Norwegian Point Park Estuary Restoration Design

Final (100%) Design – Basis of Design Summary Report

Prepared for
Wild Fish Conservancy

Prepared by
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1 Introduction

Blue Coast Engineering (Blue Coast) prepared this Final (100%) Design – Basis of Design (BOD) Summary Report to describe the design documents (drawings and technical specifications) for the estuary restoration at Norwegian Point Park (NPP) in Hansville, Washington, developed by Blue Coast Engineering. The summary information documented in this memorandum includes design assumptions, list of project elements, material specifications, material volumes, and permitting considerations. The detailed BOD information is provided in the Preliminary Design - Basis of Design Report (BODR) developed by Blue Coast in December 2022 as part of the preliminary (60%) design effort for the restoration project.

1.1 Design Objectives

The design objectives for the project were identified during preliminary (60%) design and include the following;

Restore the natural processes in lower Finn Creek that create and sustain habitats used by wild fish populations, while meeting Kitsap County (landowner) flood objectives. These natural processes include fish passage; sediment sorting, scour, delivery, and longshore drift; riparian shading, filtering, and bank stability; and large wood recruitment (WFC 2019).

Provide a demonstration project in NPP to inform the public about the importance of protecting and restoring watersheds in the context of wild-salmon recovery (WFC 2019).

The project will remove barrier culverts and the tide gate at the mouth of Finn Creek to restore natural nearshore sediment transport and beach-forming processes, and provide fish access to nearly 2 miles of spawning and rearing habitat within the watershed. The final project will provide the following:

Improve tidal inundation and saltmarsh habitats at the stream mouth and within the park.

Naturalize the ditched reach of Finn Creek through NPP by adding sinuosity, large woody debris, and a native riparian corridor.

Incorporate interpretive signs within NPP.

Design criteria and assumptions are outlined in Section 11 of the Preliminary BODR (Blue Coast 2022) and are summarized here for the 100% design.

1.2 Permitting Assumptions

The following permits are anticipated to be required for this project:

United States Army Corps of Engineers (USACE) Nationwide Permit 27

Washington Department of Fish & Wildlife (WDFW) Hydraulic Project Approval (HPA)

Washington State Department of Ecology (WA ECY) Section 401 Water Quality Certification

WA ECY Construction Stormwater General Permit

This project is anticipated to qualify for WDFW's Habitat Recovery Pilot Program, which is designed to streamline the local and state environmental permitting process. As a result, the project is expected to be exempt from local permitting requirements through Kitsap County, except for the Flood Plain Development Permit.

2 Final Design Refinements

The following refinements were made to the preliminary (60%) design as part of the final (100%) design.

2.1 Levee Design

To prevent localized coastal flooding from the estuary onto neighboring properties, a levee will be constructed around the proposed estuary restoration area. Aspect Consulting, LLC (Aspect) provided the geotechnical basis of design for the levee in a technical memorandum, which is included as Attachment A. Blue Coast provided the wave run-up and overtopping design criteria for the levee that were used to inform the levee crest elevation and armoring requirements. Blue Coast's evaluation is provided in a technical memorandum as Attachment B. Design constraints and design criteria from the geotechnical and coastal engineering evaluations are summarized below.

2.1.1 Design Constraints

The design of the levee maximizes the restoration footprint despite space constraints of the site that include the road and parking area along the western and southern perimeters, park amenities on the northwestern perimeter, and private properties along the eastern perimeter.

2.1.2 Hydraulic Design Criteria

The hydraulic design criteria for coastal flooding and freshwater flooding at the site are as follows:

The project is designed to allow tidal inundation of the stream and estuary by removing the tide gate and outfall, which will also decrease episodic freshwater flooding of adjacent properties caused by backwatering of the stream channel when the tide gate is closed. Water levels in the proposed estuary project will be dominated by the tidal water levels.

Coastal flooding and the FEMA-designated extent of the coastal floodplain will not be impacted by the project. The defined coastal floodplain covers the entire project area and adjacent properties with or without the project (see FEMA FIRM #53035C0050F). The levee is not designed to protect public or private property adjacent to the project site from coastal flooding (i.e., tides, storm surge, and wave run-up).

The levee and estuary are designed to prevent localized freshwater flooding from the estuary onto neighboring properties. In addition, complementing upstream culvert, stream channel, and other improvements currently under design will reduce freshwater flood impacts south of the estuary. Based on the above hydraulic design criteria, the levee crest elevation is designed to 14 feet NAVD88.[1] The crest elevation provides more than 3 feet minimum freeboard from coastal overtopping during the highest astronomical tide conditions (10.1 feet NAVD88) and more than 2 feet of minimum freeboard above the design coastal flood elevation (11.8 feet NAVD88) in accordance with USACE guidelines (2000).

The wave run-up and overtopping design criteria are as follows:

The levee is designed for survivability against wave run-up and overtopping for a 50-year return interval wave event combined with a design coastal flood elevation (11.8 feet NAVD88).

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[1] North American Vertical Datum of 1988

The allowable overtopping rate before concerns of breaching is 0.1 cubic feet per second (cfs)/feet (10 l/s/meter) for grass-covered earthen levees (USACE 2018; EurOtop 2018)—this is the design overtopping threshold used for the project.

Based on the wave run-up and overtopping design criteria, Blue Coast recommends the following with respect to the levee alignment and armoring (see Attachment B for more details):

Terminate the levee landward of the alignment termination point shown in the 60% design drawings to move it landward of expected impacts from wave run-up. The toe of the levee slope should be at 12 feet NAVD88 on the landward side of the beach berm. This applies to the north and south ends of the levee.

No action is needed to armor along the north and south side of the levee where there is bench at 12 feet NAVD88. This assumes the bench will dissipate wave energy and is relatively stable with respect to channel migration as suggested by hydraulic modeling completed during the 60% design. However, higher water levels in the future resulting from sea level rise may increase wave transmittal across the benches. This may be addressed through adaptive management to add elevation to the benches, raise the levee crest elevation or armoring along the levee slope.

The levee along the western slope of the estuary channel at the narrowest point of the estuary requires armoring to protect against wave run-up and overtopping. The armoring should consist of two layers of armor rock and a filter layer to protect the levee slope. The recommended median (D_{50}) rock size for armoring is 1.0 feet (median weight = 175 lb) with an armor layer thickness of 2.0 feet. The recommended filter layer is 0.5 feet thick with a median rock diameter of 1.5 inches (0.13 feet). No geotextile fabric layer is recommended based on the coastal engineering design criteria for the slope protection. The backside (landward side) of the levee slope along the western levee alignment should be lined with quarry spalls (filter rock material) to prevent against potential erosion from overtopping waves. Armoring on the levee will transition back to earthen berm with tapered ends, as shown in the drawing detail.

The toe of the levee embankment along the eastern slope of the estuary channel at the narrowest point of the estuary will be armored with WSDOT 12" Streambed Cobble that extends down the bank of the stream channel to prevent scour of the stream channel bank at the toe of the levee at this location.

2.1.3 Geotechnical Design Criteria

The geotechnical engineering analysis of the levee design included the following components:

Review of the previous subsurface exploration and laboratory testing data.

Development of soil engineering properties.

Determination of critical levee section locations and geometry based on the coastal engineering analysis completed by Blue Coast.

Settlement, stability, seepage, and liquefaction evaluations at the critical section.

2.1.4 Levee Design Criteria

Settlement analyses suggest that 6 to 8 inches of settlement will occur along the levee alignment; the recommended overbuild thickness is 1 foot.

Seepage guidelines from the USACE (2000) recommend a maximum vertical exit gradient at/near the landside toe of the levee embankment of 0.5 (dimensionless). Additionally, Aspect assumed that excessive levee seepage for the project is defined as 200 gallons per minute per 100 linear feet of embankment.

Liquefaction settlement (as a result of earthquake shaking) on the order of 4 to 8 inches is expected to occur. Liquefaction will trigger evaluation of the levee post-seismic event.

Slope Stability was considered for three design cases: end-of construction, steady state seepage, and sudden drawdown from full flood stage. The recommended levee geometry meets the minimum factors of safety for levee stability.

Based on the above evaluated design criteria, the levee geometry is as follows:

Crown width of 6 feet; to be gravel-surfaced underlain with geotextile fabric for use as a trail/walking path along Point No Point Road and Hansville Road. No gravel surface will be added to levee parallel to private drive.

The top of the levee is defined as the top of the levee select fill and the base of the gravel surfacing.

The levee crown should be sloped at 2% away from the levee centerline to avoid water ponding.

The levee side slopes should not be steeper than 2.5H:1V (horizontal to vertical).

Additional recommendations for material (levee select fill, topsoil, base course, and geosynthetics), construction, and additional geotechnical services are described in Attachment A.

2.2 Channel Scour and Migration Protection

The channel width and bank geometry, combined with the streambed sediment bed substrate, is designed to reduce the risk of scour and lateral migration during flood events up to the 100-year flood.

2.2.1 Channel Bed Substrate

The channel bed will be composed of a 2-foot layer of WSDOT streambed sediment (section 9-03.11(1)), which is a well-graded gravel and sand mix that is frequently used by WSDOT on constructed restored streambeds. This bed composition will help to minimize the vertical scour and channel migration risk in the restored estuary.

The D_{50} of WSDOT Streambed Sediment material can range between 0.25 and 1.0 inches. Using the critical shear stress particle size reference table (USGS 2008), a median stable stone particle size (D_{50}) of 0.6 inches or larger (Coarse Gravel) is predicted to be stable during the 100-year stream flow event in the estuary channel coinciding with low tide conditions in Puget Sound. Therefore, the streambed sediment should have a minimum D_{50} of 0.6 inches. Some smaller fractions of the streambed sediment may become mobile during high flow events, which is how a natural system would behave. These sediments will be gradually replaced over time with deposition from sediment transported from upstream reaches of Finn Creek and sediment entering the estuary from Puget Sound.

2.2.2 Bank Scour Protection

Riprap bank scour protection was designed to provide an additional level of long-term stability to the estuary channel banks in key locations. The first key location is the areas of estuary channel bank adjacent to the outlet of the proposed culvert replacement project (Hansville – Buck Lake Road culvert replacement). In this location, the width, height, and elevation of the diagonal crossing is yet to be determined; however, it is anticipated that angular riprap revetment will be required in this critical location to provide bank scour protection. The specific locations and size of this material will be determined after completion of the culvert replacement design.

Downstream of the culvert outlet, there are four critical bends in the proposed estuary channel that will require additional riverbank scour protection to limit the risk of long-term channel bank migration over time. The computed stable particle size of this armoring was determined using the model-predictions of the 2- and 100-year flood with MLLW tidal conditions. High stream flow combined with low tides is representative of the steepest hydraulic gradient between upstream and downstream. Using the USACE engineering manual (EM) 1110-2-1601 equations for riverbed armor sizing (USACE 1994), the computed stable median grain size D_{50} on the channel banks is approximately 3.5 inches (cobble). The calculation accounts for the bend curvature, the side slopes of the design channel, the model-predicted depth of flow and velocity for both the 2- and 100-year flood events and includes a safety factor of 1.5.

The stable particle size for the channel banks immediately downstream of the culvert (approximate sta. 10+50 to sta. 9+00) will be revisited after the completion of the culvert design along with the large wood design for this section of the channel. Cobble channel bank scour protection will be included at the three additional bends downstream:

Sta. 8+00 to 7+30 left bank, next to the high marsh bench.

Sta. 5+50 to 3+50 right bank, where the channel is relatively close the east levee.

Sta. 4+00 to 2+00 left bank, where the channel is relatively close to the west levee.

Rounded cobble is more habitat friendly compared to traditional angular armor rock (i.e., riprap) and was therefore selected as the bank protection material. WSDOT streambed cobble material was selected because it provides a well-graded mix of cobble sizes and is habitat friendly in a stream and estuary environment compared to angular stone. The corresponding WSDOT rounded cobble material (Standard Specifications 9-03.11(2)) with a minimum D_{50} size of 3.5 inches is the 12″ Streambed Cobble, which can have conforming D_{50} sizes between 3.5 and 7 inches. The required thickness of the cobble layer will be a minimum of 2 feet to provide a minimum of two layers of cobble (two times the D_{100} maximum grain size). See sheet C-06 for locations of the bank scour protection locations.

2.3 Embedded Large Wood Design

The large wood design in the estuary was designed with a different intent than typical stream restoration or culvert replacement projects. In stream restoration, large wood is often clustered together to provide shade, shelter, and streambed complexity through scour and deposition. In coastal and estuarine environments, the benefits of large wood can be similar, but placement is more critical due to the effects of buoyancy on the wood stability. We also anticipate that some large wood from Puget Sound will be naturally recruited to the restored estuary over time and provide habitat benefits at varying elevations in the estuary.

The intent of the embedded large wood design is to optimize the initial channel alignment to strategically force tidal and freshwater flows to favor the opposite side of the estuary channel. This provides two key benefits: helps to discourage channel migration (in addition to the cobble armoring described above) and reduces the flow velocity in the channel during outgoing tide conditions by breaking up the momentum of the ebb tidal flows and freshwater flows.

The wood was designed in a series such that the flows during ebb tide would be redirected away from each bend in the restored estuary channel (see sheets C-06 for locations of each large wood piece). In a tidal environment, mechanical anchoring or chaining together multiple pieces of large wood is typically required to maintain stability. Using the USDA large wood stability software (Computational Design Tool for Evaluating the Stability of Large Wood Structures [Rafferty 2017]), it was determined that placement of the exposed rootwad at the toe of the channel with the stem of the log embedded upstream and into the bank would likely remain stable during flood tide conditions when the wood becomes completely inundated (the details of this placement are shown on Sheet C-10). In addition, it was determined that the maximum size of the large wood should be 20 feet in length with a mean diameter of 1.5 feet with an approximate rootwad diameter of 4.5 feet. For large wood with typical dimensions, this would mean up to 18 ft of the stem could be embedded on a 20-ft piece. The type of large wood selected is Douglas Fir.

After placement of the large wood, 2 feet of rounded cobble armoring will be placed on top of the embedded large wood piece as shown on the drawings. This material is not required as ballast for the large wood, but it will help to deter channel formation or channel migration into the channel bank behind the large wood. These cobbles will only be placed on the channel banks adjacent to the rootwad and above the embedded stem and because the cobble will be placed as a top-dressing and will protrude above the surrounding grade (i.e., the channel bank), the cobble may move around over time—especially during higher freshwater flows at lower tides. The cobble is not designed specifically as bank protection (Section 2.2.2) and is only intended to limit scour caused by the exposed rootwads. WSDOT 12″ Streambed Cobble was selected for the large wood scour protection. This is the same material that was determined to be suitable for bank scour protection (Section 2.2.2) in accordance with EM 1110-2-1601 (ASCE 1994).

2.4 Stormwater Updates

Stormwater from the gravel parking lot and drive aisle areas were modeled by Pacific Surveying and Engineering (PS&E) using the Western Washington Hydrology Model (WWHM v.3). Stormwater facilities were sized in accordance with the WA ECY's Stormwater Management Manual for Western Washington (SWMMWW; WA ECY 2019). Surface water runoff from these areas will be managed onsite with compost-amended vegetated filter strips and washed rock infiltration trenches. The compost-amended vegetated filter strips will be 18 inches deep and constructed per the SWMMWW Best Management Practice T7.40. The 1.5-foot-wide infiltration trench will also be 18 inches deep. An 8-inch-diameter perforated pipe will run the entire length of the infiltration trench adjacent to the gravel parking area to ensure that stormwater is distributed throughout the trench to maximize infiltration. PS&E provided the stormwater design report for the site in a technical memorandum which is included as Attachment C.

2.5 Planting Plan

Onsite plantings will consist of drought-resistant grasses, shrubs, and trees. Armored areas inside and outside of the levee will not be planted. Unarmored interior and exterior sections of the levee surface will be planted with erosion-control seed mix to prevent loss of levee soil materials. Plants in unarmored sections of the levee interior have been selected based on elevation, as some plantings will need to be saltwater tolerant. The summary below lists proposed plantings based on elevation:

Levee and levee setback areas will be planted with a native erosion control see mix.

Riparian Area (defined as elevation 12 feet NAVD88 and above not on the levee) consists of a selection of trees, shrubs, and live stakes, including maples, crabapple, spruce, pine, hemlock, willow, oceanspray, serviceberry, twinberry, ninebark, rose, currant, and snowberry.

Transitional Area (elevation 11 feet to 12 feet NAVD88) consists of native grasses and groundcover, including dune grass, strawberry, and gumweed.

Beach Backshore (elevation 9 feet to 11 feet NAVD88) along the shoreline will be planted with a variety of salt-tolerant plants, including verbena, sedge, silverweed, sandwort, lupine, and burweed.

High Marsh (elevation 10 feet to 11 feet NAVD88) will be planted with aster, sedge, hairgrass, and gumweed.

Low Marsh (elevation 9 feet to 10 feet NAVD88) will be planted with jaumea, arrowgrass, silverweed, and pickleweed.

3 Project Elements

The Project elements included in the final (100%) design documents are summarized below:

Mobilization and site preparation: Construction will occur during the summer low-flow period and be coordinated with the tides. To the extent possible, all work will be done in the dry.

Water management: Divert the stream at Hansville Rd NE through temporary bypass pipe to Puget Sound. Install temporary fish block nets prior to coffer dam/bypass pipe installation. Install energy dissipation splash pad at downstream bypass to reduce scour on beach.

