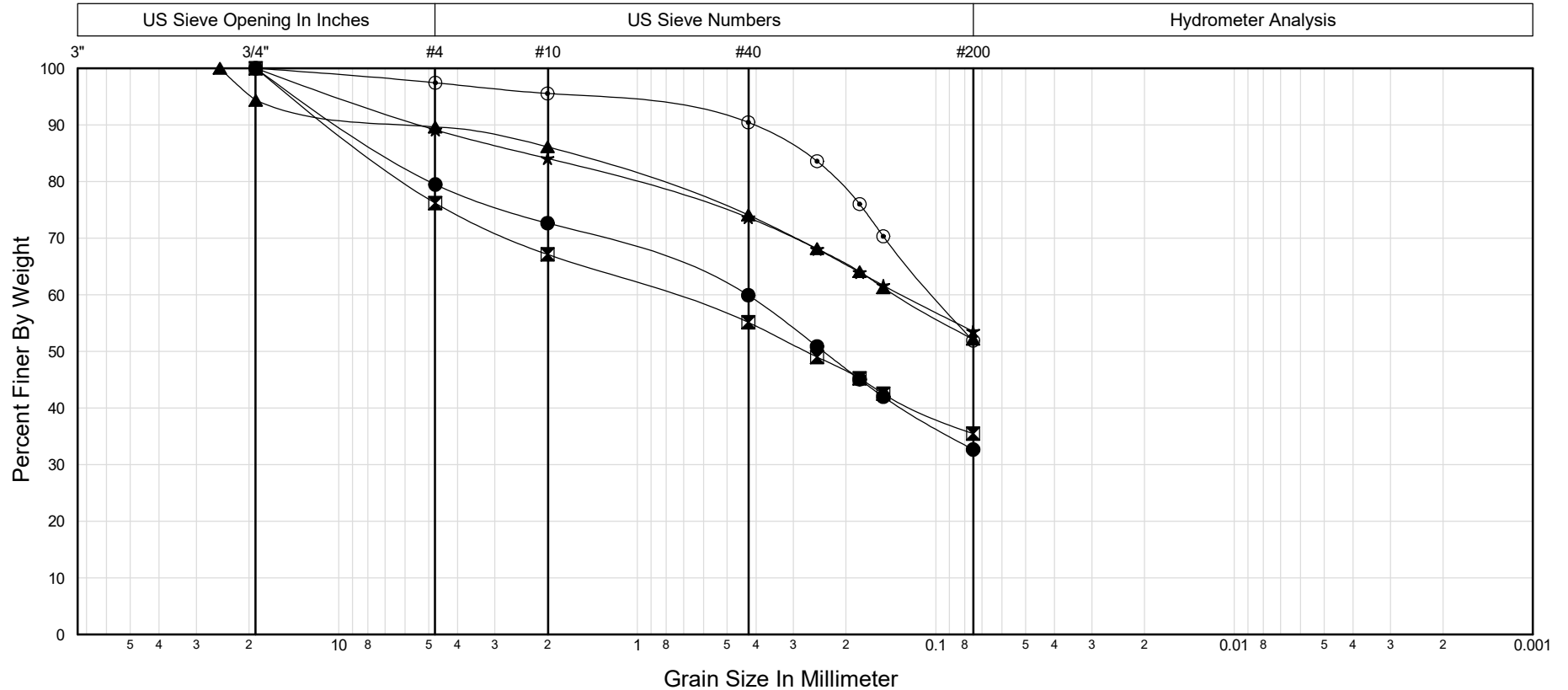


Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		

Job No: **XL5949**

Project: **Advanced Work on Fish Barriers: I-5/ UNT to Fisher Creek (Unnamed Trib to Milltown Creek) -995242 and 03.0183 1.20-**

Symbol	Depth (feet)	Sample No.	USCS	Description	Test Date	MC (%)	LL	PL	PI	Moist Density (lbs/ft ³)	Specific Gravity	Gravel (%)	Sand (%)	Fines (%)	C _c	C _u	D ₆₀ (mm)	D ₅₀ (mm)	D ₃₀ (mm)	D ₂₀ (mm)	D ₁₀ (mm)
●	9.0	D-2	SM	SILTY SAND with GRAVEL	6-30-21	12	n/a	n/a	NP			20.5	46.8	32.7			0.429	0.238			
⊠	19.0	D-4	SM	SILTY SAND with GRAVEL	6-30-21	13	18	15	3			23.8	40.7	35.5			0.797	0.272			
▲	39.0	D-8	CL-ML	SANDY SILTY CLAY	6-30-21	12	20	14	6			10.4	37.5	52.1			0.136				
★	49.0	D-10		SANDY SILT	6-30-21	12						10.9	35.6	53.6			0.130				
⊙	69.0	D-14		SANDY SILT	6-30-21	14						2.6	45.5	51.9			0.102				

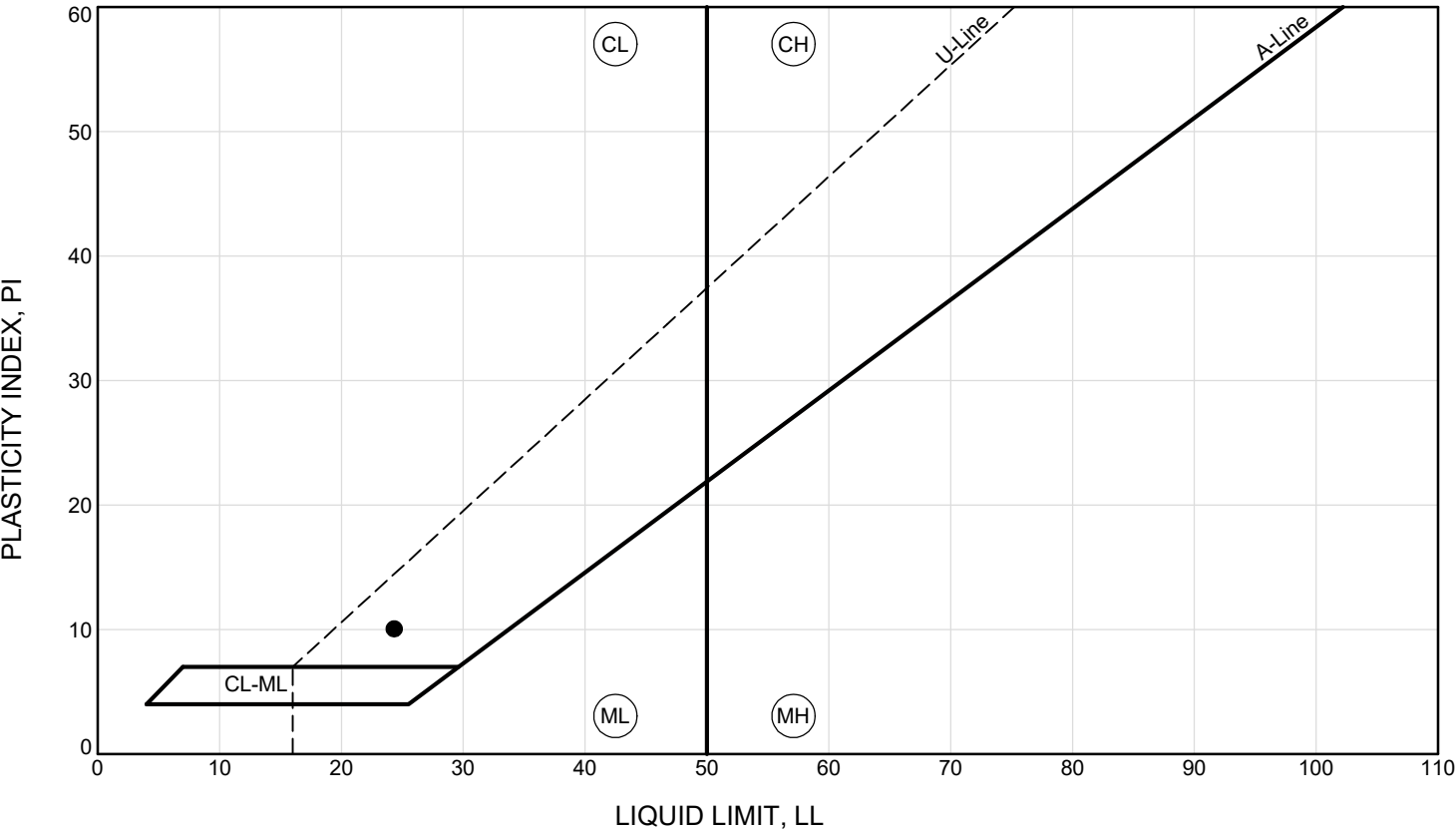


Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		

Project: **Advanced Work on Fish Barriers: I-5/Unnamed Tributary to West Fork Church Creek (Freedom Creek) -996077-**[illegible]