Clearing and grubbing of vegetation within the work area limits: Remove and control of invasive species (English ivy, bamboo, and Himalayan blackberry), trees, and timber rail fence.

Protect in place the existing boathouse and concrete bulkhead on shoreline in front of boathouse.

Remove the tidegate and manhole near the existing NPP parking area off Hansville Rd NE.

Remove concrete outfall from the shoreline area (approximately 5 feet landward of the OHWL) and fill upland section of buried outfall with control density fill (CDF) prior to abandoning in place.

Relocate the existing gazebo, deconstruct, demolish concrete pad, build new concrete pad and reconstruct gazebo. Relocation of existing fishing cabins will be completed by others prior to the start of construction.

Coordinate with Puget Sound Energy, who will be relocating identified overhead power poles and lines.

Remove the short, undersized culvert at the midpoint of the existing ditch adjacent to Hansville Rd NE and backfill ditch.

Remove pump house at the midpoint of the existing ditch and backfill excavated area.

Excavate the upper estuary channel with a bottom width of 12 feet, a top width of approximately 38 feet (varies), and a thalweg elevation of 5.5 feet NAVD88. The width of the channel will vary.

Transition excavation to that of the lower estuary channel with a bottom width of 26 feet, a top width of approximately 70 feet (varies), and a channel bottom elevation of 5.0 feet NAVD88. The overall width of the channel will vary.

Transition excavation to the outlet of estuary channel with a bottom width of 36 feet, a top width of approximately 125 feet (varies), and a channel bottom elevation of 5.0 ft NAVD88.

Reuse excavated materials to create high marsh, fill, and levee areas, as required. Allow to dewater prior to use, as required.

Place appropriate stream channel substrate and large wood within the excavated estuary channels.

Armor sections of the stream channel and levee areas, as required.

Construct private gravel roadway (east side of levee) and parking areas.

Protect in place stormwater system to the east of the project area adjacent to the new private gravel roadway alignment.

Construct a crushed rock walking trail on the crown of the levee.

Construct concrete stairs within levee embankment to access walking trail

Construct a crushed gravel parking area and paths along Hansville Road and within NPP.

Planting of native species along the levee, riparian corridor, transition area, back beach, high marsh bench and low marsh areas.

3.1 Materials

Material specifications for the estuary restoration materials are provided below.

3.1.1 Levee Materials

Stockpiled soil from the channel excavation will be used to construct the levee. Levee Select Fill materials shall be a well graded soil, free of organic and deleterious material. Suitable USCS soil types include ML, SM, and SP-SM. Levee Select Fill may be from on-site or import sources. Levee Select Fill from onsite sources should be screened and oversized particles and deleterious material removed. Fines (material passing the No. 200 sieve) should have a maximum plasticity index of 40 and a maximum liquid limit of 45 percent. Levee Select Fill shall conform to the requirements shown in Table 3-1:

Table 3-1: Levee Select Fill Gradation

Sieve Size	Levee Select Fill
3-inch	100
No. 200 (0.075 mm)	15 min.
Organic Content	1 max.

3.1.2 Streambed Sediment

Streambed sediment will consist of mixed sand and gravel that meets WSDOT 2022 standard specification 9-03.11(1) for streambed sediment. The material will be placed on the streambed of the channel to a thickness of 1 foot to prevent scour and to reduce velocities in the channel. Streambed sediment has a maximum diameter of 2.5 inches. For this project, the streambed sediment should have a minimum D_{50} of 0.6 inches while meeting all other gradation requirements and WSDOT material specification requirements.

3.1.3 Rounded Cobble

The material selected for the top 2-foot layer of the cobble berm, as well as the apron for the embedded large wood within the stream channel, is a well-graded rounded cobble stone that meets WSDOT 2022 standard specifications for 12" Streambed Cobbles Section 9-03.11(2) (WSDOT, 2021). This material is a naturally rounded cobble material that provides a more natural-looking gravel berm and has less fine-grained materials in the gradation. Like the pit run cobble, the design streambed cobble material has a maximum particle size of 12 inches with a gradation presented below.

Table 3-2: 12 Inch[1] Rounded (Streambed) Cobble Gradation

Approximate Size	Percent Passing (%)
12-inch	99-100

Approximate Size	Percent Passing (%)
10-inch	70-90
5-inch	30-60
¾-in	10 max.

Notes: [1]WSDOT 2022 Standard Specifications for Road, Bridge, and Municipal Construction Division 9.

3.1.4 *Large Wood (Beach Foreshore)*

Logs should be placed irregularly (not anchored) above MHHW elevation and below elevation 12 feet NAVD88, approximately four pieces per 25 feet. Large wood should consist of salvaged driftwood and fallen tree logs (various species), stockpiled onsite prior to construction. Salvaged large wood can be reused as driftwood, nurse logs, or woody debris.

3.1.5 *Large Wood (Stream Channel)*

Large wood will consist of 20-ft Douglas Fir logs with rootwad attached, and 1.5 ft average stem diameter. Wood should be in good condition with no signs of rot.

3.1.6 *Riprap Armor Rock*

Armor rock will conform to WSDOT 2022 specification for Class A Rock for Erosion and Scour Protection, 9-13.4(2). Class A Rock has a median diameter of 8 to 12 inches. Armor rock must be durable and angular stone.

3.1.7 *Filter Rock*

Filter rock will consist of a well graded 4- to 8-inch angular quarry spall rock that is clean and free of debris. The material should not contain significant quantities of elongated or flat rocks. The gradation shall conform to WSDOT 2022 specification 9-13.1(5) Quarry Spalls material as shown below in Table 3-3.

Table 3-3: Filter Rock Gradation

Approximate Sieve Size (inches)	Percent Passing (%)
8″	100
3″	40 max.
¾″	10 max.

3.1.8 *Chinking Rock*

A chinking material shall be a minimum of 4 inches average dimension. The maximum dimension of chinking material shall not exceed 8 inches on any side. Individual imported filter rocks that meet the armor rock chinking material size requirements can be used for chinking material.

3.1.9 *Crushed Surfacing*

Crushed surfacing base course and top course will conform to WSDOT 2022 specification 9-03.9(3).

3.1.10 *Topsoil and Amendments*

Topsoil Type A will conform to WSDOT 2022 specification 9-14.2(1). Topsoil Type B will conform to WSDOT 2022 specification 9-14.2(2). Fertilizer will conform to WSDOT 2022 specification 9-14.4. Mulch and amendment will conform to WSDOT 2022 specification 9-14.5(2). Bark and wood chips will conform to WSDOT 2022 specification 9-14.5(3). Compost will conform to WSDOT 2022 specification 9-14.5(8).

3.1.11 *Plant Materials and Appurtenances*

Plant materials will conform to WSDOT 2022 specification 9-14.7. Seeding material will confirm to WSDOT 2022 specification 9-14.3. Stakes, guys, and wrapping materials will conform to WSDOT 2022 specification 9-14.8.

3.1.12 *Temporary Erosion and Sediment Control*

Biodegradable erosion control blanket materials for slopes (flatter than 3H:1V) will conform to WSDOT 2022 specification 9-14.6(2)B. Coir log materials will confirm to WSDOT 2022 specification 9-14.6(7). Wattle materials will confirm to WSDOT 2022 specification 9-14.5(5). Silt fence materials will confirm to WSDOT 2022 specification 9-14.6(9). Permeable ballast for the construction entrance will conform to WSDOT 2022 specification 9-03.9(2).

3.2 Geometry and Material Volume Estimates

Engineer’s estimates of material volumes are provided in Table 3-4:

Table 3-4: Material Volume Estimates

Description	Unit	Estimated quantity
Mobilization/Demobilization	LS	1
Construction Surveying and Record Drawings	LS	1
Clearing and Grubbing	ACRE	7
Relocate Pavilion	LS	1
Creek Diversion Measures	LS	1
Water Pollution Control	LS	1
Excavation for Channel Construction	CY	13,171
Disposal of Structures and Obstructions	TON	300
Furnish and Place Streambed Cobble	TON	1,333
Furnish and Place Streambed Sediment	TON	2,456
Furnish and Place Armor Rock	TON	308
Furnish and Place Filter Rock	CY	52
Furnish and Place Quarry Spalls	CY	44
Furnish and Place Large Wood in the Estuary Channel	EA	20
Place Large Wood in the Shoreline	EA	20
Procure and Install Concrete Wheel Stops	EA	65
Procure and Install Parking Signs	EA	5

Description	Unit	Estimated quantity
Procure and Install Removable Bollard	EA	2
Furnish and Place Geotextile Material	SY	1,450
Place and Grade Levee Materials	CY	11,040
Furnish and Install Gravel Base Course for Parking, Driveway, Spreader	TON	1,815
Furnish and Install Crushed Surfacing Top Course for Parking, Driveway	TON	406
3/4" Crushed Rock	TON	256
Compost Amended Vegetated Filter Strip	SY	4,082
Construction Geotextile	SY	627
Underdrain Pipe 8 In. Diam.	LF	850
Type 1 Catch Basin	EA	7
Water Service Transfer - Replace 2-inch Potable Water line	EA	435
Place and Grade Stockpiled Sand	CY	325
Topsoil A Material	CY	836
Topsoil B Material	CY	312
Furnish and Place Compost Amendment	CY	216
Furnish and Place Wood Chip Mulch	CY	220
Waterfowl Exclosure Fencing	SY	1,477
Furnish and Plant Trees (5 gal)	EA	40
Furnish and Plant Shrubs (2 gal)	EA	935
Furnish and Install 10 In-Cu plugs	EA	7,783
Seeding	SF	94,000
Furnish and Install Livestakes	EA	593
Furnish and Install Coir Fabric	SY	1,477
Furnish and Install Coir Log	EA	130
Install Salvaged Tree Snag	EA	3
Install Log Edging	EA	1
Concrete Stairs	SF	320
Furnish and Construct Rock Pedestrian Path	TON	255
Galvanized Metal Hand Railing	LF	128
Procure and Install Log Barrier in Parking Area	LF	128
Relocate Utility Poles Along Private Driveway	EA	2

Notes: All costs are in 2024 dollars.

3.3 Engineer’s Opinion of Construction Cost

Based on design elements illustrated in the final design drawings, which are included as Attachment D, and narrative in this section, an engineer’s opinion of construction cost has been developed for the Project. The total cost, which is included as Attachment E, for the Project elements shown on the design drawings is estimated at $3,000,000. This cost estimate does not include Kitsap County's diagonal culvert replacement as that will be completed during the next phase of design. Assumptions included in the cost estimate are:

- Clearing and grubbing.
- Demolition of existing tide gate, outfall, derelict pumphouse, and culvert (located at the midpoint of the existing ditch adjacent to Hansville Rd NE).
- Relocation of the gazebo structure, including the concrete foundation structure.
- Temporary diversion of Finn Creek away from active construction areas.
- Excavation and grading within the Work Area Limits.
- Furnishment and placement of 1,335 cubic yards (CY) of streambed cobble and 2,500 CY of streambed sand for placement within the excavated streambed.
- Placement of re-use material within the project area, including estuary and levee areas.
- Furnishment and placement of 220 CY of armor rock, 52 CY or filter rock, and 44 CY of quarry spalls for placement on a section of the levee vulnerable to wave action.
- Furnishment and placement of 1,000 CY of crushed surfacing base course and 220 CY of top course for the parking areas. private roadway, and pedestrian trail areas.
- Construction of approximately 4,400 square feet (SF) of Compost Amended Vegetated Filter Strips and 2,750 SF infiltration trenches to manage surface water onsite.
- Furnishment and placement of large wood in the stream.
- Relocation of private driveway and a 2-inch potable water line serving private properties adjacent to the Park.
- Relocation of two utility poles along the private driveway.
- Riparian plantings (trees, shrubs, grasses, seeding) and bird exclosure.
- Four sets of concrete stairs that provide access to the pedestrian trail on top of the levee.
- Mobilization and de-mobilization costs are 10% of the overall construction cost.
- A 9% sales tax for Kitsap County.

Fishing cabins will be relocated by others prior to the start of construction. Fish exclusion will be completed by WFC prior to the stream diversion is in place. Additionally, costs for the culvert replacement and the public utility pole relocations along Hansville Rd NE and NE Point No Point Rd are not included in this estimate.

4 References

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Attachment A

Geotechnical Basis of Design Technical Memorandum

Aspect
A Geosyntec Company

MEMORANDUM

Project No. 190092-C-01

February 28, 2024

To: Jennifer Allen
Senior Scientist
Blue Coast Engineering

From:

49471

2/28/2024

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Staff Engineer
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Re: **Norwegian Point Park Restoration Project – Levee Basis of Design**

This memorandum presents the results of Aspect Consulting, LLC's (Aspect) geotechnical engineering analyses and basis of design for the earthen levee associated with the Norwegian point Park Restoration Project (Project). The Project is located on Kitsap County Parcels 162802-4-097-2000 and 162802-4-086-2003, -2102, -2201, -2300, -2409, -2508, -2607 in Hansville, Washington (Site; Figure 1).

Aspect previously completed subsurface explorations at the Site (Aspect 2019, 2022) and a preliminary geotechnical engineering report for the Project. This memorandum utilizes the previously completed subsurface exploration data along with design updates described below to document the basis of design for the levee.

1 Project Description and Background

The primary goal of the Project is to restore estuary and floodplain processes near the mouth of Finn Creek at the Site. Finn Creek enters the Site via a 3-foot-diameter corrugated metal pipe (CMP) that carries the creek below the intersection of Hansville Road NE and NE Point No Point Road and into a ditch at the southwest corner of the Site. The creek currently flows in a ditch along the west boundary of the Site and through a culvert to Puget Sound.

To restore the mouth of the creek, the culvert and a tide gate will be removed, and a new tidally influenced creek channel will be graded through the Site. During high tides, the Site will become inundated, necessitating a levee to provide flood protection to the adjacent properties. The culvert beneath the intersection of Hansville Road NE and NE Point No Point Road will be replaced with a larger structure as part of a forthcoming design managed by the Kitsap County Department of Public Works. The culvert will be a penetration through the proposed levee.

We understand grade control in the form of 12-inch cobble and coarse streambed materials will prevent appreciable creek channel vertical scour or lateral migration. Scour/erosion protection will be required in constricted areas, around the outlet of the proposed culvert at the southwest corner of the Site, along a northeastern portion of the levee, and on a section of the northwestern portion of the levee in an area where wave runup and overtopping is anticipated.

Blue Coast Engineering (Blue Coast) has advanced the Project design with the current concept shown on Figure 2.

1.1 Levee Design Criteria

We evaluated the proposed levee in general accordance with guidance provided in the following USACE design manuals:

- Engineering Manual (EM) 1110-2-1913 Design and Construction of Levees (USACE, 2000).
- EM 1110-2-1902 Slope Stability (USACE, 2003)
- EM 1110-1-1904 Settlement Analysis (USACE, 1990)
- EM 1110-2-6053 Earthquake Design and Evaluation of Concrete Hydraulic Structures (USACE, 2007), as referenced by the Engineering Regulation (ER) 1110-2-1806 Earthquake Design and Evaluation for Civil Works Projects (USACE, 2016)
- Engineering Technical Letter (ETL) 1110-2-569 Design Guidance for Levee Underseepage (USACE, 2005)

The design levee heights and basic geometry used in our analyses were based on our preliminary recommendations and communications with Blue Coast. The levee design heights were determined based on the 1 percent annual probability of exceedance flood, or 100-year flood plus 2 feet of freeboard. In addition to the 2 feet of freeboard, the levee design height includes an appropriate allowance for future levee embankment settlement.

Source material for the levee is anticipated to come from the on-Site excavations for the new creek channel or other local sources with materials meeting the design requirements.

1.2 Site Conditions

We previously provided a preliminary geotechnical engineering report which included our high-level conclusions and recommendations regarding this Project, as well as a memorandum addressing evaluation of impacts of groundwater hydrology and salinity (Aspect, 2019 and Aspect, 2022). We have included the exploration logs and lab results from our previous report as Appendix A and Appendix B of this report, respectively.

The Site is relatively level and bound by Puget Sound to the north, NE Point No Point Road to the south, single family residences to the east, and Hansville Road NE to the west. Finn Creek enters the Site in the southwest corner and flows north into the Puget Sound. See Section 2.1 of our preliminary report for a full description of the Site surface and subsurface conditions.

2 Geotechnical Engineering Analyses

Our geotechnical engineering analyses for the proposed levee included reduction of the previous subsurface exploration and laboratory testing data, development of soil engineering properties, determination of critical levee section locations and geometry based on design updates by Blue Coast, with settlement, stability, seepage, and liquefaction evaluations at the appropriate critical section. The following sections describe the basis of our methodologies, key assumptions, and results.

2.1 Soil Engineering Properties

We developed soil engineering and hydrogeologic properties based on the results of the previously completed subsurface explorations, lab test results, empirical correlations with standard penetration test (SPT) blow counts, empirical formulas for estimating hydraulic conductivity, literature review, and our experience with the local geology.

For levee embankment materials, we assumed a uniform levee section consisting of levee select fill. Based on our understanding of the Project design, we have assumed the levee select fill will be derived from the excavations for the proposed creek channel. Based on this likely levee select fill material, we developed representative engineering properties for use in our analyses. To account for the range and variability of each material, we also varied the engineering properties used in our analyses for sensitivity scenarios and to help verify the assumed engineering properties.