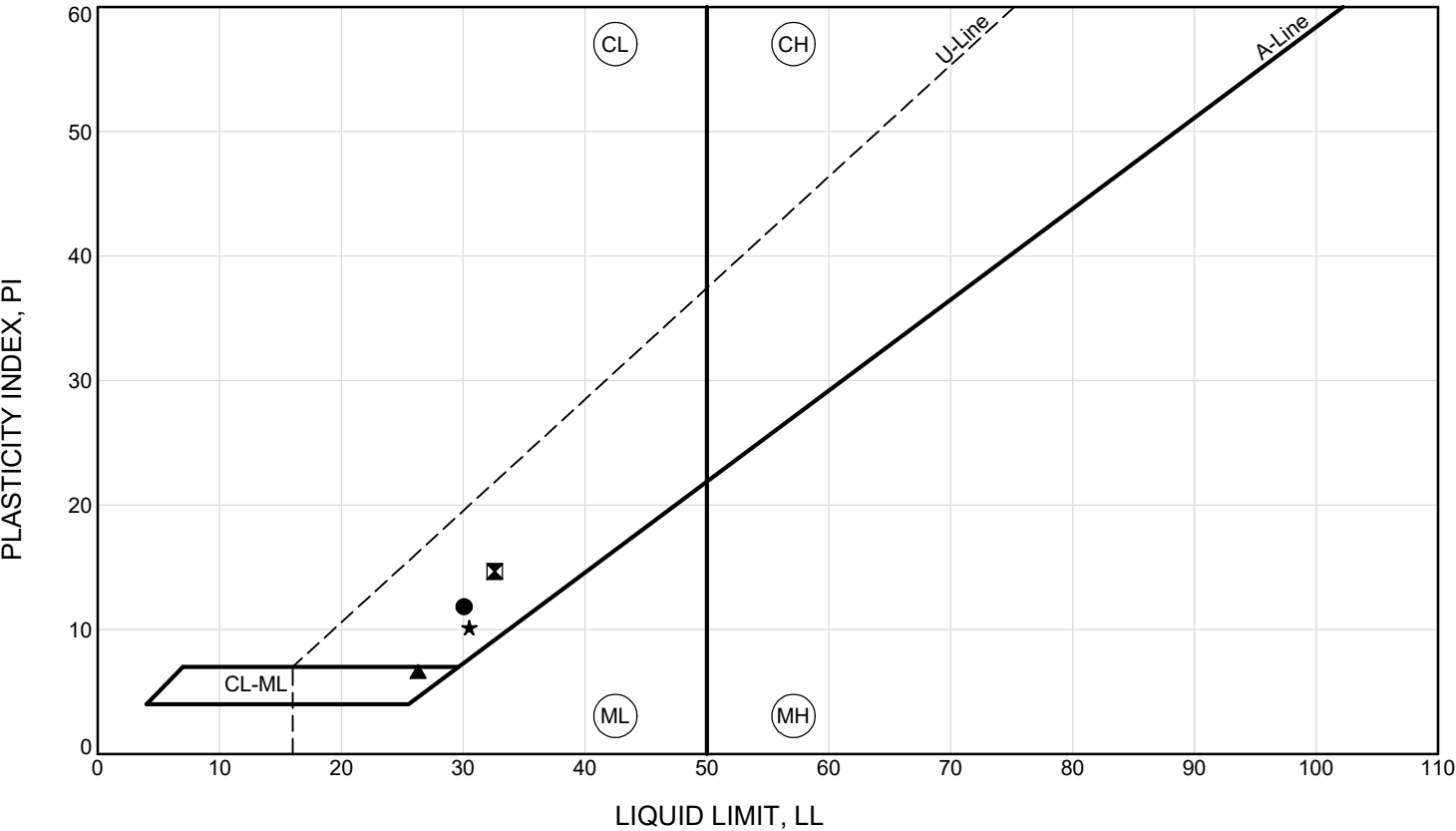
USCS codes listed on graph: CL = lean clay; CH = fat clay; ML = silt; MH = elastic silt; CL-MH = silty clay

Job No: **XL5949**
Project: **Advanced Work on Fish Barriers: I-5/ WF Church Creek (Freedom Creek) -996073-**

[illegible]

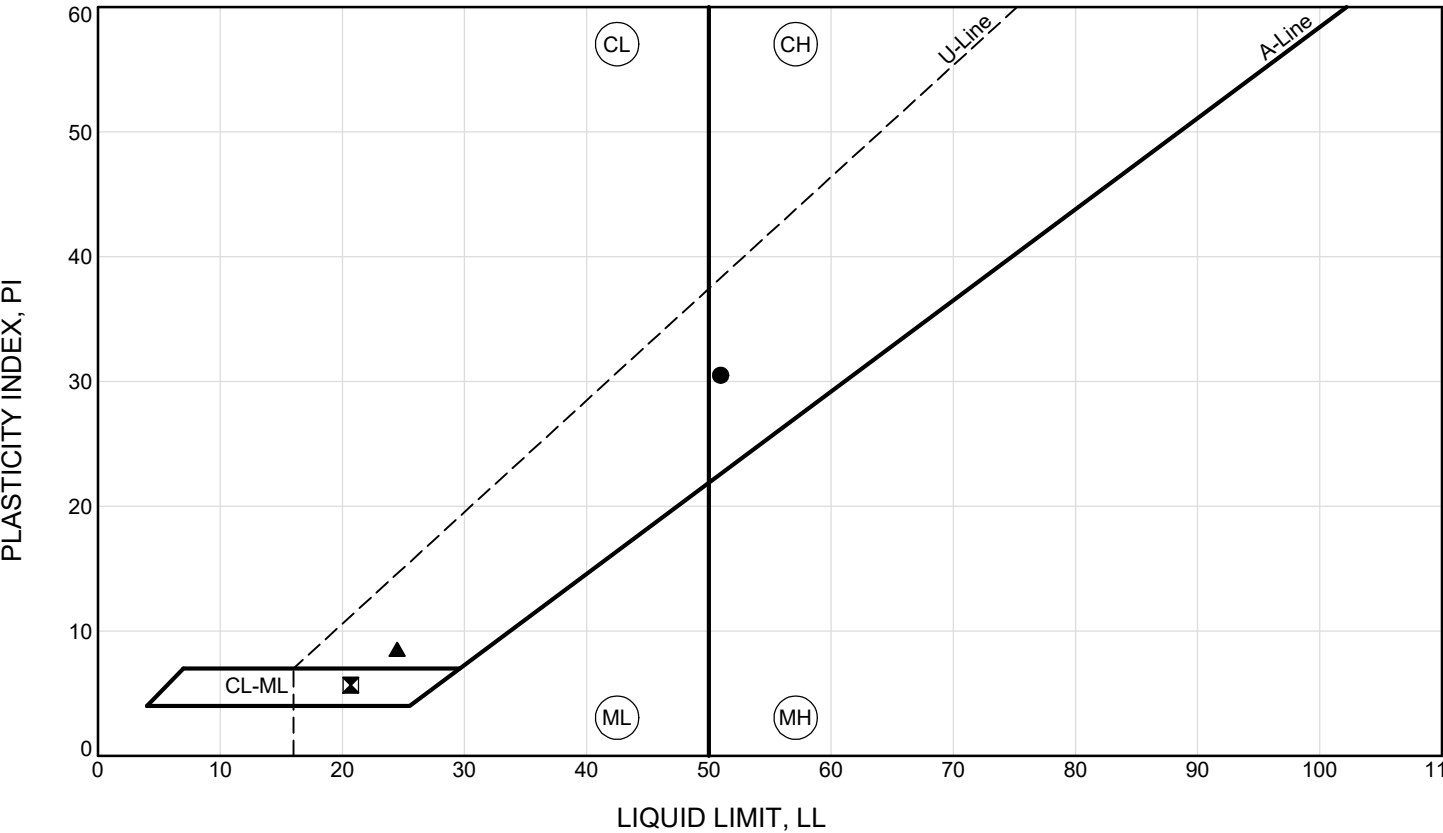
LL = liquid limit; MC = moisture content; n/a = test attempted; NP = nonplastic; PI = plasticity index; PL = plastic limit; USCS = Unified Soil Classification System code
USCS codes listed on graph: CL = lean clay; CH = fat clay; ML = silt; MH = elastic silt; CL-ML = silty clay

Job No: **XL5949**
Project: **Advanced Work on Fish Barriers: I-5/Unnamed Tributary to West Fork Church Creek (Freedom Creek) -996071-**

[illegible]

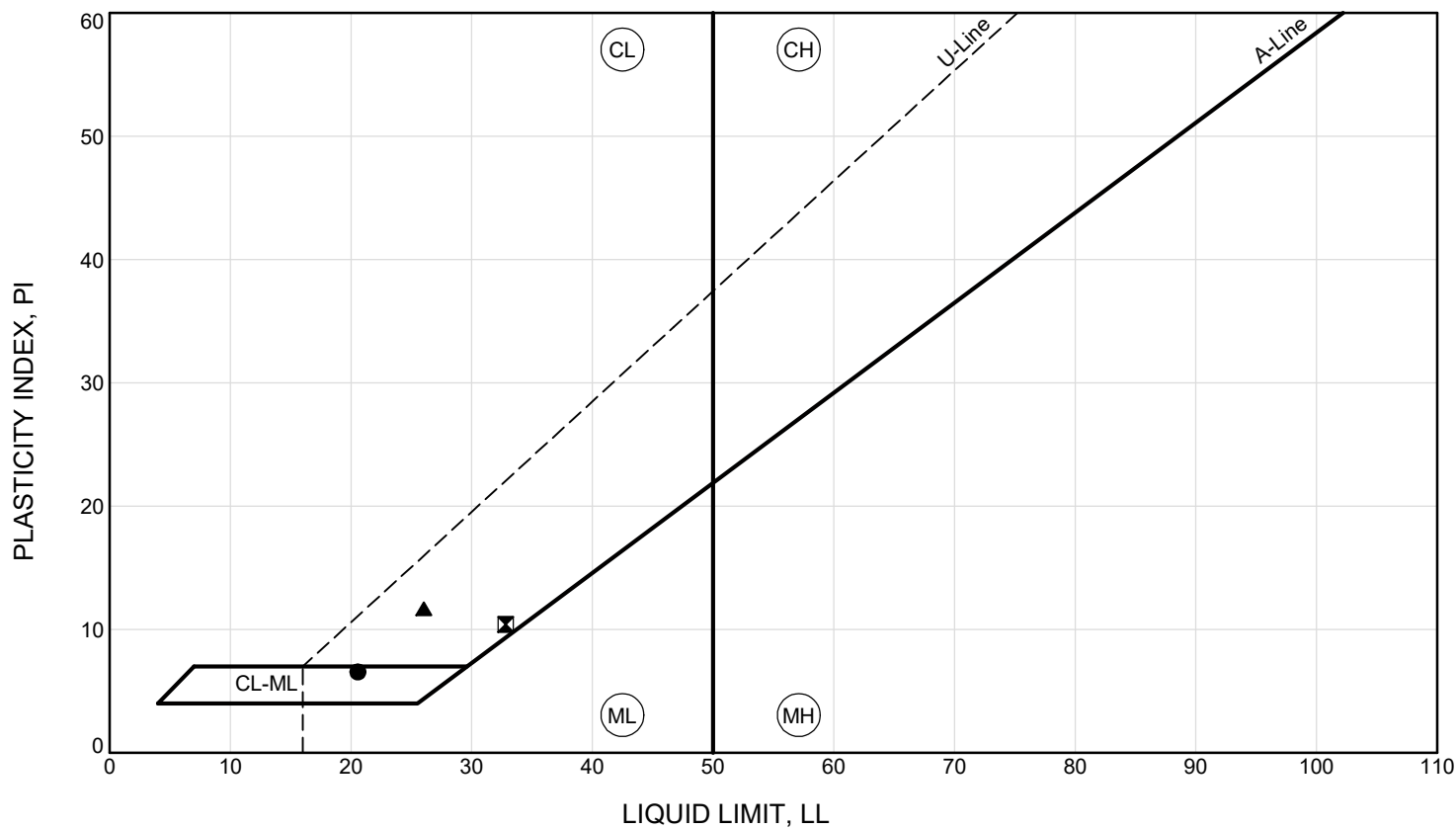
ABBREVIATIONS:
LL = liquid limit; MC = moisture content; n/a = test attempted; NP = nonplastic; PI = plasticity index; PL = plastic limit; USCS = Unified Soil Classification System code
USCS codes listed on graph: CL = lean clay; CH = fat clay; ML = silt; MH = elastic silt; CL-ML = silty clay

Job No: **XL5949**
Project: **Advanced Work on Fish Barriers: I-5/ UNT to Fisher Creek (Unnamed Trib to Milltown Creek) -995242 and 03.0183 1.20-**

[illegible]

LL = liquid limit; MC = moisture content; n/a = test attempted; NP = nonplastic; PI = plasticity index; PL = plastic limit; USCS = Unified Soil Classification System code
USCS codes listed on graph: CL = lean clay; CH = fat clay; ML = silt; MH = elastic silt; CL-ML = silty clay

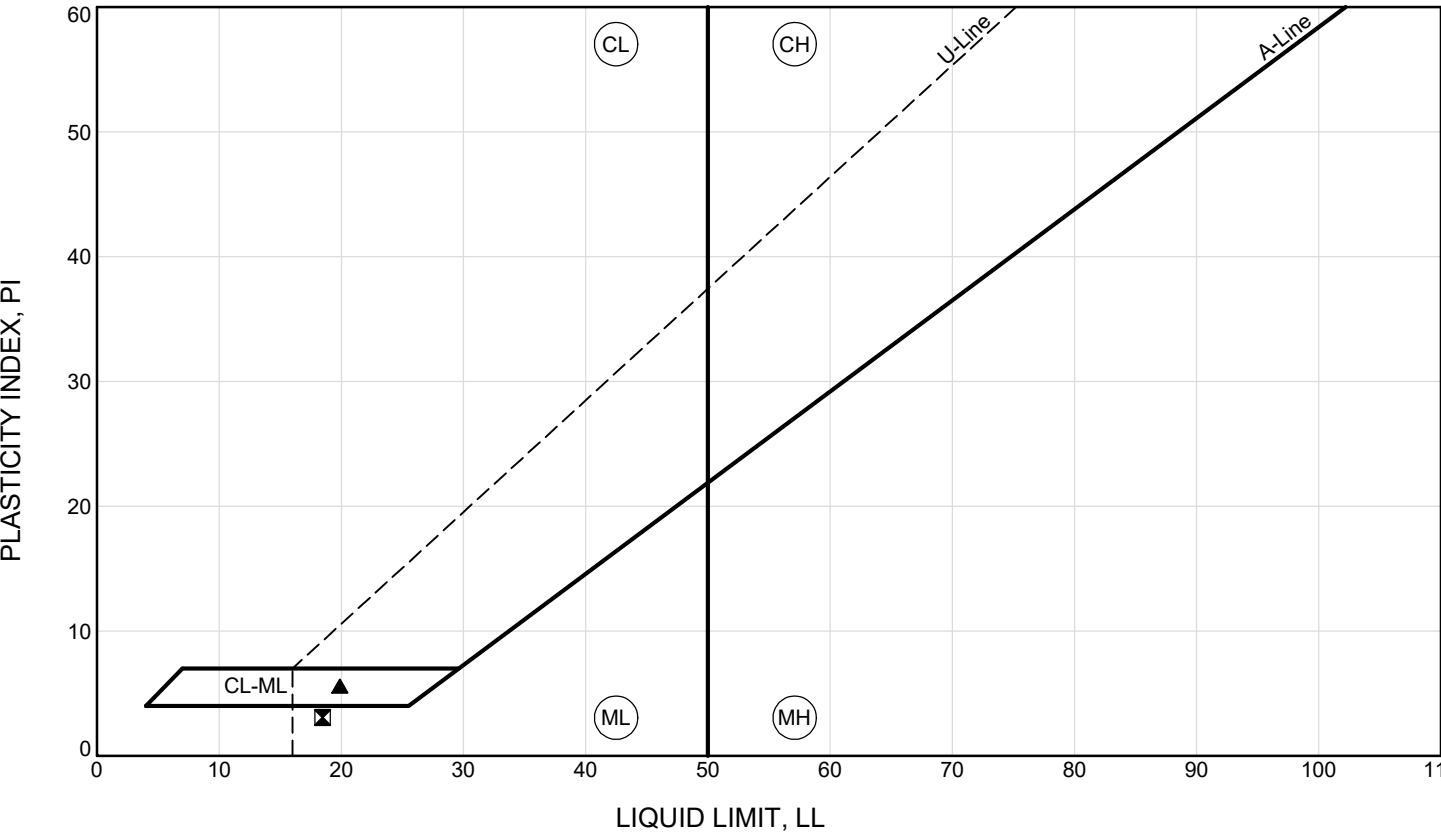
Job No: **XL5949**

Project: **Advanced Work on Fish Barriers: I-5/Unnamed Tributary to Secret Creek (992175)**[illegible]

ABBREVIATIONS:

LL = liquid limit; MC = moisture content; n/a = test attempted; NP = nonplastic; PI = plasticity index; PL = plastic limit; USCS = Unified Soil Classification System code
USCS codes listed on graph: CL = lean clay; CH = fat clay; ML = silt; MH = elastic silt; CL-ML = silty clay

Job No: **XL5949**
Project: **Advanced Work on Fish Barriers: I-5/ UNT to Fisher Creek (Unnamed Trib to Milltown Creek) -995242 and 03.0183 1.20-**

[illegible]

LL = liquid limit; MC = moisture content; n/a = test attempted; NP = nonplastic; PI = plasticity index; PL = plastic limit; USCS = Unified Soil Classification System code
USCS codes listed on graph: CL = lean clay; CH = fat clay; ML = silt; MH = elastic silt; CL-ML = silty clay

Project Name: WSDOT F.P.

 Project No.: 102097-016

Jar Slake Index

WSDOT Test Method T501

No.	Point ID	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Specimen Depth (ft)	2 minutes	4 minutes	6 minutes	8 minutes	10 minutes	15 minutes	20 minutes	60 minutes	1440 minutes
1	A-445p-21	D9	SPT	34	35	34	1	1	1	1	1	1	1	1	1
2	A-446p-21	D6	SPT	24	25	24	3	2	2	1/2	1	1	1	1	1
3	A-446p-21	D9	SPT	39	40	39	1/2	1	1	1	1	1	1	1	1
4															
5															
6															

Photos						
	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Initial	Photo Unavailable	Photo Unavailable	Photo Unavailable			
Final	Photo Unavailable	Photo Unavailable	Photo Unavailable			

 Test Fluid: ☐ Tap water ☒ Distilled water ☐ Other _____

Behavior Index, I _j	Behavior Description
1	Degrades into a pile of flakes or mud
2	Breaks rapidly and/or forms many chips
3	Breaks rapidly and/or forms few chips
4	Breaks slowly and/or forms several fractures
5	Breaks slowly and/or forms few fractures
6	No change

	Description
Sample 1	
Sample 2	
Sample 3	
Sample 4	
Sample 5	
Sample 6	

**Washington State Department of Transportation
State Materials Laboratory
PO Box 47365 Olympia WA 98504 / 1655 S. 2nd Ave Tumwater WA 98512
Miscellaneous Report**

Work Order : XL5949

Sample ID : 0000012a158

Section : 17-19 Advanced Work On Fish Barriers Nwr

State Route No :

Lab Number : MC0210136

Project Engineer : Lamay, Mikkell

Bid Item No :

Org Code : 412358

Date Received : 7/29/2021

Local Agency No :

Material : Soils

Contractor :

Pit Number : A-449-21

Supplier Name :

Date Sampled : 6/16/2021

Acceptance No :

Date Received : 7/29/2021

Sampled Location : 4.0' to 5.5'

Sampled By : Drill Crew

Make :

IAS Sample No : D-1

Manufacturer :

Lot Number :

Test Name	Test Result	Test Specifications
pH Reading	8.17	
Resistivity (ohm-cm)	6000	

Result Code: Informational

Remarks :

Kurt R. Williams, P.E.

State Materials Engineer

Steve Landers By: _____

Structural Material Testing Engineer

Date : 7/29/2021

Phone : (360) 709-5446

Billing Code

T44P - 1

T44V - 1

**Washington State Department of Transportation
State Materials Laboratory
PO Box 47365 Olympia WA 98504 / 1655 S. 2nd Ave Tumwater WA 98512
Miscellaneous Report**

Work Order : XL5949

Sample ID : 0000012a281

Section : 17-19 Advanced Work On Fish Barriers Nwr

State Route No :

Lab Number : MC0210135

Project Engineer : Lamay, Mikkell

Bid Item No :

Org Code : 412358

Date Received : 7/29/2021

Local Agency No :

Material : Soils

Contractor :

Pit Number : A-449-21 GP-T5

Supplier Name :

Date Sampled : 6/24/2021

Acceptance No :

Date Received : 7/29/2021

Sampled Location : 39.0' to 40.5'

Sampled By : Drill Crew

Make :

IAS Sample No : D-8

Manufacturer :

Lot Number :

Test Name	Test Result	Test Specifications
pH Reading	8.38	
Resistivity (ohm-cm)	5000	

Result Code: Informational

Remarks :

Kurt R. Williams, P.E.