Specific references utilized in the development of the soil engineering and hydrogeologic properties include the WSDOT Geotechnical Design Manual (GDM; WSDOT, 2019), the Navy Facilities Engineering Command (NAVFAC) Design Manual 7.1 (NAVFAC, 1986), USACE EM 1110-2-1904 *Settlement* (1990)*,* and USACE 1110-2-1901 *Seepage Analysis and Control for Dams* (1993).

The soil engineering and hydrogeologic properties used in our geotechnical engineering analyses are shown on Table 1, attached to this report.

2.2 Levee Section Analyzed

We evaluated a single critical section for the proposed levee, shown on Figure A and at the location shown on Figure 2.

Material Name	Color
Levee Fill	🟨
Existing Fill	🟩
Wetland Deposits (Peat)	🟧
Beach Deposits	🟪
Beach Deposits (Liq)	🟫
Floodplain Fill	🟥

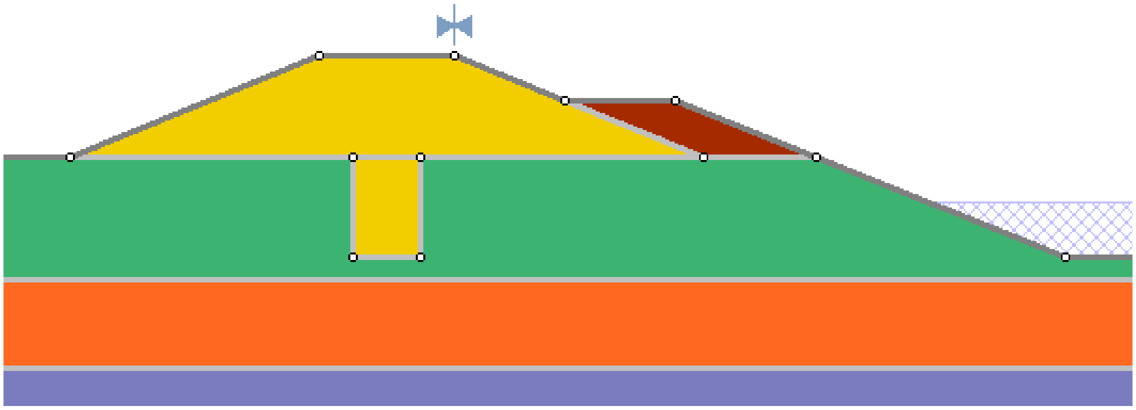

Figure A. *Critical levee cross section analyzed using Slide2 (Rocscience, 2022).*

The section we analyzed is located at approximately STA 20+00 along the levee alignment. We deemed this location to be critical because it is where the planned creek channel is closest to the levee. Consequently, this section will contain the smallest amount of flood plain fill between the levee and the water in the creek driving seepage. We also assumed this section will have worst case thickness of fibrous peat wetland deposits (four feet) underlying the levee.

2.3 Earthquake Engineering

Following the procedures outlined in United States Army Corps of Engineers (USACE) Engineering Manual (EM) 1110-2-6053 *Earthquake Design and Evaluation of Concrete Hydraulic Structures* (USACE, 2007), we have determined seismic parameters for design as presented in Table 2 representing an Operating Basis Earthquake (OBE). The OBE is the level of ground motion for which the levee is able to maintain operation with little to no damage. It corresponds to a 50-percent probability of exceedance over a Project service life of 100 years, which corresponds to a 144-year return period event.

The OBE has an associated moment magnitude (M_w) and effective peak ground acceleration (PGA).

The National Earthquake Hazard Mapping Program (NEHRP) expresses the effects of site-specific subsurface conditions on the ground motion response in terms of the “Site Class” (NEHRP, 2003). The Site Class can be correlated to the average standard penetration resistance (SPT) or average shear wave velocity in the upper 100 feet of the soil profile. Based on our observations from the subsurface exploration programs, we recommend Site Class D/E as a representative site class description of the upper 100 feet of the soil profile at the Site. Site Class D/E represents stiff soil on a scale of soft clay soil to hard rock.

The USACE EM 1110-2-6053 presents guidelines for determining the effective PGA based on the soil Site Class designation. The U.S. Geological Survey (USGS) has completed probabilistic ground motion studies and design maps for Washington (USGS, 2014).

Table 2 below outlines the earthquake parameters used in our analyses.

Table 2. Design Ground Motion Parameters

Parameter	OBE Value
Site Soil Class	"D/E Boundary" – Stiff Soil
Return Interval	144-year
Mean Magnitude Earthquake, M_w (2,3)	7.1
Mean Distance to Epicenter, km(2,3)	68.94
Effective Peak Ground Acceleration, g (PGA)	0.227

Notes:

1) OBE = Operating Basis Earthquake
2) Based on the latitude and longitude of the Site: 47.916311°, -122.546262°
3) Values taken from the USGS Unified Hazard Tool (USGS, 2014)
4) g = acceleration of gravity

2.4 Settlement

We evaluated settlement using the software program Settle3D (Rocscience, 2023), a 3-dimensional finite element analysis program that calculates settlement, stress, and pore pressures through a 3-dimensional soil volume.

Key inputs into Settle3D are soil engineering parameters such as elastic modulus and time-dependent consolidation parameters, groundwater conditions, and loading conditions. Through finite element analysis within the subsurface, Settle3D computes three-dimensional stress changes and one-dimensional (vertical) settlement and pore-pressures.

The key outputs from the settlement analyses are elastic settlement, primary consolidation, and secondary compression at user-defined time intervals.

The results of our settlement analysis are presented in Table 3 below. The results of the settlement analysis are the basis for our recommended overbuild thicknesses discussed in Section 3.9.

Table 3. Settlement Analysis Results

Elastic Settlement, inch(1)	Consolidation Settlement, inch(2)	Secondary Compression, inch(2)	Long-Term Settlement, inch(3)	Total Settlement, inch
0.18	6.7	1.27	6.97	8.11

Notes:

1) Elastic settlement is anticipated to occur as the levee is built.
2) Measured in 0.3,1 ,2 ,5 -,10-, 25-, and 50-year time stages.
3) Long-term settlement = consolidation settlement + secondary compression

2.5 Seepage

To evaluate seepage through the proposed levee embankment, we performed steady-state seepage analyses using the finite element analysis groundwater module within the computer program Slide (Rocscience, 2022). The Slide program groundwater module is a two-dimensional, finite-element program that simulates fluid flow and estimates pore-water pressure distribution in saturated and unsaturated porous material.

Key inputs into the Slide groundwater module are levee embankment geometry, soil hydraulic properties (horizontal hydraulic conductivity, k_h), and ratio of vertical to horizontal hydraulic conductivity (k_v:k_h) and known boundary conditions (in this case, steady-state flood total head conditions). Through iterative calculations of successive finite element runs, the groundwater analysis module computes the pressure head throughout the model and determines the piezometric surface, flow directions, gradients, and seepage potential.

Key outputs from the Slide groundwater module are the vertical exit gradients at/near the toe of the levee and levee seepage through the levee toe per 100 linear feet of embankment.

2.5.1 Design Requirements

We performed seepage analyses in accordance with the United States Army Corps of Engineers (USACE) Engineering Technical Letter (ETL) 1110-2-569 *Design Guidance for Levee Underseepage* (USACE, 2005). These guidelines recommend a maximum vertical exit gradient at/near the landside toe of the levee embankment of 0.5 (dimensionless). In addition, we have assumed that excessive levee seepage for the Project can be defined as more than 200 gallons per minute (gpm) over 100 linear feet of embankment (USACE, 2005).

2.5.2 Design Conditions for Analysis

We performed steady-state seepage analyses to evaluate groundwater flow through and beneath the proposed levee at the critical section outlined in Section 2.2 of this report. We considered three water levels in our steady-state seepage analyses representing the average tidal water surface elevation (WSE), the 100-year WSE, and the bank-full WSE (BCE, 2023). These water levels are at Elev. 7.4[1], Elev. 10.13, and Elev. 14, respectively, and are shown on Figure C-1.

2.5.3 Seepage Analyses Results

The results of our seepage analyses are presented in Table 4 below and shown graphically in the attached analysis output Appendix C (Figures C-1 through C-4). Our steady-state seepage analyses indicate that seepage through the levee embankment is unlikely to manifest in excessive vertical exit gradients or excessive seepage, as defined in Section 2.5.1, indicating the proposed levee sections and design are sufficient from a seepage perspective and meet the Project design and USACE criteria.

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[1] Elevations used in analysis are in reference to the NAVD88 vertical datum.

Table 4. Seepage Analysis Results

Analysis Output Figure	Levee Conditions	Water Surface Elevation	Vertical Hydraulic Exit Gradient(1)	Flow per 100 linear feet of levee, gpm(2)
C-1	Long-term (Master Scenario)	-	-	-
C-2	Long-term	100-yr Flood	0.12	30.3
C-3	Long-term	Average Tidal	0.04	9.9
C-4	Long-term	Bank-Full(3)	0.24	61.0

Notes:

1) Vertical hydraulic exit gradient measured within 5 feet of the levee toe.
2) Discharge in gallons per minute (gpm) per 100 linear feet of levee embankment, measured within 5 feet of the levee toe.
3) Representing water levels up to the crest of the levee.

2.6 Liquefaction

We conducted liquefaction evaluations using WSliq, a liquefaction analysis software program that was created as part of an extended research project supported by WSDOT. Liquefaction occurs when loose, saturated, and relatively cohesionless soil deposits temporarily lose strength as a result of earthquake shaking. Primary factors controlling the development of liquefaction include intensity and duration of strong ground motion, characteristics of subsurface soil, *in situ* stress conditions, and the depth to groundwater. Potential effects of soil liquefaction include temporary loss of shear strength and liquefaction-induced settlement and ground movement which could result in damage to the levee.

Key inputs into WSliq are the subsurface profile, including the relative density of the soil, standard penetration blow counts (“N-values”), fines contents, moisture contents and groundwater levels, grain-size d_{50} values, Atterberg limits, earthquake magnitude, distance to epicenter, and peak ground acceleration (PGA). With these inputs, WSliq computes the factor of safety (FS) of the soil layers to liquefaction, which is defined as a ratio of cyclic resistance ratio (CRR) to cyclic stress ratio (CSR), and CRR is defined as the capacity of soil to resist liquefaction and CSR is defined as the seismic demand to a soil layer. A FS less than 1.0 indicates liquefaction will occur in that soil layer. For soil layers with FS less than 1.0, WSliq can then compute the response spectrum of the soils, potential for lateral spreading and settlement, and residual strength of liquefied soils after the earthquake event.

Key outputs from WSliq include anticipated settlement due to liquefaction, residual shear strengths, and magnitude of lateral spreading.

2.6.1 Design Requirements

Following the procedures outlined in United States Army Corps of Engineers (USACE) Engineering Manual (EM) 1110-2-6053 *Earthquake Design and Evaluation of Concrete Hydraulic Structures* (USACE, 2007), we have determined seismic parameters for the OBE as presented in Table 2.

2.6.2 Liquefaction Analyses Results

The results of our liquefaction analyses indicate that liquefaction settlement can be anticipated within isolated layers of the beach deposits which underlie the levee. We anticipate liquefaction settlement on the order of 4 to 8 inches. Our results also indicate that lateral spreading is expected to be on the order of a couple inches. Liquefaction of the isolated layers of the beach deposits will trigger residual shear strength conditions and require evaluation of stability in the post-seismic case.

It should be noted that similar levels of ground deformation should be expected across the greater floodplain at and near the Site with potential for damage to roadways, utility infrastructure, and other structures. In our opinion, these predicted ground deformations resulting from liquefaction can be repaired through conventional grading and earthwork-oriented methods along the levee and the risk of a significant flood event coinciding with or occurring shortly after the OBE earthquake is low.

2.7 Slope Stability

To evaluate slope stability of the proposed levee embankment, we performed analyses using the slope stability module within the computer program Slide (Rocscience, 2022). The Slide slope stability module is a two-dimensional, finite-element program that performs slope stability computations based on the modeled slope conditions and calculates factors of safety against slope failure. The factor of safety is defined as the ratio of resisting forces to driving forces. A factor of safety of 1.0 indicates a “just-stable” condition, and a factor of safety less than 1.0 would indicate unstable conditions.

Key inputs into the Slide slope stability module are levee embankment geometry, soil parameters such as unit weight, soil shear strength parameters (friction angle and cohesion), and groundwater conditions. We coupled the Slide groundwater and slope stability modules to determine pore pressures and phreatic surfaces for each water surface elevation scenario. We used Spencer’s method in our Slide analyses. Through iterative calculations of successive finite element runs, the slope stability module computes forces and performs limit equilibrium calculations on each slip surface.

Key outputs from the Slide slope stability module are the factors of safety of thousands of slip surfaces throughout both the riverside and landside of the levee embankment. Analysis outputs for this Project control slip surface searches to include only failures that intersect the levee crest or beyond. Surficial failures (less than 3 to 5 feet thick) are considered maintenance issues and are not included, since they do not affect the core of the levee.

2.7.1 Design Requirements

We performed slope stability analyses in accordance with the United States Army Corps of Engineers (USACE) Engineering Manual (EM) 1110-2-1913 *Design and Construction of Levees* (USACE, 2000). These guidelines recommend that three design cases be considered in design: end-of-construction, steady state seepage, and sudden drawdown from full flood stage. Additionally, we conducted a risk assessment of the slope stability scenario where steady-state flood conditions reach the top of the levee crest (“bank-full conditions”), in recognition that these conditions can quickly lead to failure.

The minimum factor of safety requirement for each design case is presented in Table 5 below. Each design case is further described below.

Table 5. Minimum Factors of Safety for Levee Stability

Analysis Case	Minimum Factor of Safety (FS)
End-of-Construction	1.3
Steady-State Seepage	1.4
Sudden Drawdown	1.1
Seismic (Pseudostatic)	1.1
Post-Seismic (Liquefied Conditions)	1.1

2.7.2 Design Conditions for Analysis

We performed slope stability calculations at the critical section discussed in Section 2.2. We did not perform additional slope stability analysis on an armored section of the levee because we determined that the unarmored section governed stability. We considered three steady state water levels in our stability analyses representing the average tidal WSE, the 100-year WSE, and bank-full conditions (BCE, 2023). Additionally, we considered analysis of rapid drawdown conditions between the 100-year WSE and the low tide WSE, as well as seismic and residual conditions coinciding with average tidal conditions. We created the subsurface profiles used in the models based on the previously completed subsurface explorations at the Site. Future scour or creek channel migration was assumed to be minimal due to the incorporation of cobble scour protection and utilization of coarse streambed sediment in the proposed creek channel.

Typical levee section geometry modeled in Slide are presented in Section 3.2.

2.7.3 Slope Stability Analyses Results

The results of our slope stability analyses are presented in Table 6 below and shown graphically in the attached analysis output in Appendix C (C-5 through C-17). Our slope stability analyses indicate that slope stability through both the waterward and landward sides of the levee embankment meet the minimum required factors of safety. In our opinion, the levee sections and design are sufficient from a slope stability perspective and meet the Project design and USACE criteria.

Table 6. Slope Stability Analysis Results

Analysis Output Figures	Analysis Case	Water Surface Elevation[(1)]	Minimum Factor of Safety (FS)[(2)]	Failure Location
C-5	Steady-State Seepage	Average Tidal Conditions / End-of-Construction	2.27	Waterside
C-6	Seismic	Average Tidal Conditions	1.58	Waterside
C-7	Post-Seismic[(3)]	Average Tidal Conditions	1.58	Waterside
C-8	Steady-State Seepage	100-yr Flood	2.57	Waterside
C-9	Steady-State Seepage	Bank-Full	2.65	Landside
C-10	Sudden Drawdown	100-yr Flood → Low Tide	1.41	Waterside

Notes:

1) Water surface elevations provided by Blue Coast (BCE, 2023).
2) Minimum factor of safety affecting the levee crest or beyond.
3) Post-seismic conditions represent conditions after liquefaction has occurred.

3 Geotechnical Engineering Conclusions and Recommendations

Based on the previously completed subsurface explorations, our review of the updated design concepts from Blue Coast, and our geotechnical engineering analyses, we have developed the following design conclusions and recommendations for the Project.

3.1 Levee Embankment Design

In our opinion, the proposed levee may be comprised of a uniform material type with the expectation that the primary source for levee select fill will be the on-Site excavations for the proposed creek channel. Due to the wave runup and overtopping potential along a portion of the northwest section of levee, typical sections with and without scour/erosion protection are required.

The foundation for the levee embankment should be stripped to an appropriate depth to remove the primary rooted zone, organic topsoil, and other objectionable material. For design purposes, this depth is assumed to be 6 inches; however, a geotechnical professional should observe stripping to ensure proper removal of rooted zone, organic topsoil, or other objectionable material. A limited inspection trench should also be excavated beneath the proposed levee foundation to identify any unacceptable underground features, such as abandoned utilities, pockets of unsuitable material, or other debris that could create adverse underseepage paths beneath the levee prism.

3.2 Levee Geometry

The crown width of the levee embankment is 6 feet and will be gravel-surfaced for use as a trail/walking path. The top of levee, defined for the Project, should be taken at the top of the levee select fill and at the base of the gravel surfacing. The levee crown should be sloped at 2 percent away from the levee centerline to avoid water ponding on the levee crest. The levee embankment should have side slopes that are no steeper than 2.5H:1V (horizontal:vertical). Our recommended typical levee sections for the Project are shown below.