State Materials Engineer

Steve Landers By: _____

Structural Material Testing Engineer

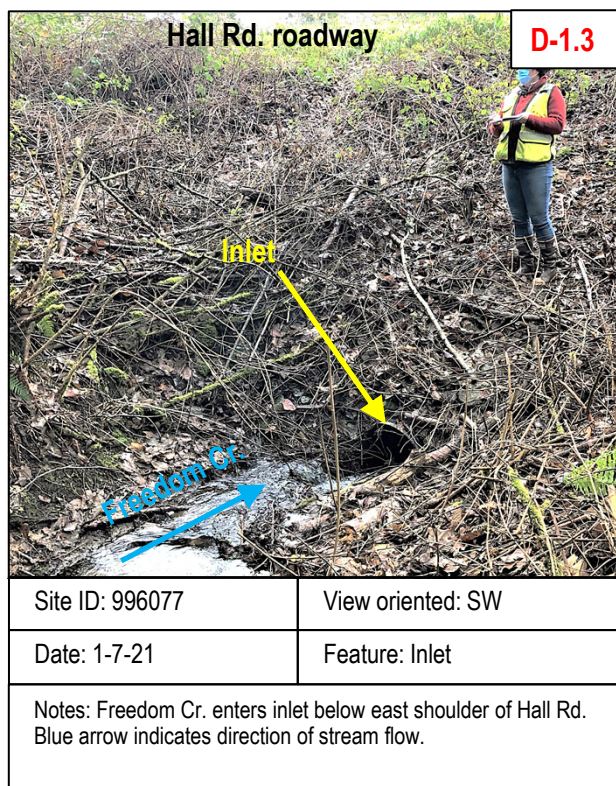
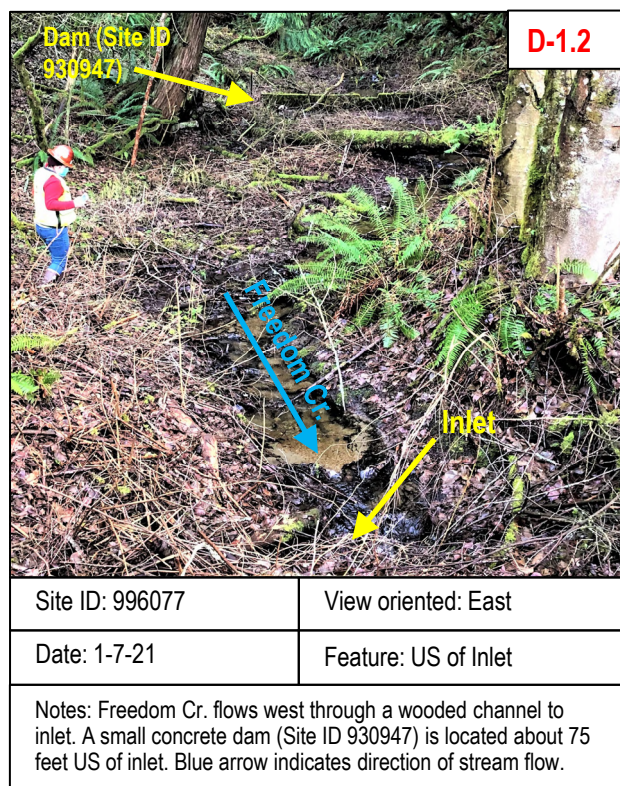
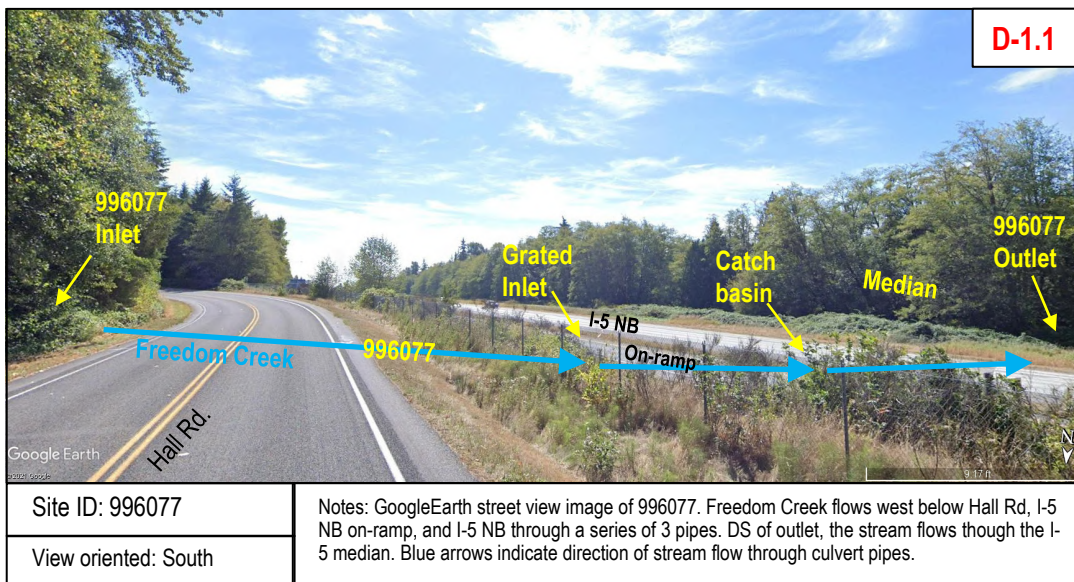
Date : 7/29/2021

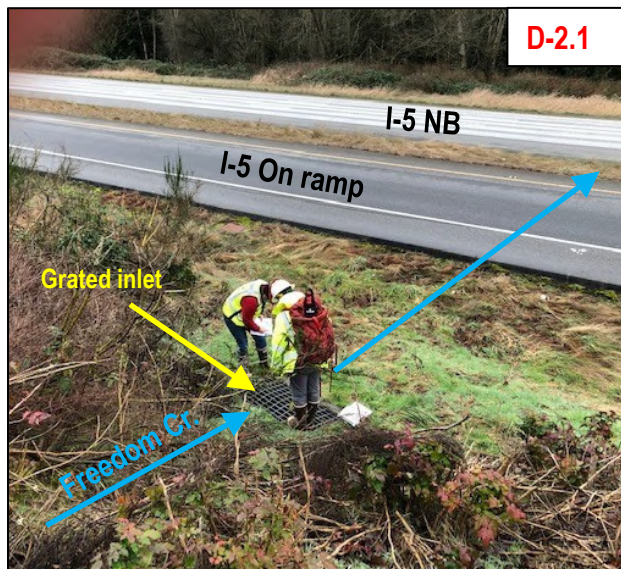
Phone : (360) 709-5446

Billing Code

T44P - 1

T44V - 1





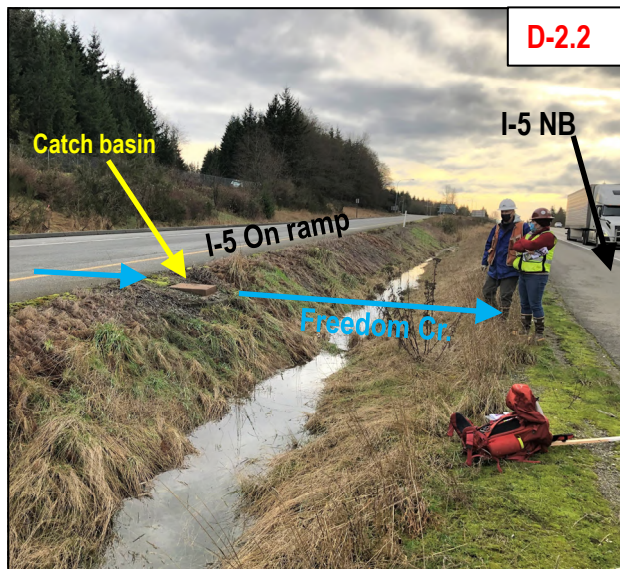
Site ID: 996077

View oriented: SW

Date: 1-7-21

Feature: Grated inlet

Notes: From inlet, Freedom Cr. flows west below Hall Rd to median between Hall Rd and I-5 on ramp where ditched flow enters at grated inlet.



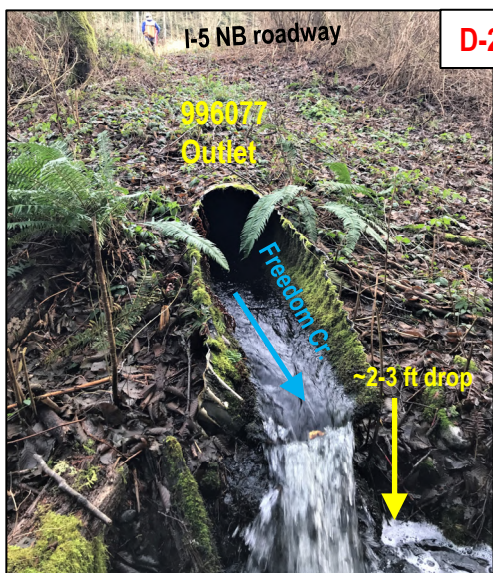
Site ID: 996077

View oriented: South

Date: 1-7-21

Feature: Catch basin

Notes: From grated inlet, stream flows below I-5 NB on-ramp and enters catch basin in median along east shoulder of I-5 NB. From catch basin, flow continues west below I-5 NB.