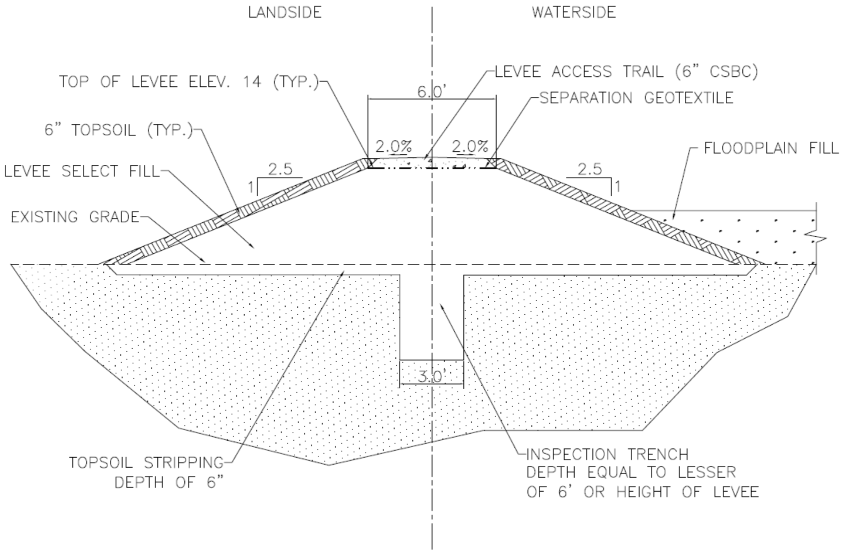

Figure B. *Typical Non-Armored Levee Section (NTS)*

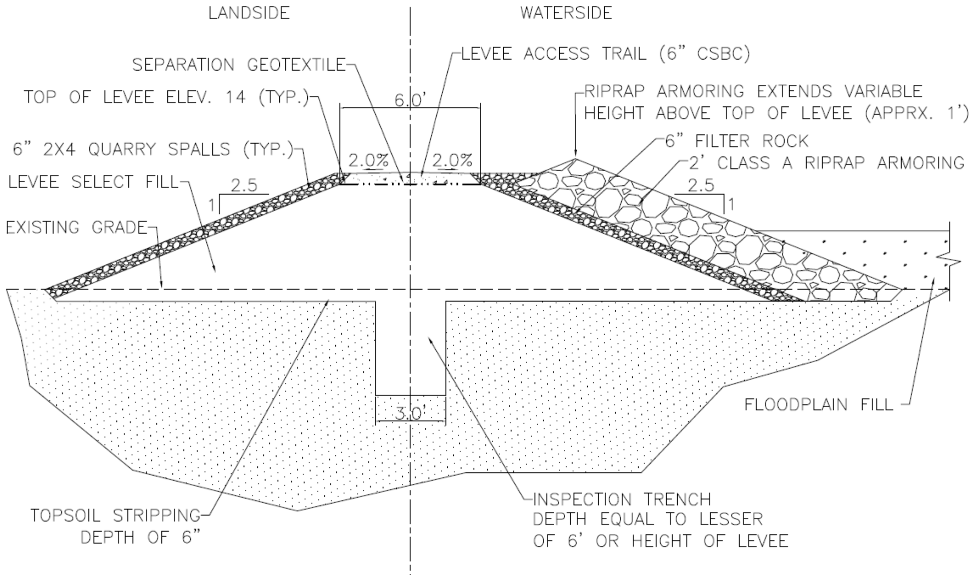

Figure C. *Typical Armored Levee Section (NTS)*

3.3 Levee Select Fill

We recommend the levee embankment (except for surfacing and scour/erosion protection where needed) consist of a single, relatively uniform levee select fill material. The levee select fill should consist of relatively well-graded soil free of organic and deleterious material, and meet the USCS soil type classification of ML, SM, and SP-SM. The gradation of the material should have a maximum particle size of 3 inches and a minimum fines content (material passing the No. 200 sieve) of 15 percent. The fines should have a maximum plasticity index of 40 and a maximum liquid limit of 45 percent. The maximum organic content should not exceed 1 percent by dry weight.

Based on our previous subsurface explorations at the Site, we anticipate the existing fill that mantles the upper 2 to 5 feet of the Site and consists of silty sand (SM) with gravel will be suitable for reuse as levee select fill. The organic-rich wetland deposits present below the fill are not suitable for reuse as levee select fill due to their high organic content, low shear strength and high compressibility characteristics.

Based on the results of laboratory testing and our observations of the existing fill at the Site, presented in Appendices A and B, the moisture content is above the optimum moisture content for compaction; therefore, existing fill will require moisture conditioning (drying) prior to use as levee select fill for the Project. We recommend planning the levee construction for the dry season and to allow an area of the Site to be used for spreading and aerating the existing fill. The existing fill is also variable and will require some level of processing (screening and mixing) to remove oversized particles and to create a uniform material type.

If the Project material sources change prior to or during construction, and result in materials that are significantly different from the recommendations above, Aspect should review samples and gradations of the proposed material and update our geotechnical engineering analyses and design recommendations, as needed.

The levee select fill should be compacted to a minimum of 90 percent of the maximum dry density and within 2 percent of the optimum moisture content as determined by ASTM D1557 (Modified Proctor).

3.4 Levee Scour/Erosion Protection and Filter

The levee scour/erosion protection rock for the armored levee section (Figure C) has been sized by Blue Coast based on the anticipated wave runup forces and dynamics and stream flow. We understand the scour/erosion protection on the waterside of the levee will consist of Class A Rock for Erosion and Scour Protection, per WSDOT Standard Specifications Section 9-13.4(2), with a minimum thickness of 2 feet (measured perpendicularly to the levee embankment side slope). A filter layer between the scour/erosion protection rock and the levee select fill should be included in the design and be a minimum of 6 inches thick and meet the requirements for Quarry Spalls, per WSDOT Standard Specifications Section 9-13.1(5). The scour/erosion protection on the landside of the levee will consist of Quarry Spalls, per WSDOT Standard Specifications Section 9-13.1(5), with a minimum thickness of 6 inches (measured perpendicularly to the levee embankment side slope).

3.5 Crushed Surfacing Base Course

For surfacing the levee crown, we recommend a minimum section of 6 inches of Crushed Surfacing Base Course (CSBC) meeting the requirements of WSDOT Standard Specification 9-03.9(3). To promote a finer surface for trail users, the surfacing may consist of Crushed Surfacing Top Course (CSTC).

3.6 Topsoil

Topsoil will be placed on the levee side slopes over the levee select fill for the non-armored levee section. We anticipate topsoil stripped from the levee and/or creek channel alignments may be stockpiled and reused. Imported topsoil should meet the requirements of Topsoil Type C per WSDOT Standard Specifications Section 9-14.2(3). We recommend a minimum topsoil thickness on the levee side slopes of 6 inches.

3.7 Geosynthetics

We recommend separation geotextile between the CSBC surfacing and levee select fill to prevent migration of the CSBC into the levee embankment and aid with long-term performance of the trail/access path surface. The separation geotextile should meet the requirements for Geotextile for Soil Separation as shown on Table 3 of WSDOT Standard Specifications Section 9-33.2(1) (WSDOT, 2024).

3.8 Inspection Trench

Based on USACE guidance, we recommend an inspection trench be excavated below the levee alignment to verify levee subgrade conditions, check for buried utilities, and to confirm that adverse seepage conditions are not present beneath the setback levee (old drainage features, animal burrows, concentrated organics/logs, or other debris). We recommend the inspection trench be as deep as the height of the levee and approximately 3 feet wide.

The subsurface conditions revealed by the inspection trench should be carefully evaluated and any zones of unsuitable foundation soil should be removed or appropriately mitigated at the discretion of the geotechnical engineer. The inspection trench may be backfilled with the excavated soil after inspection, provided the soil can be placed back into the inspection trench to achieve compaction and permeability conditions equal to or better (more compact and less permeable) than the surrounding, near-surface native soil. If the excavated soil is unsuitable (contains excessive organics/debris or cannot be replaced/compacted adequately), material meeting the requirements for levee select fill described in Section 3.3 should be placed and compacted for the inspection trench backfill. Compaction may be performed by placing up to 12 inches (loose lifts) of the excavated soil or levee select fill material into the trench and tamping it using the excavator bucket to achieve a degree of compaction that is equal to or better than the surrounding soil.

3.8.1 Known Relic Features

During our previous subsurface investigation, we attempted to excavate a test pit near the waterside toe of the existing 4-foot-tall berm near the northeast corner of the Site. The excavation encountered a shallow layer of clean, rounded rock which indicated a drain could be present. The excavation was terminated to avoid damaging the potential drain. Upon further reconnaissance of the berm, we observed a corrugated plastic pipe daylighting from the waterside toe of the berm and into the ditch. With this, we conclude a French drain is present along portions of the waterside toe of the existing berm. The locations and extent of the French drain should be further evaluated during construction and depending on its location relative to the levee embankment alignment, it should be properly removed and backfilled with levee select fill.

3.9 Settlement Mitigation

Settlement along the levee alignment should be mitigated through staged construction and overbuilding the height of the levee. As discussed in Section 2.4, our settlement analyses predict between 6 and 8 inches of total settlement will occur along the proposed levee alignment. To mitigate this settlement, we recommend overbuilding the levee section by 1 foot. Alternatively, settlement can be monitored and additional material can be added to re-establish/maintain the required levee crest elevation as-needed after construction as the levee settles.

Our settlement analysis assumes construction of the proposed levee will occur over several weeks, during which all the elastic settlement and some of the consolidation settlement will occur. We expect that most of the consolidation settlement will occur within the first year after construction is completed. Up to approximately 4.5 inches of consolidation settlement and secondary compression settlement are expected to occur after the first year. We recommend monitoring settlement during construction and up to 2 years after construction. Based on the monitoring and degree of settlement, the levee section can be built back up to desired elevation. The monitoring data should be evaluated to ascertain if additional significant settlement is expected and/or additional monitoring is required. After the settlement is determined to be substantially complete, any portions of the levee that are below the design elevation, should be raised to or above the design elevation. In areas where the levee is above the design elevation, it may be graded down to the design elevation or left at the higher elevation.

3.10 Woody Vegetation-Free Zone

We recommend incorporating a woody vegetation-free zone on both sides of the levee in accordance with USACE EP 1110-2-18 (USACE, 2019). Woody vegetation is defined as trees, shrubs, vines, and other woody vegetation that can create structural and seepage instabilities in a levee and/or prevent adequate access for inspections, maintenance, and flood-fighting activities. The woody vegetation-free zone should extend a minimum of 15 feet horizontally from the toe of the levee embankment. Native, perennial grasses that can withstand regular mowing are allowed within the woody vegetation-free zone for ground cover and erosion protection.

3.11 Culvert Penetration

The Project is connected to the adjacent Finn Creek Culvert Replacement project that is under design (by others) and includes the replacement of the culvert which conveys Finn Creek underneath the intersection of NE Point No Point Road and NE Buck Lake Road. The culvert replacement structure will penetrate through the levee embankment to connect Finn Creek with the restored estuary and will require specific design considerations as a result.

In accordance with guidance from USACE EM 1110-2-1913, structures (including culverts) that create a penetration through a levee embankment should be provided with drainage fill around the ‘landside’ third of the structure (USACE, 2000). In this case, ‘landside’ refers to the side of the culvert away from the estuary. This will help provide a controlled and filtered release of hydrostatic pressure and seepage while minimizing the potential for soil piping (soil loss during seepage).

We recommend the primary structural fill around the culvert consist of material meeting the requirements of Select Borrow per Section 9-03.14(2) of the WSDOT Standard Specifications. For the landside third of the culvert and within 18 inches of the culvert walls, the structural fill should consist of Gravel Backfill for Walls meeting the requirements of Section 9-03.12(2) of the WSDOT Standard Specifications. For the waterside two thirds of the culvert, Select Borrow should be used as structural fill directly against the culvert walls.

A geotextile filter fabric should be placed between the Gravel Backfill for Walls and the rest of the culvert backfill. This includes at the interface between Gravel Backfill for Walls and Select Borrow at the landside third of the culvert walls. This added measure will help control and prevent soil piping. The geotextile should be woven and meet the requirements for soil separation as specified on Table 3 of Section 9-33.2(1) of WSDOT Standard Specifications (WSDOT, 2024).

4 Construction Recommendations

Based on the subsurface exploration data across the Site and our understanding of the Project, it is our opinion that the contractor should be able to complete planned excavations and earthwork activity with relatively standard construction equipment. We did encounter organic material and oversized cobbles in some of the completed explorations. Although not encountered in the explorations, regional experience and the depositional history of the overbank and alluvial deposits in the floodplain indicate that oversized materials, such as buried stumps, logs, cobbles, and boulders, could be present in excavations near the ground surface across the Site.

The Project will include excavations for the proposed creek channel, preparing the levee footprint, habitat area creation, and the removal of the existing culvert and tide gate. It is our opinion that the Contractor should be able to complete all required excavation and earthwork activity with relatively standard construction equipment. The Contractor should be prepared to encounter some debris and oversized materials, such as cobbles within the existing fill and logs within the wetland deposits.

Shallow groundwater conditions should be expected within the lower portions of the proposed excavations during the dry season, and shallow groundwater or ponded water may be present near or at the ground surface during the wet season and during high tide periods. The Contractor should anticipate wet excavations and soil conditions that may not support excavation equipment. We recommend maintaining working platforms for equipment a minimum of 3 feet above the groundwater level and strategically planning excavations to allow for elevated working platforms and access/haul routes. Other strategies for completing wet excavations include:

- Using long-reach excavators and/or wide-tracked and low-pressure equipment.
- Use hog fuel, spalls, and/or geosynthetics to create stabilized temporary access/haul roads and working pads.

Scarifying and moisture conditioning of the subgrade materials may be required prior to placing embankment fill.

4.1 Temporary Excavation Slopes

Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the contractor. For worker safety, all temporary cuts in excess of 4 feet in height that are not protected by trench boxes or otherwise shored, should be sloped in accordance with Part N of Washington Administrative Code (WAC) 296-155 (WAC, 2023). This guidance generally applies to cuts or trenches in which workers will be working. The inspection trench included in the levee design does not necessarily require workers to enter it.

In general, the near surface soils across the Project area classify as Occupational Safety and Health Administration (OSHA) Soil Classification Type C. Temporary excavation side slopes within the shallow fill, wetland, and beach deposits are anticipated to stand as steep as 1.5H:1V, up to a maximum height of 10 feet. The cut-slope inclinations estimated above are for planning purposes only and are applicable to excavations above the groundwater table and without inflowing stormwater. Excavations below the groundwater table should be sloped at 2.5H:1V initially and monitored for performance and adjusted accordingly to achieve stable conditions.

With time and the presence of seepage, tidal fluctuations, and/or precipitation, the stability of temporary unsupported cut slopes can be significantly reduced. The contractor should monitor the stability of the temporary cut slopes and adjust the construction schedule and slope inclination accordingly. Vibrations created by traffic and construction equipment may cause caving and raveling of the cut slopes. In such an event, the cut slopes should be flattened by the Contractor to prevent loss of ground support.

4.2 Wet Weather Earthwork and Erosion Control

Existing Site soils may prove to be difficult to handle or traverse with construction equipment during periods of wet weather.

Therefore, general recommendations relative to earthwork performed in wet weather or in wet conditions are presented below. These recommendations should be incorporated into the contract specification and should be required when earthwork is performed in wet conditions:

- Site stripping and fill placement should be accomplished in small sections to minimize exposure to wet weather. Excavation or removal of unsuitable soil should be followed promptly by placement and compaction of a suitable thickness of clean structural fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance.
- No soil should be left uncompacted so it can absorb water. Stockpiles of excavated soil should either be shaped and the surface compacted or be covered with plastic sheets. Soils that become too wet should be removed and replaced with clean granular materials.
- Excavation and placement of fill should be monitored by someone experienced in wet weather earthwork to determine that the work is being accomplished in accordance with the project specifications and the recommendations contained herein.

Soil erosion can be minimized by implementing these recommendations, careful grading practices, and the appropriate use of silt fences and/or straw bales. Surface runoff control during construction should be the responsibility of the contractor. All collected water should be controlled and discharged in accordance with local regulations. Grading measures, slope protection, ditching, sumps, dewatering, and other measures should be employed, as necessary, to permit proper completion of the work. Permanent control of surface water should be incorporated in the final grading design. Water should not be allowed to pond immediately adjacent to the levee.

4.3 Subgrade Preparation

Based on the results of our subsurface explorations at the Site, we estimate a typical stripping depth (topsoil, sod, and roots greater than about 0.5-inch diameter) of approximately 4 to 8 inches will be required. In isolated areas, the stripping depth and/or presence of unsuitable foundation soil may result in greater stripping depths, but it is our opinion that these areas will comprise approximately 10 percent of the levee footprint or less. Unsuitable foundation soil is defined as unstable, soil that has significantly higher permeability than the surrounding subgrade soil (significant void space), and/or organic-rich material. Based on our evaluations, the older topsoil horizon present below the existing fill can be left in-place and is not expected to adversely impact the levee performance.