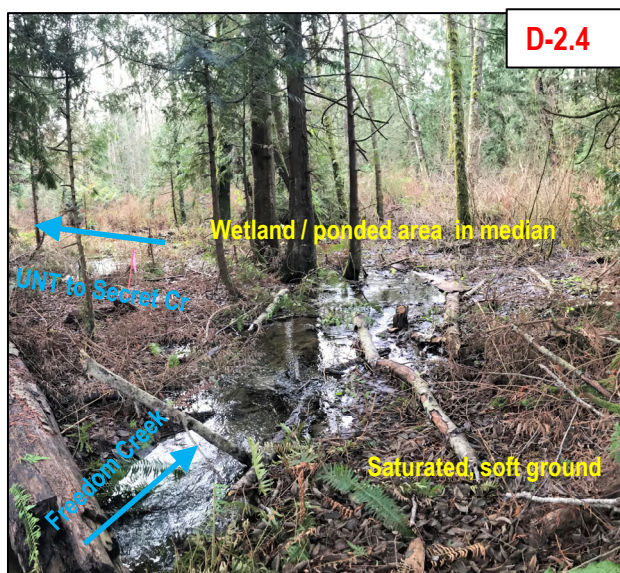
Site ID: 996077

View oriented: East

Date: 1-7-21

Feature: Outlet

Notes: At the outlet, located below the west shoulder of I-5 NB, Freedom Creek flows down a 2- to 3-ft drop into a small scour pool. Blue arrow indicates direction of stream flow.



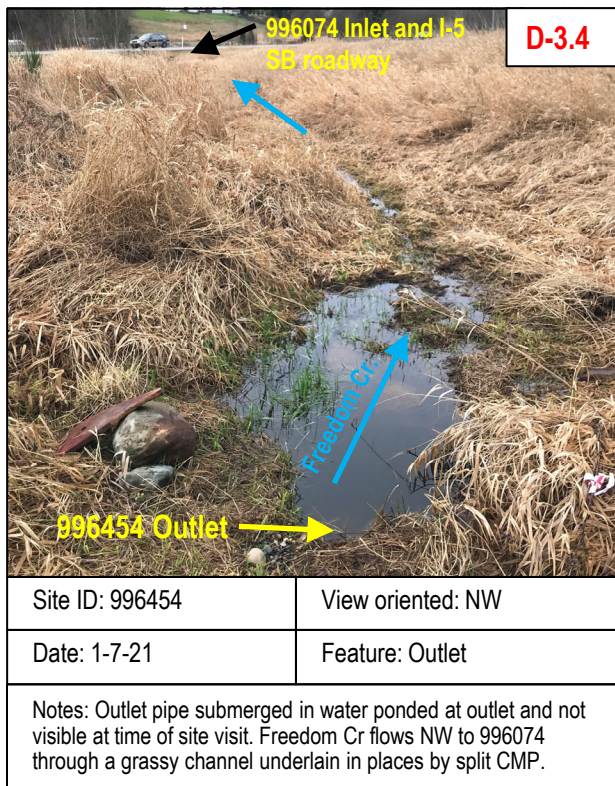
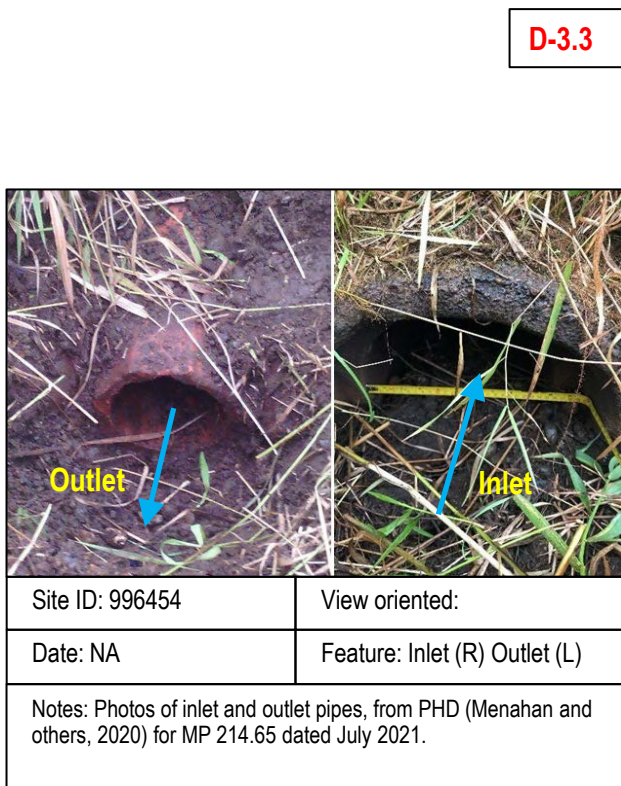
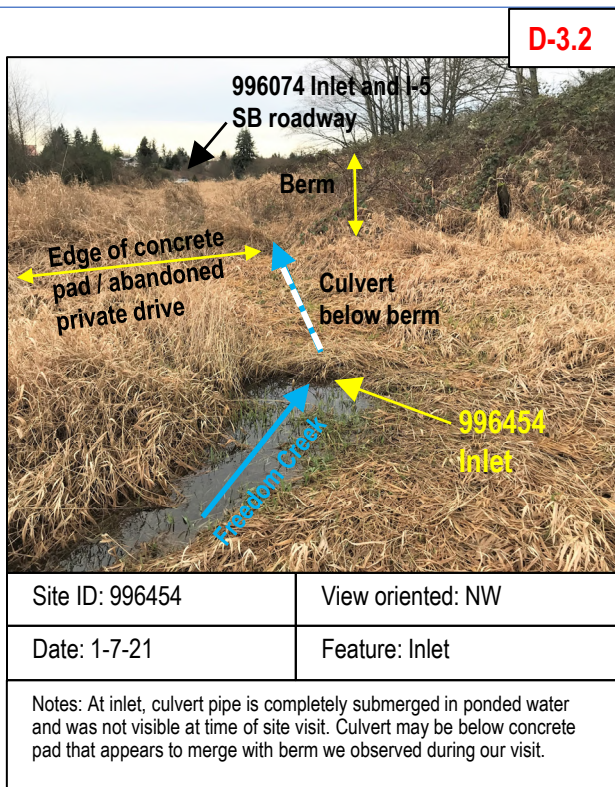
Site ID: 996077

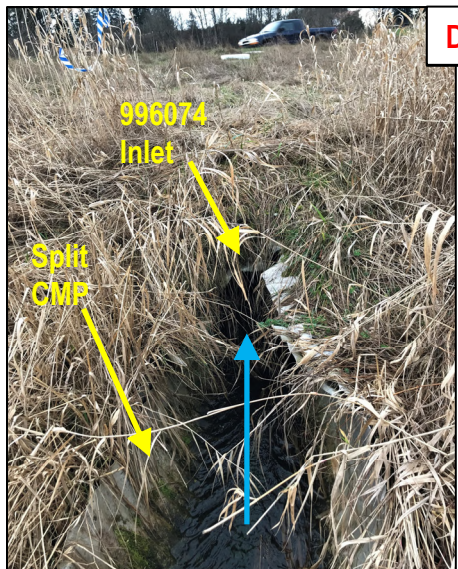
View oriented: SW

Date: 1-7-21

Feature: DS of outlet

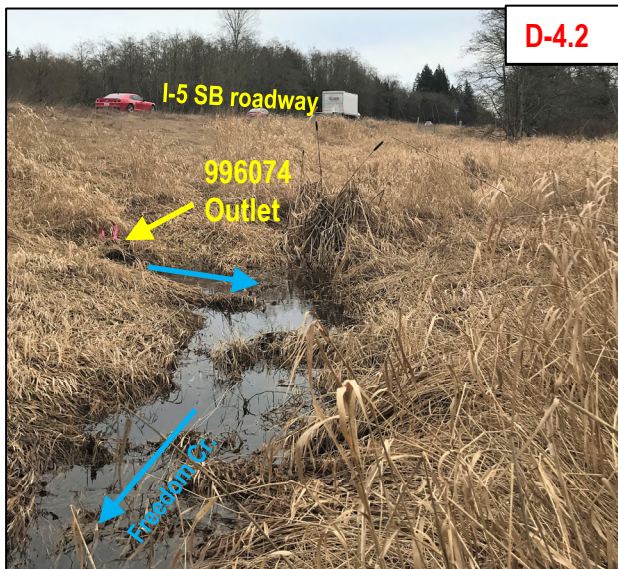
Notes: DS of outlet, Freedom Cr. flows west into wetland and then south through the I-5 median via a chain of ponds and wetlands; southerly flow is referred to as UNT of Secret Creek.





D-4.1

Site ID: 996074	View oriented: West
Date: 1-7-21	Feature: Inlet
Notes: Freedom Creek enters inlet through split CMP. Blue arrow indicates direction of stream flow.	



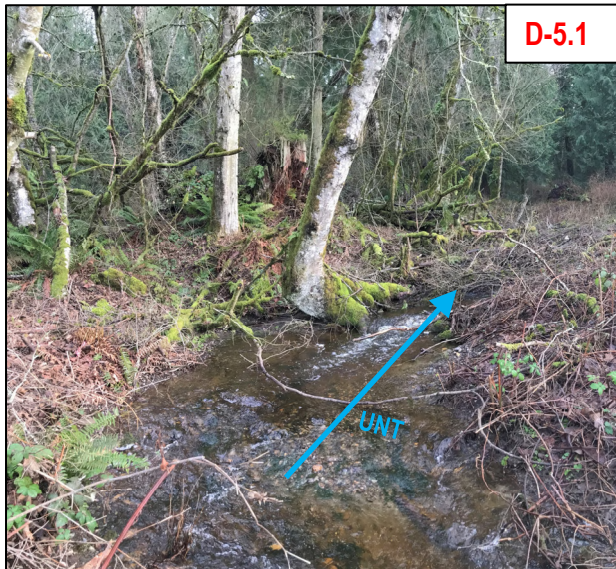
D-4.2

Site ID: 996074	View oriented: South
Date: 1-7-21	Feature: Outlet
Notes: DS of the outlet, Freedom Cr flows west then turns north to follow west shoulder of I-5 SB. Blue arrow indicates direction of stream flow.	