Levee embankment subgrade should be inspected by visual inspection, probing, and/or proof rolling with a loaded dump truck or similar construction equipment to determine its suitability to receive fill materials for embankment construction. The embankment subgrade should be graded and compacted, as-needed, to achieve a relatively smooth, firm, drained (no standing water), and consistent surface. Just prior to placing levee select fill, the subgrade should be scarified to a depth of about 6 inches to help ensure a good bond between the foundation subgrade and the levee select fill to reduce the potential for ponding water on the subgrade and to eliminate preferential slide planes along the interface.

An inspection trench, as described in Section 3.8, should be completed along the levee alignment prior to placing levee fill.

4.4 Compaction Requirements

For compaction of the levee select fill, we recommend the material be placed in lifts no greater than 8 inches thick (loose) and compacted to a minimum of 90 percent of the maximum dry density, as determined by ASTM D1557 (Modified Proctor). The moisture content of the levee select fill should be controlled to within +/- 3 percent of the optimum moisture content, as determined by

ASTM D1557. The equipment and methods used for compacting the levee embankment should be approved by the Project Engineer.

The levee trail CSBC/CSTC should be compacted to a minimum of 90 percent of the maximum dry density, as determined by ASTM D1557.

The procedure to achieve the specified minimum relative compaction depends on the size and type of compacting equipment, the number of passes, thickness of the layer being compacted, and certain soil properties. When the size/constraints of the fill area restrict the use of heavy equipment, smaller equipment can be used, but the soil must be placed in thin enough lifts to achieve the required compaction. A sufficient number of in-place density tests should be performed as the fill is placed to verify the required relative compaction is being achieved.

Generally, loosely compacted soils are a result of poor construction technique or improper moisture content. Soils with a high percentage of silt or clay are particularly susceptible to becoming too wet, and coarse-grained materials easily become too dry, for proper compaction. Silty or clayey soils with a moisture content too high for adequate compaction should be dried, as necessary, or moisture conditioned by mixing with drier materials, or other methods.

5 Recommendations for Continuing Geotechnical Services

Throughout this memorandum, we have provided recommendations where we consider it would be appropriate for Aspect to provide additional geotechnical input to the design and construction process. Additional recommendations are summarized in this section.

5.1 Additional Design and Consultation Services

Before construction begins, we recommend that Aspect:

- Continue to meet with the design team, as needed, to address geotechnical questions that may arise throughout the remainder of the design process.
- Review the geotechnical elements of the Project plans to see that the geotechnical engineering recommendations are properly interpreted.

5.2 Additional Construction Services

We are available to provide geotechnical engineering and monitoring services during construction. The integrity of the geotechnical elements depends on proper Site preparation and construction procedures. In addition, engineering decisions may have to be made in the field if variations in subsurface conditions become apparent.

During the construction phase of the Project, we recommend that Aspect be retained to perform the following tasks:

- Review applicable submittals.
- Observe and evaluate stripping and grubbing activities, inspection of trench excavation and backfilling, levee subgrade preparation, and levee embankment fill placement.
- Attend meetings, as needed.
- Address other geotechnical engineering considerations that may arise during construction.

The purpose of our observations is to verify compliance with design concepts and recommendations, and to allow design changes or evaluation of appropriate construction methods if subsurface conditions differ from those anticipated prior to the start of construction.

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Limitations

Work for this project was performed for Blue Coast Engineering (Client), and this report was prepared consistent with recognized standards of professionals in the same locality and involving similar conditions, at the time the work was performed. No other warranty, expressed or implied, is made by Aspect Consulting (Aspect).

Recommendations presented herein are based on our interpretation of site conditions, geotechnical engineering calculations, and judgment in accordance with our mutually agreed-upon scope of work. Our recommendations are unique and specific to the project, site, and Client. Application of this report for any purpose other than the project should be done only after consultation with Aspect.

Variations may exist between the soil and groundwater conditions reported and those actually underlying the site. The nature and extent of such soil variations may change over time and may not be evident before construction begins. If any soil conditions are encountered at the site that are different from those described in this report, Aspect should be notified immediately to review the applicability of our recommendations.

Levees and flood protection systems include many components like earthen embankments, filters, scour protection, and drainage elements that must work together to ensure effective performance. It is not practical to know and/or control all of the engineering properties of the components and system; therefore, inherent uncertainty about the system performance exists. Regular inspections and flood monitoring of the flood protection components and system should be performed by a qualified professional with any deficiencies mitigated appropriately.

It should be understood that some seepage through and beneath the flood protection system is normal and expected during significant flood events. Uses incompatible with this type and frequency of seepage should not be allowed in areas protected by the flood protection system. Excavations near or within the levee could compromise the system and should not be performed without adequate engineering and construction controls. Similarly, any future penetrations through or beneath the flood protection system should be assessed on a case-by-case basis by a qualified professional as penetrations can result in failures or undesirable performance if not appropriately designed.

Risks are inherent with any site involving levees and flood control structures subject to flooding and geologic hazards and no recommendations, geologic analysis, or engineering design can assure performance. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the Client.

It is the Client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, and agents, are made aware of this report in its entirety. At the time of this report, design plans and construction methods have not been finalized, and the recommendations presented herein are based on preliminary project information. If project developments result in changes from the preliminary project information, Aspect should be contacted to determine if our recommendations contained in this report should be revised and/or expanded upon.

The scope of work does not include services related to construction safety precautions. Site safety is typically the responsibility of the contractor, and our recommendations are not intended to direct the contractor's site safety methods, techniques, sequences, or procedures. The scope of our work also does not include the assessment of environmental characteristics, particularly those involving potentially hazardous substances in soil or groundwater.

All reports prepared by Aspect for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect. Aspect's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Please refer to Appendix D titled "Report Limitations and Guidelines for Use" for additional information governing the use of this report.

We appreciate the opportunity to perform these services. If you have any questions please contact Andrew Holmson, PE, Senior Associate Geotechnical Engineer.

Attachments: Table 1 – Soil Engineering and Hydraulic Properties
Figure 1 – Site Location Map
Figure 2 – Exploration Plan
Appendix A – Subsurface Exploration Logs
Appendix B – Laboratory Test Results
Appendix C – Seepage and Slope Stability Analysis Results
Appendix D – Report Limitations and Guidelines for Use

V:\190092 Norwegian Point Park Ring Dike Design\Deliverables\Levee Basis of Design Memo\NPP Levee Basis of Design_20240226.docx

TABLE

Table 1. Soil Engineering and Hydraulic Properties

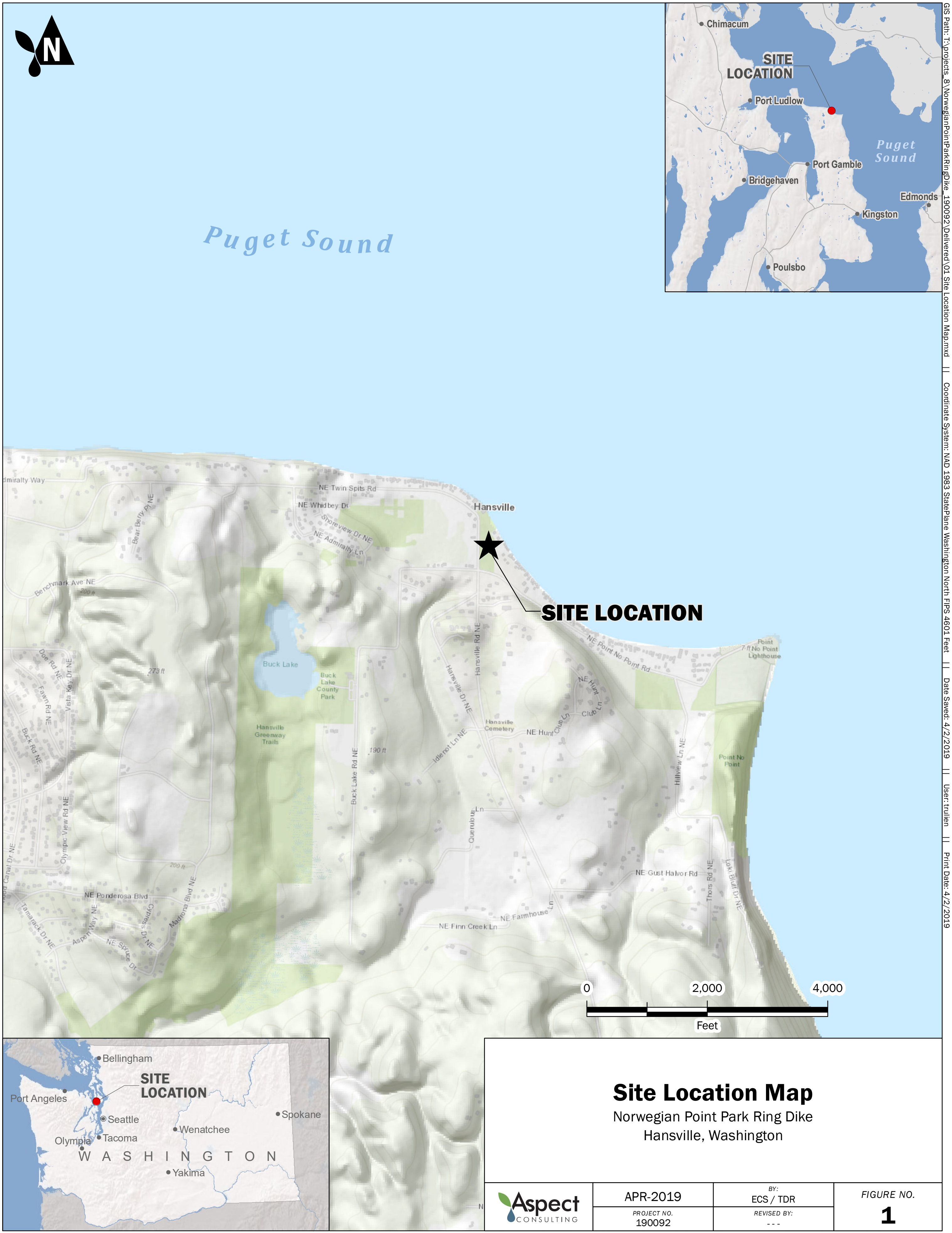
Project No. 190092, Norwegian Point Park

		General		Soil Parameters for Settlement Analyses						Soil Parameters for Seepage Analyses		Soil Parameters for Slope Stability Analyses		
		Soil Unit Weight			Consolidation Parameters[3]									
Soil Layer Number	Soil Layer	Moist, pcf[1,2]	Saturated, pcf[1,2]	Elastic Modulus, ksf[1]	Cce	Cv (ft^2/day)	Cαe	eo	OCR	Horizontal Hydraulic Conductivity, cm/s[1]	Vertical/Horizontal Hydraulic Conductivity Ratio (K_y/K_x)	Soil Cohesion, psf[1,4]	Soil Friction Angle, deg[1,4]	Seismic Residual Undrained Shear Strength, psf[1,4]
1	Existing Fill	115	120	200	-	-	-	-	-	5 x 10^-3	1	25	32	-
2	Older Topsoil Horizon	100	105	-	-	-	-	-	-	1 x 10^-2	0.1	0	29	-
3	Wetland Deposits	70	75	-	0.35	0.0147	0.02	1.13	1	1 x 10^-2	0.1	250	20	-
4	Beach Deposits	110	115	720	-	-	-	-	-	5 x 10^-2	0.1	0	30	-
5	Levee Embankment Fill	120	125	-	-	-	-	-	-	3 x 10^-4	1	50	34	-
6	Beach Deposits (Fully Liquified)	110	115	-	-	-	-	-	-	5 x 10^-2	0.1	-	-	75 increasing at 5psf/ft of depth

Notes

1. pcf = pounds per cubic foot; ksf = kips per square foot; ft/s = feet per second; psf = pounds per square foot; deg = degrees
2. Moist unit weights were applied above the water table; saturated unit weights were applied below the water table.
3. C_c = coefficient of consolidation; C_r = Recompression Index; C_v = Time Rate of Consolidation; C_α = Coefficient of Secondary Compression; e_0 = initial void ratio; OCR = Overconsolidation Ratio. All consolidation parameters are unitless.

FIGURES



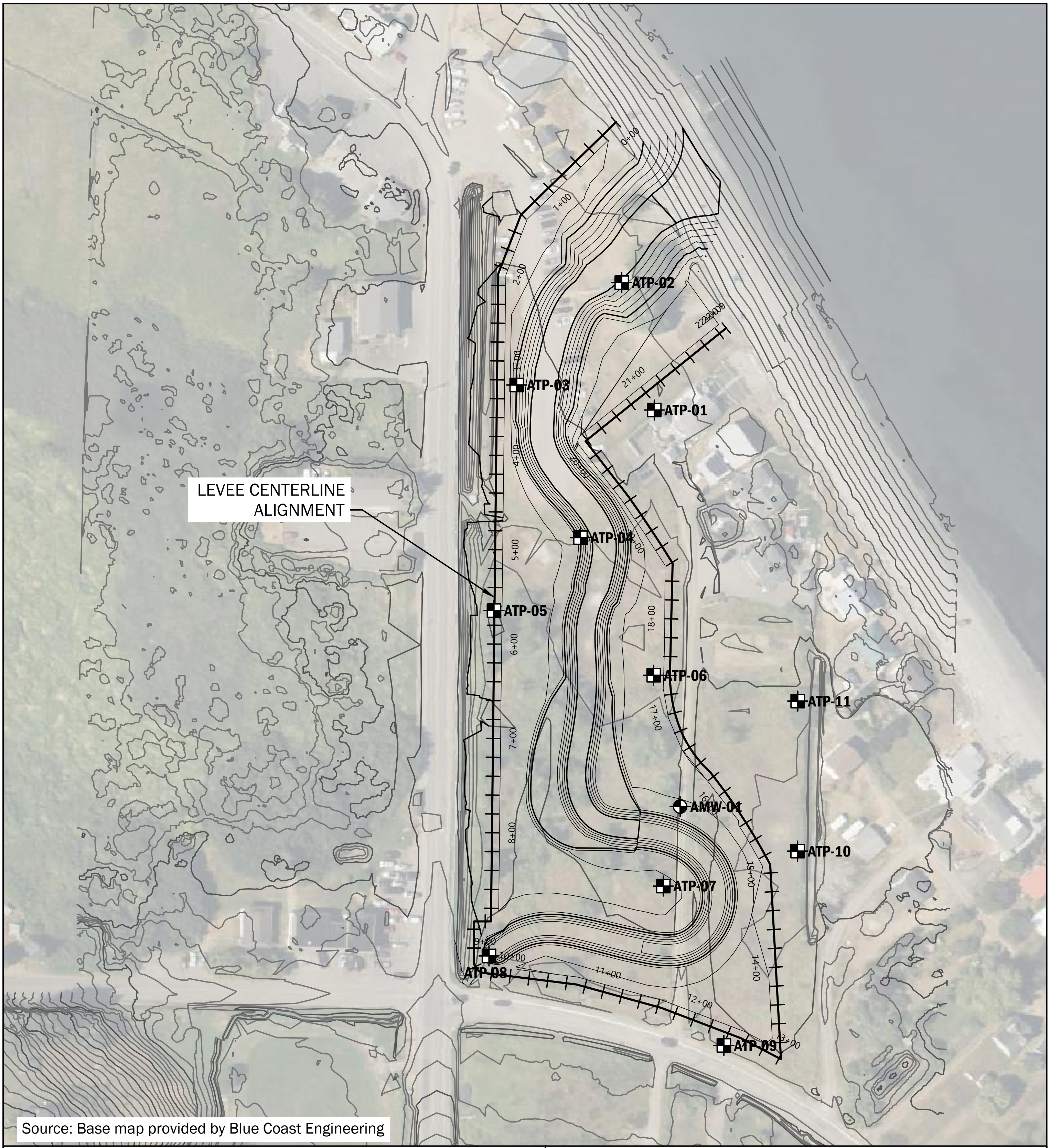
Site Location Map

Norwegian Point Park Ring Dike
Hansville, Washington

Aspect CONSULTING	APR-2019	BY: ECS / TDR	FIGURE NO.
	PROJECT NO. 190092	REVISED BY: - - -	1

GIS Path: T:\projects_8\NorwegianPointParkRingDike_190092\Delivered\01 Site Location Map.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 4/2/2019 || User: trullen || Print Date: 4/2/2019

Basemap Layer Credits | | Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community



Source: Base map provided by Blue Coast Engineering

Legend

- Aspect Test Pit Location
- Aspect Monitoring Well Location

0 140 280 Feet

Exploration Plan

Geotechnical Basis of Design Memo
Norwegian Point Park Levee
Hansville, Washington

Aspect CONSULTING	Dec-23	BY: KDS/JPR	FIGURE NO.
	PROJECT NO. 190092	REVISED BY: KDS	2

CAD Path: Q:_GeoTech\190092 Norwegian Point Park\190092-02.dwg Layout: 190092-02 | | Date Saved: 12/19/2023 1:21:15 PM | | User: jacqueline.reinhardt

APPENDIX A

Subsurface Exploration Logs

Coarse-Grained Soils - More than 50%1 Retained on No. 200 Sieve	Gravels - More than 50%^{1} of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines	▨	**GW**	Well-graded GRAVEL Well-graded GRAVEL WITH SAND
			▨	**GP**	Poorly-graded GRAVEL Poorly-graded GRAVEL WITH SAND
		≥15% Fines	▨	**GM**	SILTY GRAVEL SILTY GRAVEL WITH SAND
			▨	**GC**	CLAYEY GRAVEL CLAYEY GRAVEL WITH SAND
	Sands - 50%^{1} or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines	▨	**SW**	Well-graded SAND Well-graded SAND WITH GRAVEL
			▨	**SP**	Poorly-graded SAND Poorly-graded SAND WITH GRAVEL
		≥15% Fines	▨	**SM**	SILTY SAND SILTY SAND WITH GRAVEL
			▨	**SC**	CLAYEY SAND CLAYEY SAND WITH GRAVEL
Fine-Grained Soils - 50%1 or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50%		▨	**ML**	SILT SANDY or GRAVELLY SILT SILT WITH SAND SILT WITH GRAVEL
			▨	**CL**	LEAN CLAY SANDY or GRAVELLY LEAN CLAY LEAN CLAY WITH SAND LEAN CLAY WITH GRAVEL
			▨	**OL**	ORGANIC SILT SANDY or GRAVELLY ORGANIC SILT ORGANIC SILT WITH SAND ORGANIC SILT WITH GRAVEL
	Silts and Clays Liquid Limit 50% or More		▨	**MH**	ELASTIC SILT SANDY or GRAVELLY ELASTIC SILT ELASTIC SILT WITH SAND ELASTIC SILT WITH GRAVEL
			▨	**CH**	FAT CLAY SANDY or GRAVELLY FAT CLAY FAT CLAY WITH SAND FAT CLAY WITH GRAVEL
			▨	**OH**	ORGANIC CLAY SANDY or GRAVELLY ORGANIC CLAY ORGANIC CLAY WITH SAND ORGANIC CLAY WITH GRAVEL
Highly Organic Soils			▨	**PT**	PEAT and other mostly organic soils

"WITH SILT" or "WITH CLAY" means 5 to 15% silt and clay, denoted by a "-" in the group name; e.g., SP-SM • "SILTY" or "CLAYEY" means >15% silt and clay • "WITH SAND" or "WITH GRAVEL" means 15 to 30% sand and gravel. • "SANDY" or "GRAVELLY" means >30% sand and gravel. • "Well-graded" means approximately equal amounts of fine to coarse grain sizes • "Poorly graded" means unequal amounts of grain sizes • Group names separated by "/" means soil contains layers of the two soil types; e.g., SM/ML.

Soils were described and identified in the field in general accordance with the methods described in ASTM D2488. Where indicated in the log, soils were classified using ASTM D2487 or other laboratory tests as appropriate. Refer to the report accompanying these exploration logs for details.

1. Estimated or measured percentage by dry weight
2. (SPT) Standard Penetration Test (ASTM D1586)
3. Determined by SPT, DCPT (ASTM STP399) or other field methods. See report text for details.

GEOTECHNICAL LAB TESTS

MC = Natural Moisture Content
PS = Particle Size Distribution
FC = Fines Content (% < 0.075 mm)
GH = Hydrometer Test
AL = Atterberg Limits
C = Consolidation Test
Str = Strength Test
OC = Organic Content (% Loss by Ignition)
Comp = Proctor Test
K = Hydraulic Conductivity Test
SG = Specific Gravity Test

CHEMICAL LAB TESTS

Organic Chemicals

BTEX = Benzene, Toluene, Ethylbenzene, Xylenes
TPH-Dx = Diesel and Oil-Range Petroleum Hydrocarbons
TPH-G = Gasoline-Range Petroleum Hydrocarbons
VOCs = Volatile Organic Compounds
SVOCs = Semi-Volatile Organic Compounds
PAHs = Polycyclic Aromatic Hydrocarbon Compounds
PCBs = Polychlorinated Biphenyls

Metals

RCRA8 = As, Ba, Cd, Cr, Pb, Hg, Se, Ag, (d = dissolved, t = total)
MTCA5 = As, Cd, Cr, Hg, Pb (d = dissolved, t = total)
PP-13 = Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn (d=dissolved, t=total)

FIELD TESTS

PID = Photoionization Detector
Sheen = Oil Sheen Test
SPT^2 = Standard Penetration Test
NSPT = Non-Standard Penetration Test
DCPT = Dynamic Cone Penetration Test

COMPONENT DEFINITIONS

Descriptive Term		***Size Range and Sieve Number***
Boulders	=	Larger than 12 inches
Cobbles	=	3 inches to 12 inches
Coarse Gravel	=	3 inches to 3/4 inches
Fine Gravel	=	3/4 inches to No. 4 (4.75 mm)
Coarse Sand	=	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	=	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	=	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	=	Smaller than No. 200 (0.075 mm)

ESTIMATED^1 PERCENTAGE

% by Weight		***Modifier***	***% by Weight***		***Modifier***
<1	=	Subtrace	15 to 25	=	Little
1 to <5	=	Trace	30 to 45	=	Some
5 to 10	=	Few	>50	=	Mostly

MOISTURE CONTENT

Dry = Absence of moisture, dusty, dry to the touch
Slightly Moist = Perceptible moisture
Moist = Damp but no visible water
Very Moist = Water visible but not free draining
Wet = Visible free water, usually from below water table

RELATIVE DENSITY

Non-Cohesive or Coarse-Grained Soils

Density^3		***SPT^2 Blows/Foot***	***Penetration with 1/2" Diameter Rod***
Very Loose	=	0 to 4	≥ 2'
Loose	=	5 to 10	1' to 2'
Medium Dense	=	11 to 30	3" to 1'
Dense	=	31 to 50	1" to 3"
Very Dense	=	> 50	< 1"

CONSISTENCY

Cohesive or Fine-Grained Soils

Consistency^3		***SPT^2 Blows/Foot***	***Manual Test***
Very Soft	=	0 to 1	Penetrated >1" easily by thumb. Extrudes between thumb & fingers.
Soft	=	2 to 4	Penetrated 1/4" to 1" easily by thumb. Easily molded.
Medium Stiff	=	5 to 8	Penetrated >1/4" with effort by thumb. Molded with strong pressure.
Stiff	=	9 to 15	Indented ~1/4" with effort by thumb.
Very Stiff	=	16 to 30	Indented easily by thumbnail.
Hard	=	> 30	Indented with difficulty by thumbnail.

GEOLOGIC CONTACTS

Observed and Distinct	Observed and Gradual	Inferred
————	————	— — — —

Aspect
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Exploration Log Key

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Aspect CONSULTING

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location		*Coordinates*	*Exploration Number*
Norwegian Point Park, Hansville, WA, See Figure 2		NA	**TP-01**

Contractor	*Equipment*	*Sampling Method*	*Ground Surface (GS) Elev. (NGVD29)*
High Meadows Excavating	Mini Excavator	Grab	7'

Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019	NA	4.67' (Static)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Description	Depth (ft)
							TOPSOIL; (4 inches thick)	
							FILL SILTY SAND (SM); loose, moist, gray; fine to coarse sand; fine to coarse, subrounded to rounded gravel.	
1	6						Becomes brown	1
2	5	T-probe = 3-6 inches						2
3	4		☝				**OLDER TOPSOIL HORIZON** SILTY SAND (SM); loose, moist, black; fine to medium sand; some organics.	3
							BEACH DEPOSITS SAND (SP); loose, wet, gray; mostly medium sand with few fine and coarse sand.	
4	3	Seepage and sidewall caving observed below 4 feet						4
		▼ 3/27/2019						
5	2		☝			PS FC=1%		5
6	1							6
7	0	Test pit backfilled with excavated soils.					Bottom of exploration at 7 ft. bgs.	7
8	-1							8
9	-2							9
10	-3							10

Legend

Plastic Limit ├──┤ Liquid Limit

Sample Type: ☝ Grab sample

Water Level: ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log
TP-01
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\190092 - NORWEGIAN POINT PARK RING DIKE.GPJ June 20, 2019

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location			*Coordinates*	*Exploration Number*
Norwegian Point Park, Hansville, WA, See Figure 2			NA	**TP-02**
Contractor	*Equipment*	*Sampling Method*	*Ground Surface (GS) Elev. (NGVD29)*	
High Meadows Excavating	Mini Excavator	Grab	7'	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019	NA	

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Description	Depth (ft)
							TOPSOIL; (2 inches thick)	
							FILL SILTY SAND WITH GRAVEL (SM); loose, moist, brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel.	
1	6						SAND WITH SILT (SP-SM); loose, moist, gray; mostly medium sand with few fine and coarse sand; few fine to coarse, subrounded to rounded gravel.	1
2	5						**OLDER TOPSOIL HORIZON** SILTY SAND (SM); loose, moist, dark gray; some organics and roots.	2
							BEACH DEPOSITS SAND (SP); very loose, moist, gray; mostly medium sand with some fine and coarse sand.	
3	4	T-probe = 2 inches						3
4	3	Moderate sidewall caving from 3 to 5 feet. ♀ 3/27/2019	✋				Becomes very moist	4
5	2						Becomes wet	5
6	1						SAND WITH GRAVEL (SP); very loose, wet; mostly medium sand with some fine and coarse sand; fine to coarse, rounded gravel; occassional cobbles.	6
7	0	Test pit backfilled with excavated soils.					Bottom of exploration at 7 ft. bgs.	7
8	-1							8
9	-2							9
10	-3							10

Legend

Plastic Limit ├──┤ Liquid Limit

Sample Type: ✋ Grab sample

Water Level: ♀ Water Level (Seepage)

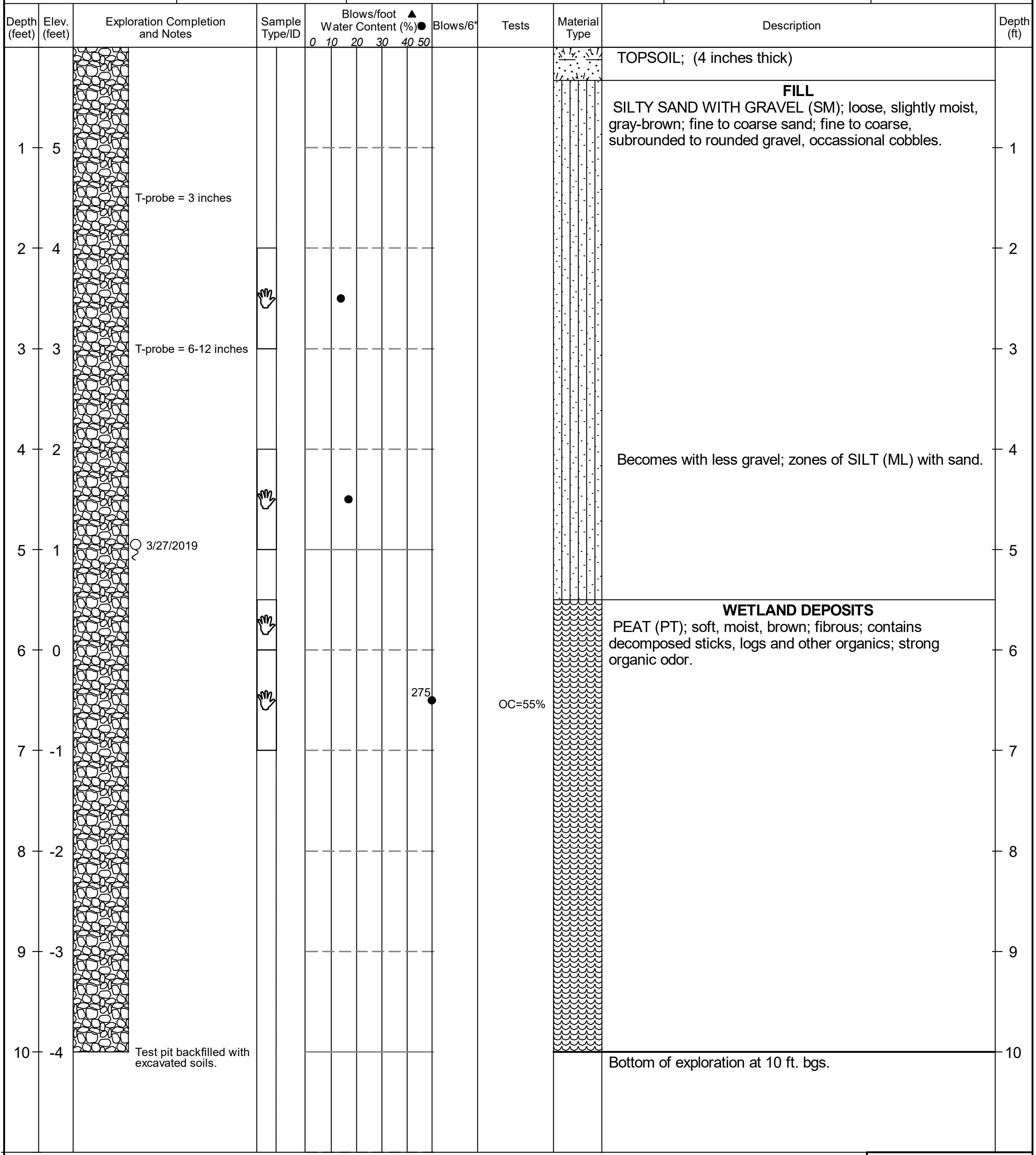
See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log
TP-02
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\190092 - NORWEGIAN POINT PARK RING DIKE.GPJ June 20, 2019

Aspect CONSULTING	Norwegian Point Park Ring Levee - 190092			Geotechnical Exploration Log	
	Project Address & Site Specific Location Norwegian Point Park, Hansville, WA, See Figure 2			*Coordinates* NA	*Exploration Number* **TP-03**
Contractor High Meadows Excavating	*Equipment* Mini Excavator	*Sampling Method* Grab		*Ground Surface (GS) Elev. (NGVD29)* 6'	
Operator Andrew	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 3/27/2019		*Top of Casing Elev. (NGVD29)* NA	*Depth to Water (Below GS)*



Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Water Content (%)	Tests	Description	Depth (ft)
0	6					TOPSOIL; (4 inches thick)	
						FILL SILTY SAND WITH GRAVEL (SM); loose, slightly moist, gray-brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel, occassional cobbles.	
1	5						1
		T-probe = 3 inches					
2	4						2
			🖐	●			
3	3	T-probe = 6-12 inches					3
4	2					Becomes with less gravel; zones of SILT (ML) with sand.	4
			🖐	●			
5	1	3/27/2019					5
			🖐			**WETLAND DEPOSITS** PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics; strong organic odor.	
6	0						6
			🖐	275 ●	OC=55%		
7	-1						7
8	-2						8
9	-3						9
10	-4	Test pit backfilled with excavated soils.				Bottom of exploration at 10 ft. bgs.	10

Legend

Sample Type: 🖐 Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: ♀ Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log
TP-03
Sheet 1 of 1

Aspect CONSULTING

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location			*Coordinates*	*Exploration Number*
Norwegian Point Park, Hansville, WA, See Figure 2			NA	**TP-04**
Contractor	*Equipment*	*Sampling Method*	*Ground Surface (GS) Elev. (NGVD29)*	
High Meadows Excavating	Mini Excavator	Grab	6'	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019	NA	No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
								TOPSOIL; (8 inches thick)	
1	5							**FILL** SILTY SAND WITH GRAVEL (SM); loose, wet, gray; fine to coarse sand; fine to coarse, subrounded to rounded gravel.	1
2	4	T-probe = 1-2 feet	✋	● (20)					2
3	3								3
4	2							**WETLAND DEPOSITS** PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics; strong organic odor.	4
5	1								5
6	0								6
7	-1								7
8	-2	Test pit backfilled with excavated soils.						Bottom of exploration at 8 ft. bgs.	8
9	-3								9
10	-4								10

Legend

Plastic Limit ├─┤ Liquid Limit

Sample Type: ✋ Grab sample

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: ECS
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Exploration Log TP-04

Sheet 1 of 1

Aspect CONSULTING

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location	*Coordinates*	*Exploration Number*
Norwegian Point Park, Hansville, WA, See Figure 2	NA	**TP-05**

Contractor	*Equipment*	*Sampling Method*	*Ground Surface (GS) Elev. (NGVD29)*
High Meadows Excavating	Mini Excavator	Grab	6'

Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019	NA	8' (Static)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	6							**FILL** SILTY SAND WITH GRAVEL (SM); loose, moist, gray; fine to coarse sand; fine to coarse, rounded gravel.	
1	5	T-probe = 6-12 inches							1
2	4		Grab						2
3	3		Grab					Becomes very moist	3
4	2								4
5	1	T-probe = 2 feet	Grab	300●		OC=57%		**WETLAND DEPOSITS** PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics. Log encountered at 5.5 feet	5
6	0								6
7	-1								7
8	-2	▼ 3/27/2019							8
8.5			Grab			PS FC=1%		**BEACH DEPOSITS** SAND (SP); loose, wet, gray; mostly medium sand with some fine and coarse sand.	9
9.5		Test pit backfilled with excavated soils.						Bottom of exploration at 9.5 ft. bgs.	
10	-4								10

Legend

Sample Type: 🖐 Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: ▼ Static Water Level