D-4.3

Site ID: 996071	Notes: UNT flows below Hall Rd. through 996095 and connects to 996071 in a ditch within the median between Hall Rd. and I-5 NB. UNT exits the 996071 outlet below the west shoulder of I-5 NB and flows south through the median between I-5 NB and I-5 SB.
View oriented: South	



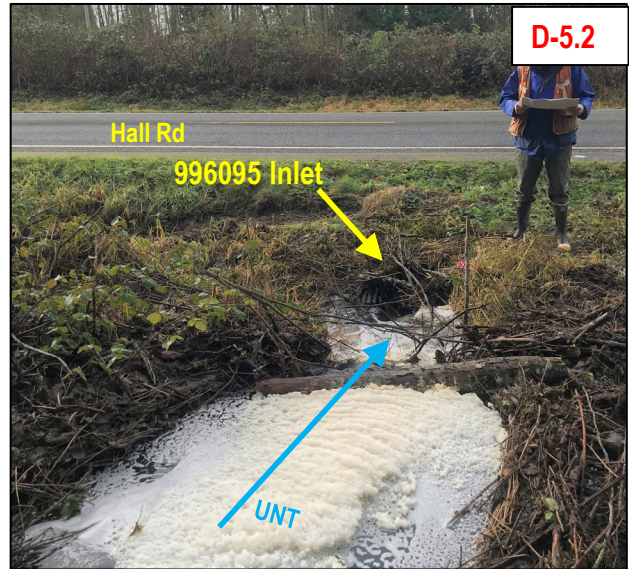
Site ID: 996095

View oriented: East

Date: 1-7-21

Feature: Upstream of inlet

Notes: Upstream of inlet, UNT flows west through a wooded, sinuous, and gravelly channel with shallow banks. Blue arrow indicates direction of stream flow.



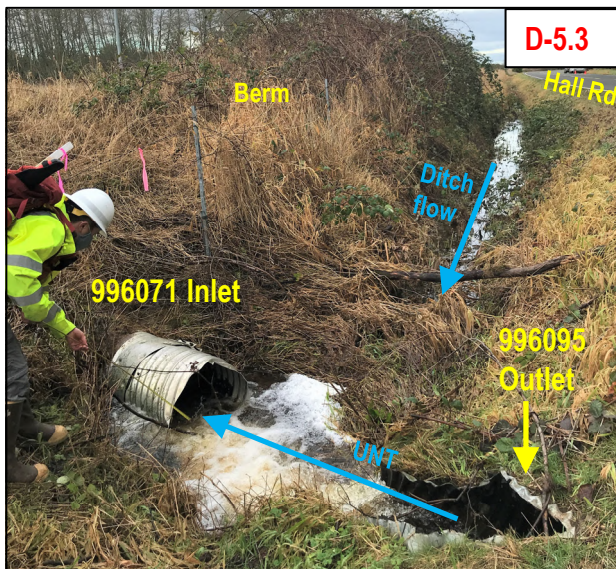
Site ID: 996095

View oriented: West

Date: 1-7-21

Feature: Inlet

Notes: Blue arrow indicates direction of stream flow.



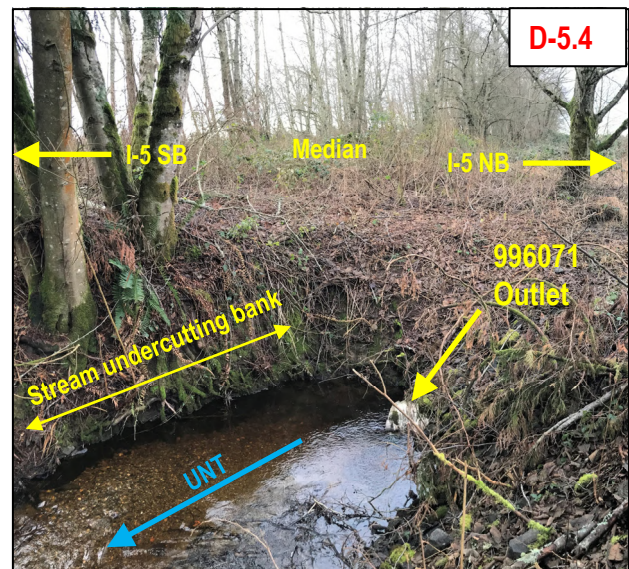
Site ID: 996095 / 996071

View oriented: North

Date: 1-7-21

Feature: Outlet (996095)/Inlet (996071)

Notes: 996095 outlet flow empties into the 996071 inlet in a ditch along the west shoulder of Hall Rd. Ditched flow enters from the north. Blue arrow indicates direction of stream flow.



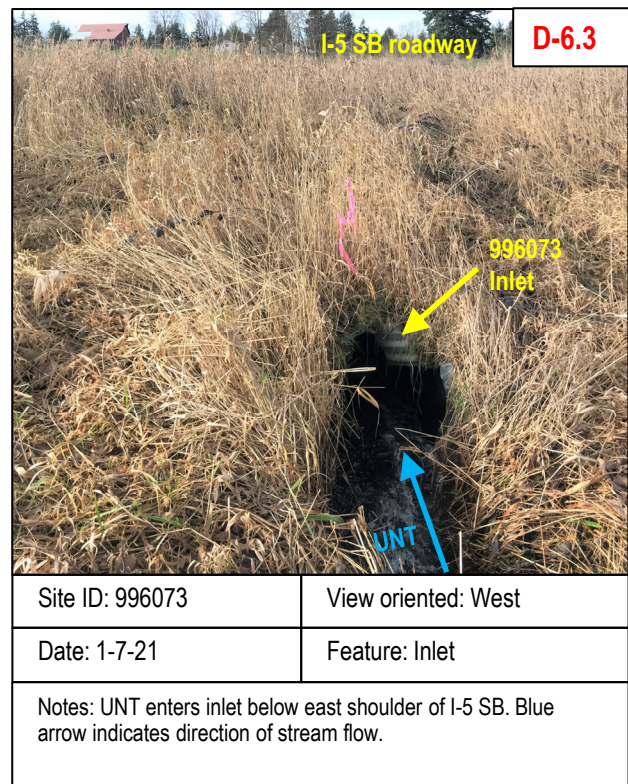
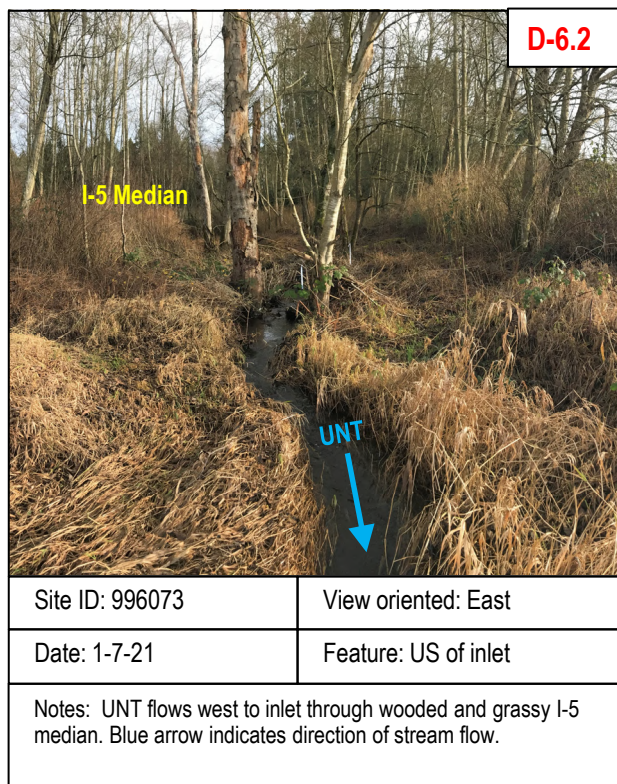
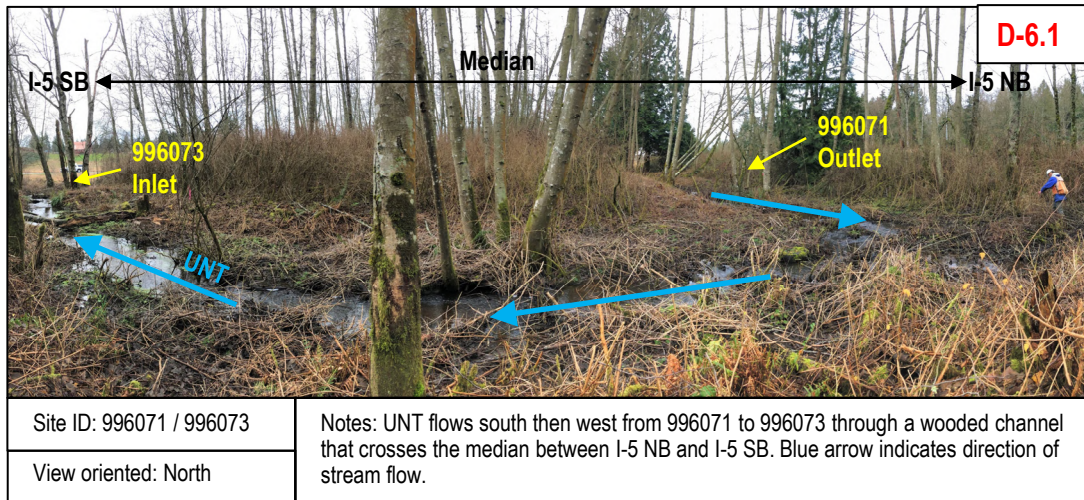
Site ID: 996071