See Exploration Log Key for explanation of symbols

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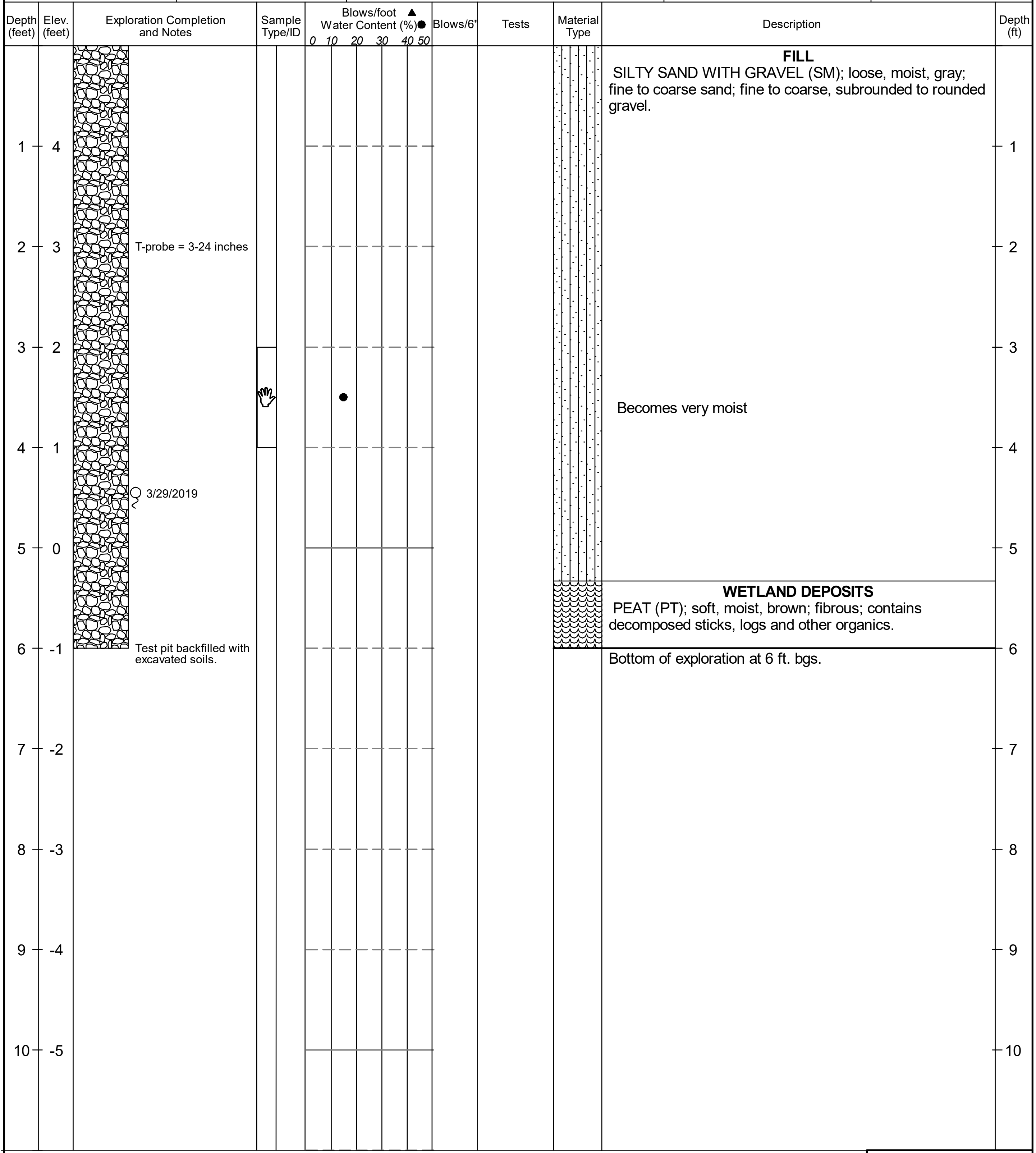
Exploration Log
TP-05
Sheet 1 of 1

Aspect CONSULTING

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location			*Coordinates*	*Exploration Number*
Norwegian Point Park, Hansville, WA, See Figure 2			NA	**TP-06**
Contractor	*Equipment*	*Sampling Method*	*Ground Surface (GS) Elev. (NGVD29)*	
High Meadows Excavating	Mini Excavator	Grab	5'	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019	NA	



T-probe = 3-24 inches

3/29/2019

Test pit backfilled with excavated soils.

FILL

SILTY SAND WITH GRAVEL (SM); loose, moist, gray; fine to coarse sand; fine to coarse, subrounded to rounded gravel.

Becomes very moist

WETLAND DEPOSITS

PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics.

Bottom of exploration at 6 ft. bgs.

Legend

Sample Type: 🖐 Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: Water Level (Seepage)

See Exploration Log Key for explanation of symbols

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Exploration Log TP-06

Sheet 1 of 1

Aspect CONSULTING	Norwegian Point Park Ring Levee - 190092			Geotechnical Exploration Log	
	Project Address & Site Specific Location			*Coordinates*	*Exploration Number*
	Norwegian Point Park, Hansville, WA, See Figure 2			NA	**TP-07**
Contractor	*Equipment*	*Sampling Method*		*Ground Surface (GS) Elev. (NGVD29)*	
High Meadows Excavating	Mini Excavator	Grab		6.5'	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*		*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019		NA	9' (Static)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Blows/foot ▲ Water Content (%) ● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description
0	6.5							TOPSOIL; (2 inches thick)
								FILL SILTY SAND WITH GRAVEL (SM); loose, moist, gray-brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel; occasional cobbles.
1–2			Grab					
2–3			Grab	● (approx. 12)		PS FC=35%		Becomes moist to very moist
								Becomes blue-gray
4	2.5							**WETLAND DEPOSITS** PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics.
9	-2.5	▼ 3/27/2019						**BEACH DEPOSITS** SAND (SP); very loose, wet, gray; mostly medium sand with some fine and coarse sand.
10	-3.5	Test pit backfilled with excavated soils.						Bottom of exploration at 10 ft. bgs.

Legend

Plastic Limit ├──┤ Liquid Limit

Sample Type: 🖐 Grab sample

Water Level: ▼ Static Water Level

See Exploration Log Key for explanation of symbols

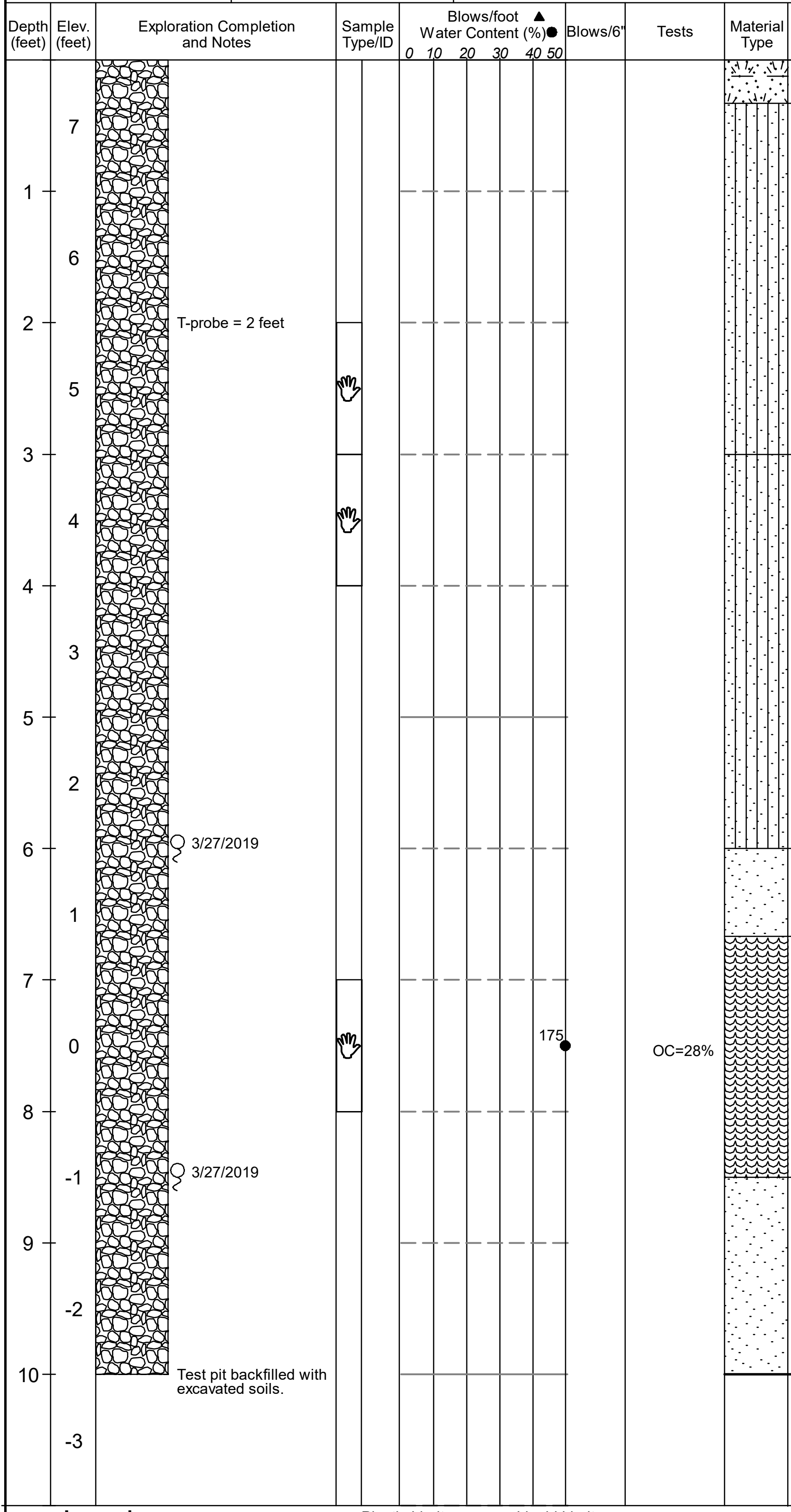
Logged by: ECS
Approved by: ECS

Exploration Log
TP-07
Sheet 1 of 1

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location			*Coordinates*	*Exploration Number*
Norwegian Point Park, Hansville, WA, See Figure 2			NA	**TP-08**
Contractor	*Equipment*	*Sampling Method*	*Ground Surface (GS) Elev. (NGVD29)*	
High Meadows Excavating	Mini Excavator	Grab	7.5'	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019	NA	



TOPSOIL; (4 inches thick)

FILL

SILTY SAND WITH GRAVEL (SM); loose, moist, blue-gray; fine to coarse sand; fine to coarse, subrounded to rounded gravel, occasional cobbles.

WETLAND DEPOSITS

SILTY SAND (SM); very loose, moist, brown; fine to medium sand; abundant organics and wood debris.

Log encountered at 4.5 feet

BEACH DEPOSITS

SAND (SP); very loose, wet, gray; mostly medium sand with some fine and coarse sand.

WETLAND DEPOSITS

PEAT (PT); soft, very moist, brown; fibrous; contains decomposed sticks, logs and other organics.

BEACH DEPOSITS

SAND (SP); very loose, wet, gray; mostly medium sand with some fine and coarse sand.

Bottom of exploration at 10 ft. bgs.

Legend

Sample Type: ✋ Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: ♀ Water Level (Seepage)

See Exploration Log Key for explanation of symbols

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Exploration Log
TP-08
Sheet 1 of 1

Aspect CONSULTING

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location	Coordinates	Exploration Number
Norwegian Point Park, Hansville, WA, See Figure 2	NA	**TP-09**

Contractor	Equipment	Sampling Method	Ground Surface (GS) Elev. (NGVD29)
High Meadows Excavating	Mini Excavator	Grab	7.5'

Operator	Exploration Method(s)	Work Start/Completion Dates	Top of Casing Elev. (NGVD29)	Depth to Water (Below GS)
Andrew	Test Pit	3/27/2019	NA	9' (Static)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Description	Depth (ft)
							TOPSOIL; (4 inches thick)	
	7						**FILL** SILTY SAND WITH GRAVEL (SM); medium dense, slightly moist, gray-brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel; occasional cobbles; iron-oxide staining.	
1		T-probe = 2-3 inches						1
	6						Becomes blue-gray	
2								2
	5						Becomes mixed gray and brown; abundant organics.	
3								3
	4							
4								4
	3						**WETLAND DEPOSITS** PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics.	
5		T-probe = 2 feet						5
	2		✋	190●		OC=31%		
6								6
	1							
7								7
	0							
8								8
	-1							
9		▼ 3/27/2019					**BEACH DEPOSITS** SAND (SP); very loose, wet, gray; mostly medium sand with some fine to coarse sand. Becomes with fine to coarse, rounded to subrounded gravels and cobbles	9
	-2		✋					
10		Test pit backfilled with excavated soils.					Bottom of exploration at 10 ft. bgs.	10
	-3							

Legend

Plastic Limit ├──┤ Liquid Limit

Sample Type: ✋ Grab sample

Water Level: ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log
TP-09
Sheet 1 of 1

Aspect CONSULTING

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location	*Coordinates*	*Exploration Number*
Norwegian Point Park, Hansville, WA, See Figure 2	NA	**TP-10**

Contractor	*Equipment*	*Sampling Method*	*Ground Surface (GS) Elev. (NGVD29)*
High Meadows Excavating	Mini Excavator	Grab	6'

Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019	NA	

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
0	6							TOPSOIL; (4 inches thick)	
								FILL SILTY SAND WITH GRAVEL (SM); loose, moist, brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel	
1	5								1
2	4								2
			🖑						
3	3	♀ 3/27/2019							3
								OLDER TOPSOIL HORIZON SILTY SAND (SM); loose, moist, black; fine to medium sand; abundant organics.	
4	2		🖑						4
								WETLAND DEPOSITS PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics.	
5	1								5
6	0								6
7	-1		🖑	409 ●		OC=56%			7
8	-2								8
9	-3	Test pit backfilled with excavated soils.						Bottom of exploration at 9 ft. bgs.	9
10	-4								10

Legend

Plastic Limit ├──┤ Liquid Limit

Sample Type: 🖑 Grab sample

Water Level: ♀ Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log
TP-10
Sheet 1 of 1

Aspect CONSULTING

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location			*Coordinates*	*Exploration Number*
Norwegian Point Park, Hansville, WA, See Figure 2			NA	**TP-11**
Contractor	*Equipment*	*Sampling Method*	*Ground Surface (GS) Elev. (NGVD29)*	
High Meadows Excavating	Mini Excavator	Grab	6'	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019	NA	6' (Static)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Description	Depth (ft)
0	6						TOPSOIL; (4 inches thick) **FILL** SILTY SAND WITH GRAVEL (SM); loose, moist, gray-brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel.	
1	5							1
2	4							2
3	3		✋				**OLDER TOPSOIL HORIZON** SILTY SAND (SM); loose, moist, black; fine to medium sand; abundant organics.	3
4	2						**BEACH DEPOSITS** SAND (SP); very moist, gray; mostly medium sand with some fine and coarse sand. **WETLAND DEPOSITS** PEAT (PT); soft, very moist, brown; fibrous; contains decomposed sticks, logs and other organics.	4
5	1		✋	198●		OC=17%	**BEACH DEPOSITS** SAND (SP); very loose, wet, gray; mostly medium sand with some fine and coarse sand.	5
6	0	▼ 3/27/2019						6
7	-1	Test pit backfilled with excavated soils.					Test pit terminated upon practical refusal on possible log Bottom of exploration at 7 ft. bgs.	7
8	-2							8
9	-3							9
10	-4							10

Legend

Plastic Limit ├──┤ Liquid Limit

Sample Type: ✋ Grab sample

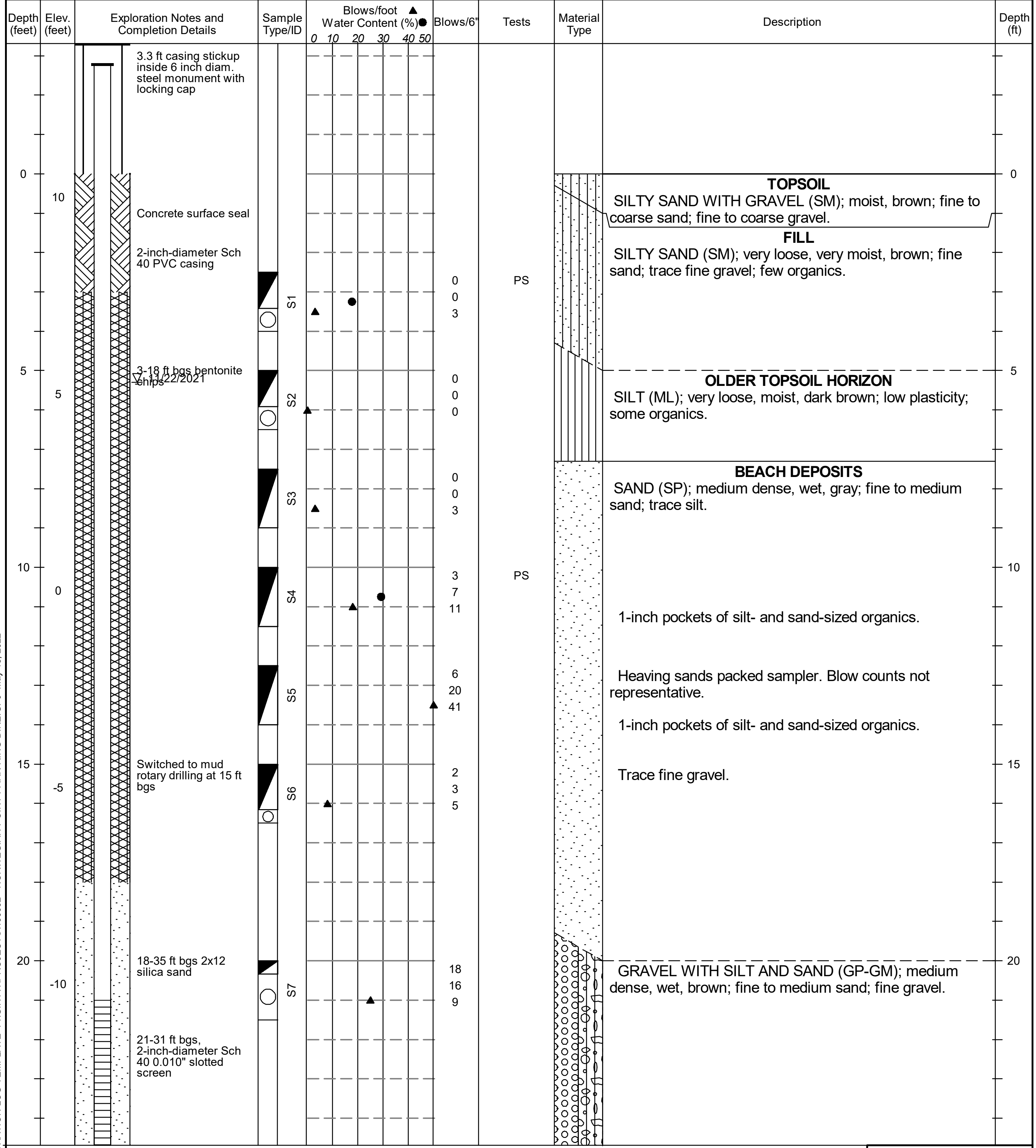
Water Level: ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log
TP-11
Sheet 1 of 1