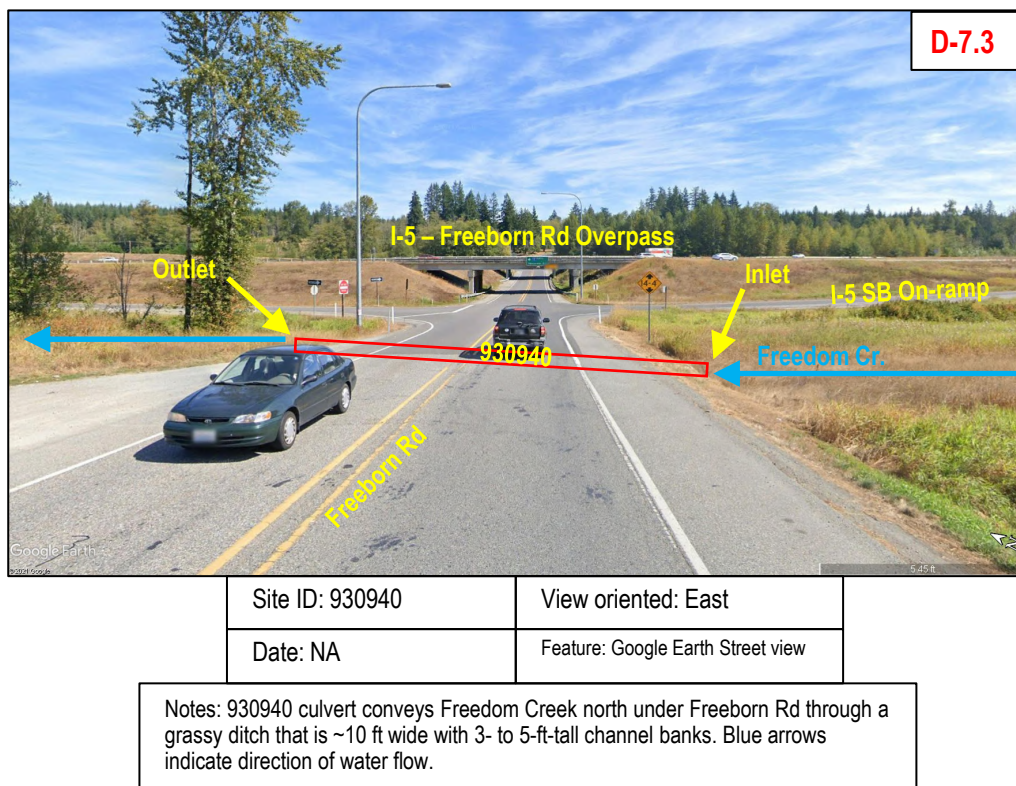
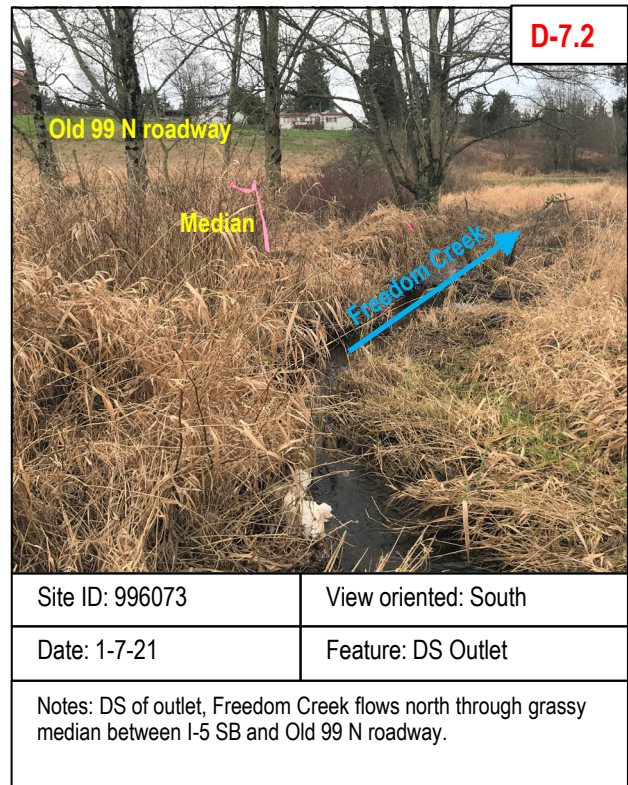
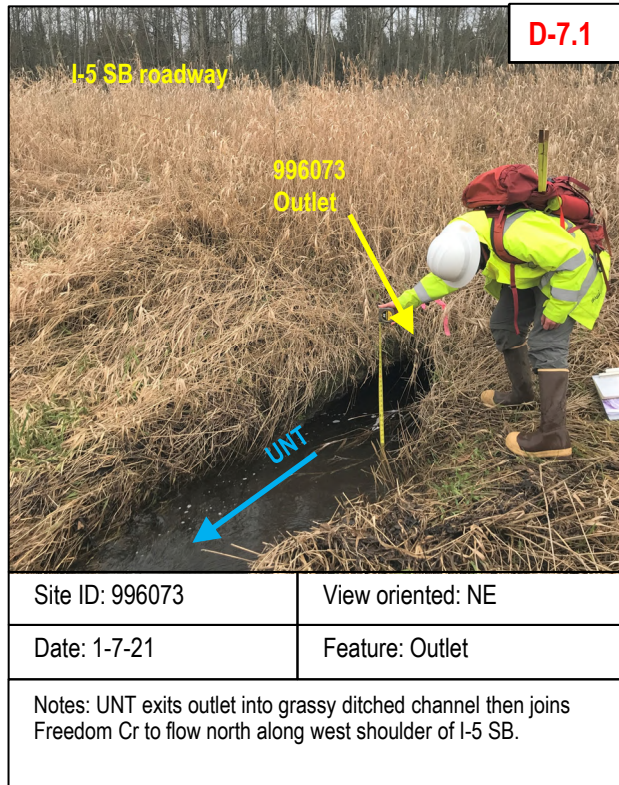
View oriented: North

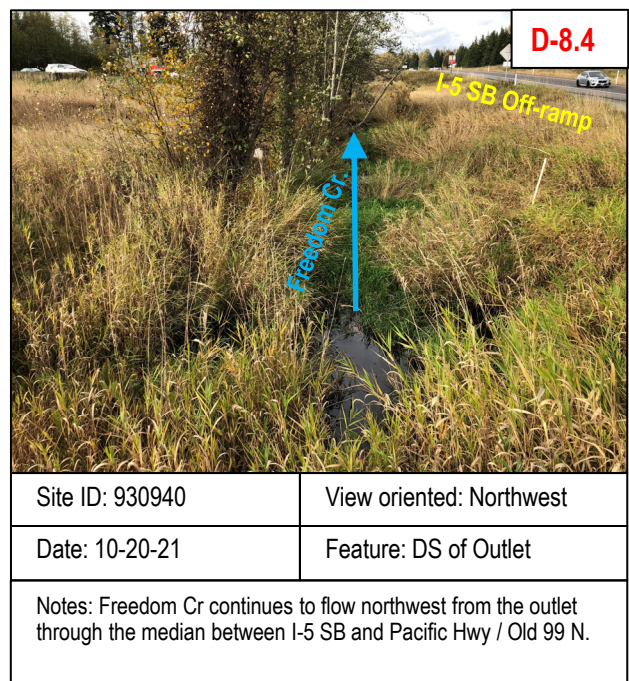
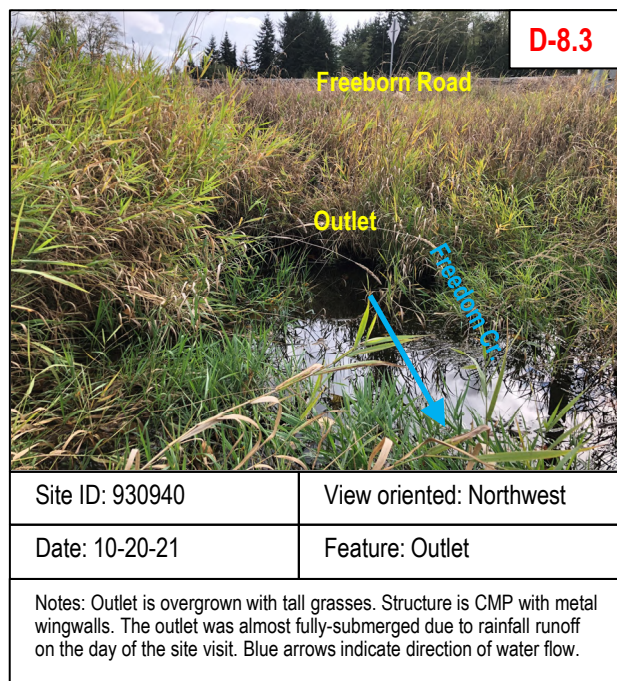
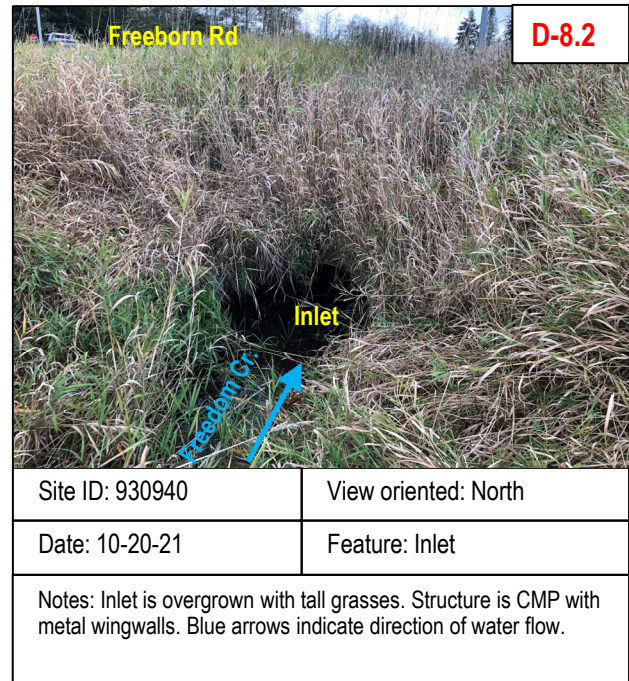
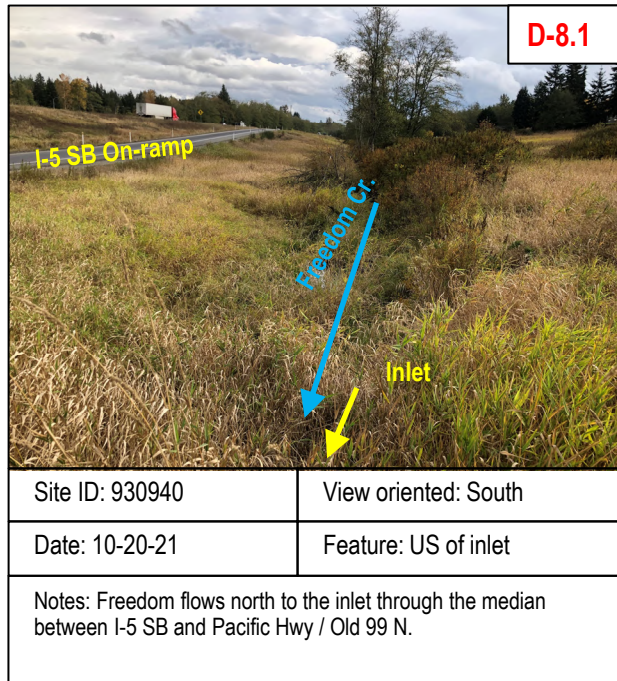
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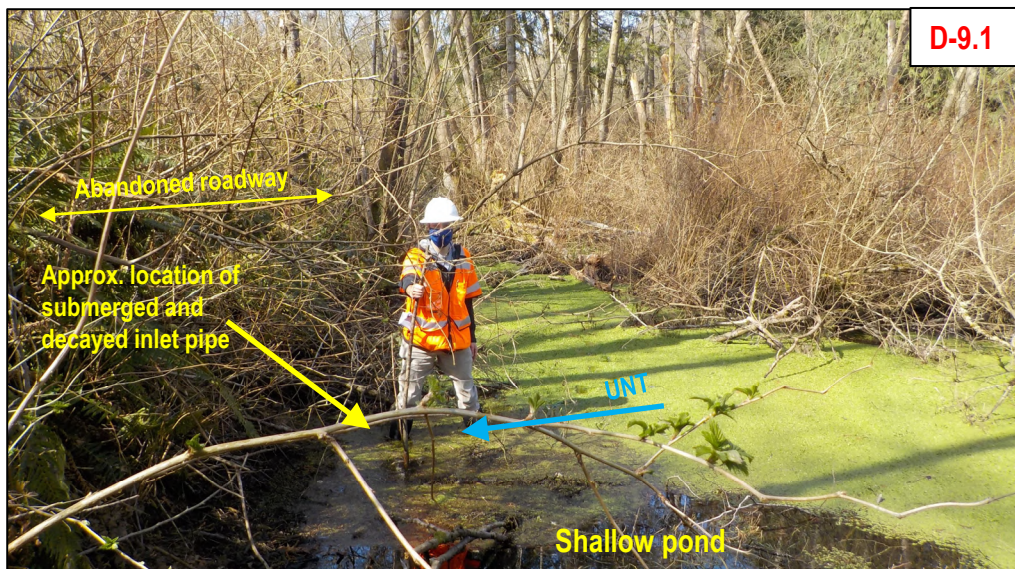
Feature: Outlet

Notes: .DS of the outlet, the UNT channel shows signs of scour and undercutting of the steep bank. Blue arrow indicates direction of stream flow.









D-9.1

Site ID: LP 66

View oriented: West

Date: 3-31-21

Feature: Pond at inlet

Notes: Culvert is below abandoned roadway and is completely submerged in water ponded in front of inlet. UNT flows south toward inlet through I-5 median via connected ponds and wetlands. Blue arrow indicates direction of stream flow.



D-9.2

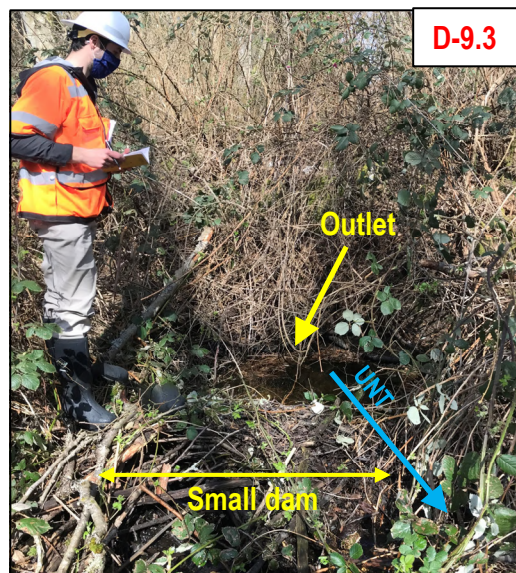
Site ID: LP 66

View oriented: North

Date: 3-31-21

Feature: Outlet

Notes: Outlet pipe is submerged in water ponded behind a small animal dam. Blue arrow indicates direction of stream flow.



D-9.3

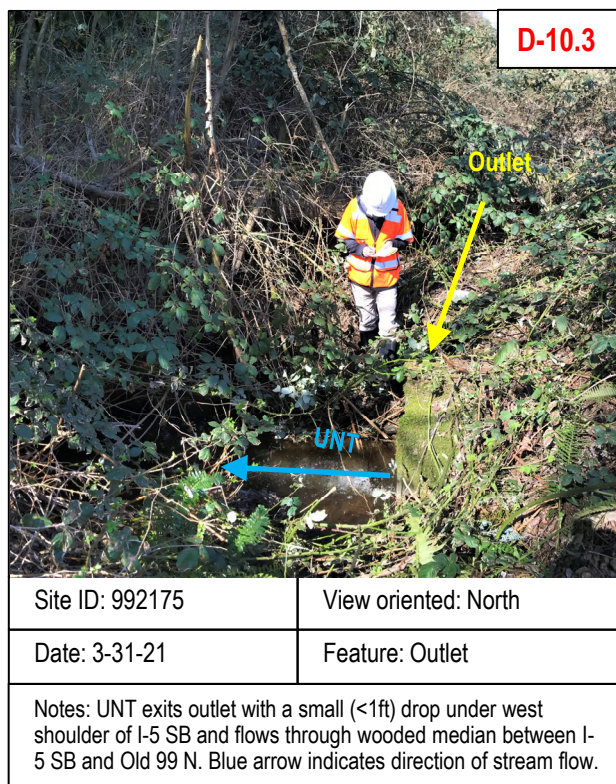
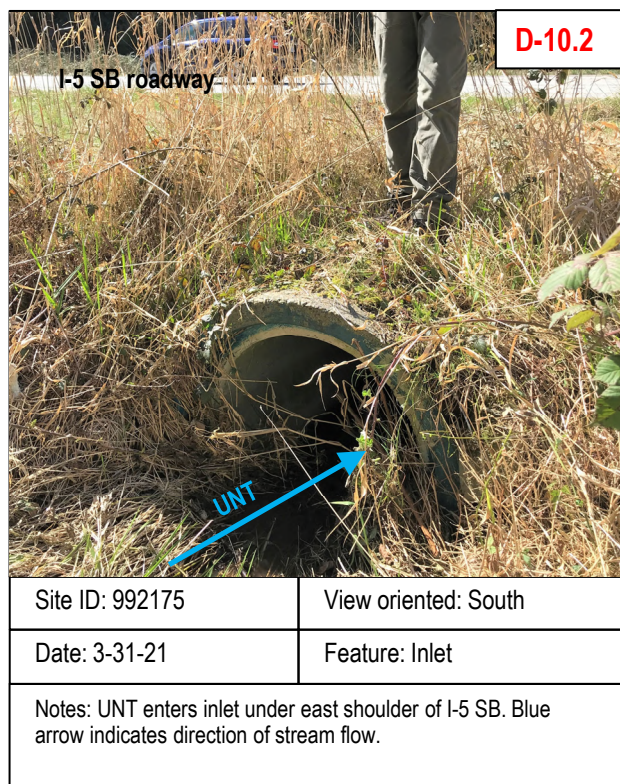
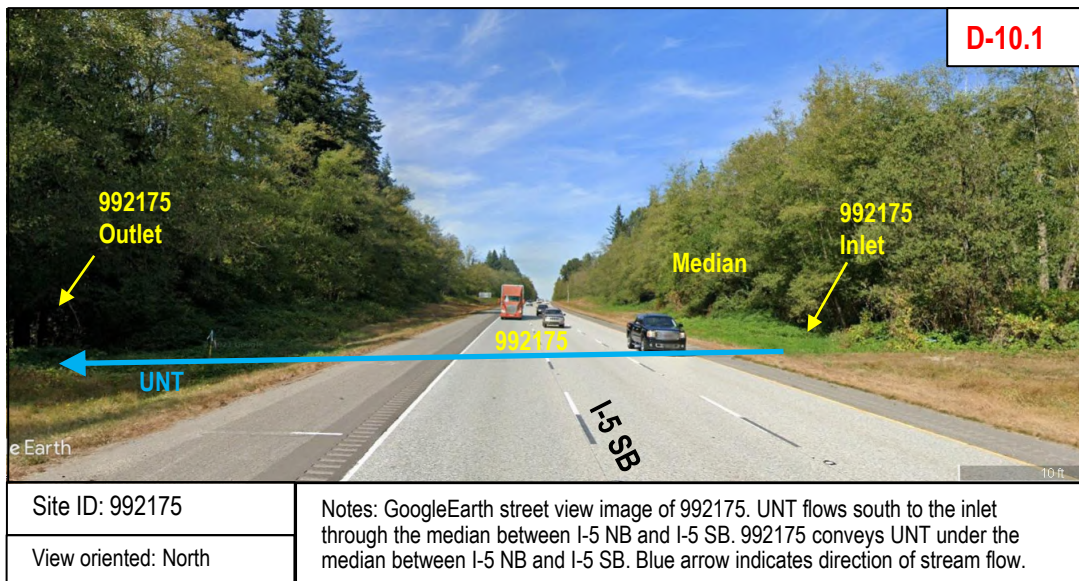
Site ID: LP 66

View oriented: North

Date: 3-31-21

Feature: Outlet

Notes: View of outlet and ponded water behind animal dam. Water seeps through and flows around the dam. Blue arrow indicates direction of stream flow.





Site ID: 992175

View oriented: SW

Date: 3-31-21

Feature: DS of Outlet

Notes: UNT channel DS of outlet facing SW toward Old 99 N roadway. Blue arrow indicates direction of stream flow.



Site ID: 995242

View oriented: North

Date: NA

Feature: Google Earth Street view

Notes: 995242 culvert conveys the UNT west under I-5 approx. 600 ft south of the Starbird Rd overpass. Blue arrows indicate direction of water flow.