Aspect CONSULTING	**Norwegian Point Park - 190092** *Project Address & Site Specific Location* Norwegian Point Park, Hansville, WA, see Figure 2 for specific location.		**Geotechnical Exploration Log** *Coordinates (Lat,Lon WGS84)* 47.9155, -122.5457 (est)	*Exploration Number* **AMW-01**
Contractor Holocene Drilling, Inc.	*Equipment* CME-85 Truck Mount	*Sampling Method* Autohammer; 140 lb hammer; 30" drop	*Ground Surface Elev. (NAVD88)* 10.6' (est)	Ecology Well Tag No. BNP024
Operator Eric	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 11/22/2021	*Top of Casing Elev. (NAVD88)* 13.9' (est)	*Depth to Water (Below GS)* 5.3' (ATD)



3.3 ft casing stickup inside 6 inch diam. steel monument with locking cap

Concrete surface seal

2-inch-diameter Sch 40 PVC casing

3-18 ft bgs bentonite chips

∇ 11/22/2021

Switched to mud rotary drilling at 15 ft bgs

18-35 ft bgs 2x12 silica sand

21-31 ft bgs, 2-inch-diameter Sch 40 0.010" slotted screen

Sample	Blows/6"	Tests
S1	0 0 3	PS
S2	0 0 0	
S3	0 0 3	
S4	3 7 11	PS
S5	6 20 41	
S6	2 3 5	
S7	18 16 9	

TOPSOIL

SILTY SAND WITH GRAVEL (SM); moist, brown; fine to coarse sand; fine to coarse gravel.

FILL

SILTY SAND (SM); very loose, very moist, brown; fine sand; trace fine gravel; few organics.

OLDER TOPSOIL HORIZON

SILT (ML); very loose, moist, dark brown; low plasticity; some organics.

BEACH DEPOSITS

SAND (SP); medium dense, wet, gray; fine to medium sand; trace silt.

1-inch pockets of silt- and sand-sized organics.

Heaving sands packed sampler. Blow counts not representative.

1-inch pockets of silt- and sand-sized organics.

Trace fine gravel.

GRAVEL WITH SILT AND SAND (GP-GM); medium dense, wet, brown; fine to medium sand; fine gravel.

Legend

Sample Type

- ○ No Soil Sample Recovery
- ◪ Split Barrel 2" X 1.375" (SPT)

Plastic Limit ├──┤ Liquid Limit

Water Level

- ∇ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: DCB
Approved by: AJD 5/15/2022

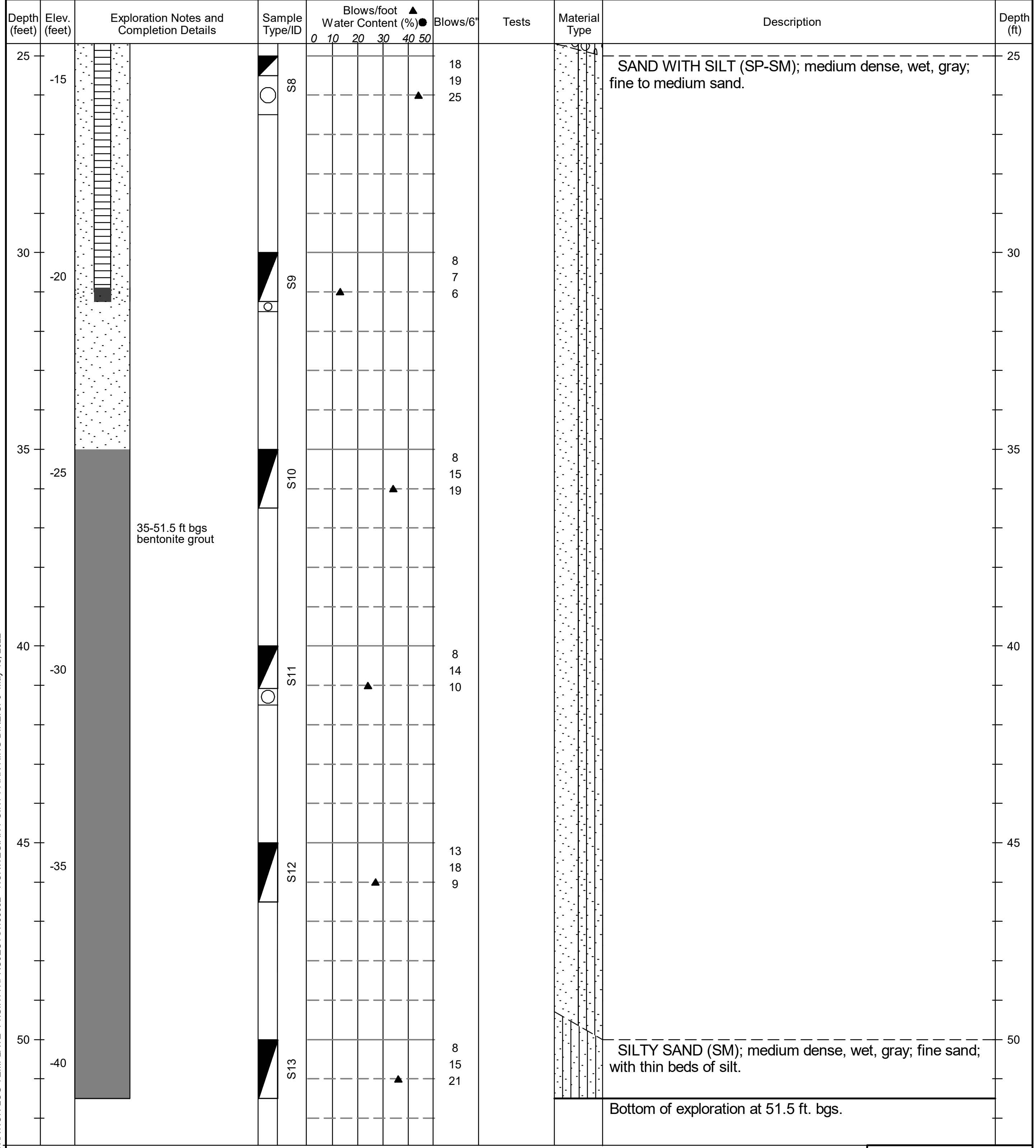
Exploration Log
AMW-01
Sheet 1 of 2

Aspect CONSULTING

Norwegian Point Park - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location		*Coordinates (Lat,Lon WGS84)*	*Exploration Number*
Norwegian Point Park, Hansville, WA, see Figure 2 for specific location.		47.9155, -122.5457 (est)	**AMW-01**
Contractor	*Equipment*	*Sampling Method*	*Ground Surface Elev. (NAVD88)*
Holocene Drilling, Inc.	CME-85 Truck Mount	Autohammer; 140 lb hammer; 30" drop	10.6' (est)
			Ecology Well Tag No. BNP024
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NAVD88)*
Eric	8.5" OD X 4.25" ID Hollow-Stem Auger	11/22/2021	13.9' (est)
Depth to Water (Below GS)			
5.3' (ATD)			



35-51.5 ft bgs bentonite grout

Sample Type/ID	Blows/6"
S8	18 19 25
S9	8 7 6
S10	8 15 19
S11	8 14 10
S12	13 18 9
S13	8 15 21

SAND WITH SILT (SP-SM); medium dense, wet, gray; fine to medium sand.

SILTY SAND (SM); medium dense, wet, gray; fine sand; with thin beds of silt.

Bottom of exploration at 51.5 ft. bgs.

Legend

Plastic Limit ├──┤ Liquid Limit

Sample Type
- ☐ No Soil Sample Recovery
- ◩ Split Barrel 2" X 1.375" (SPT)

Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: DCB
Approved by: AJD 5/15/2022

Exploration Log AMW-01

Sheet 2 of 2

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\190092 - NORWEGIAN POINT PARK RING DIKE.GPJ May 18, 2022

Review Stage:DRAFT Rev.2

APPENDIX B

Laboratory Test Results

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. Norwegian Point Park
Project #: 22S029-02
Client: Aspect Consulting
Source: Boring AMW-01 at 2.5 ft
Sample#: S22-0036

Date Received: February 5, 2022
Date Sampled: November 22, 2021
Sampled By: Client
Date Tested: February 21, 2022
Tested By: Mark Peterson

ASTM D-2487 Unified Soils Classification System
SM, Silty Sand
Sample Color:
Brownish Grey

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04

ASTM D-2216, ASTM D-2419, ASTM D-4318, ASTM D-5821

Specifications
No Specs
Sample Meets Specs ? N/A

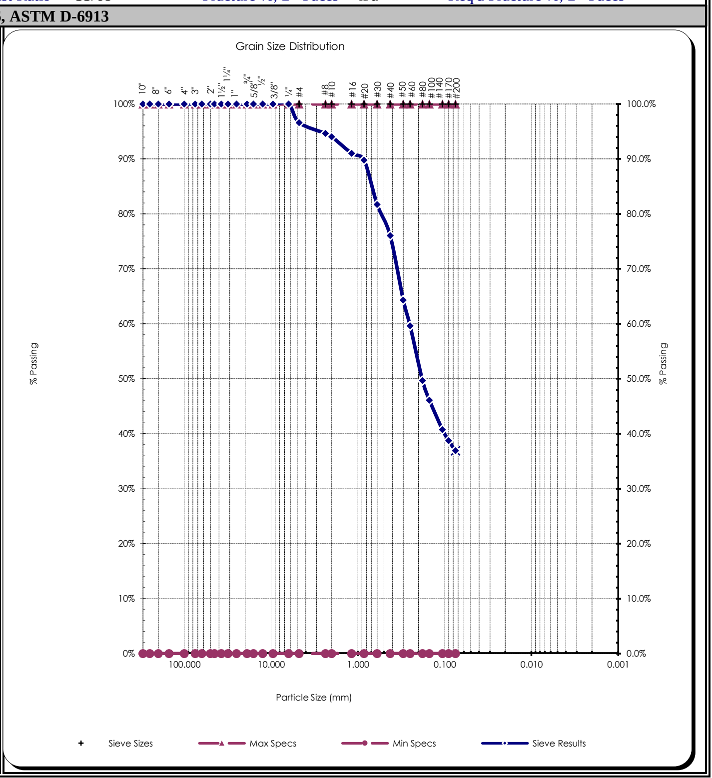
$D_{(5)}$ = 0.010 mm
$D_{(10)}$ = 0.020 mm
$D_{(15)}$ = 0.030 mm
$D_{(30)}$ = 0.061 mm
$D_{(50)}$ = 0.182 mm
$D_{(60)}$ = 0.254 mm
$D_{(90)}$ = 0.905 mm
Dust Ratio = 33/68

% Gravel = 3.4%
% Sand = 59.7%
% Silt & Clay = 36.9%
Liquid Limit = n/a
Plasticity Index = n/a
Sand Equivalent = n/a
Fracture %, 1 Face = n/a
Fracture %, 2+ Faces = n/a

Coeff. of Curvature, C_C = 0.72
Coeff. of Uniformity, C_U = 12.50
Fineness Modulus = 1.26
Plastic Limit = n/a
Moisture %, as sampled = 17.9%
Req'd Sand Equivalent =
Req'd Fracture %, 1 Face =
Req'd Fracture %, 2+ Faces =

ASTM C-136, ASTM D-6913

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
US	Metric				
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00		100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00		100%	100.0%	0.0%
3/4"	19.00		100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50		100%	100.0%	0.0%
3/8"	9.50		100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	97%	97%	100.0%	0.0%
#8	2.36	95%	95%	100.0%	0.0%
#10	2.00	94%	94%	100.0%	0.0%
#16	1.18		91%	100.0%	0.0%
#20	0.850	90%	90%	100.0%	0.0%
#30	0.600		82%	100.0%	0.0%
#40	0.425	76%	76%	100.0%	0.0%
#50	0.300		64%	100.0%	0.0%
#60	0.250	60%	60%	100.0%	0.0%
#80	0.180	50%	50%	100.0%	0.0%
#100	0.150	46%	46%	100.0%	0.0%
#140	0.106		41%	100.0%	0.0%
#170	0.090		39%	100.0%	0.0%
#200	0.075	36.9%	36.9%	100.0%	0.0%



Comments: ______

Reviewed by: Mark Peterson

Sieve Report

Project: Q.C. Norwegian Point Park
Project #: 22S029-02
Client: Aspect Consulting
Source: Boring AMW-01 at 10 ft
Sample#: S22-0037

Date Received: February 10, 2022
Date Sampled: November 22, 2021
Sampled By: Client
Date Tested: February 21, 2022
Tested By: Mark Peterson

ASTM D-2487 Unified Soils Classification System
SP, Poorly graded Sand
Sample Color:
Grey

ASTM D-2216, ASTM D-2419, ASTM D-4318, ASTM D-5821

Specifications
No Specs
Sample Meets Specs ? N/A

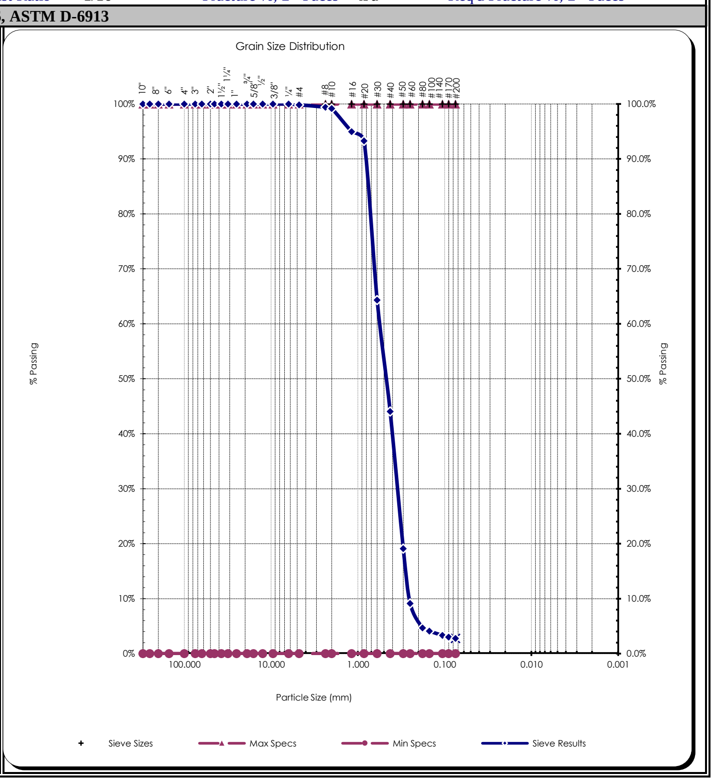
$D_{(5)}$ = 0.185 mm
$D_{(10)}$ = 0.254 mm
$D_{(15)}$ = 0.279 mm
$D_{(30)}$ = 0.355 mm
$D_{(50)}$ = 0.476 mm
$D_{(60)}$ = 0.563 mm
$D_{(90)}$ = 0.822 mm
Dust Ratio = 1/16

% Gravel = 0.2%
% Sand = 97.1%
% Silt & Clay = 2.8%
Liquid Limit = n/a
Plasticity Index = n/a
Sand Equivalent = n/a
Fracture %, 1 Face = n/a
Fracture %, 2+ Faces = n/a

Coeff. of Curvature, C_C = 0.88
Coeff. of Uniformity, C_U = 2.21
Fineness Modulus = 2.18
Plastic Limit = n/a
Moisture %, as sampled = 29.5%
Req'd Sand Equivalent =
Req'd Fracture %, 1 Face =
Req'd Fracture %, 2+ Faces =

ASTM C-136, ASTM D-6913

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00		100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00		100%	100.0%	0.0%
3/4"	19.00		100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50		100%	100.0%	0.0%
3/8"	9.50		100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36	99%	99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		95%	100.0%	0.0%
#20	0.850	93%	93%	100.0%	0.0%
#30	0.600		64%	100.0%	0.0%
#40	0.425	44%	44%	100.0%	0.0%
#50	0.300		19%	100.0%	0.0%
#60	0.250	9%	9%	100.0%	0.0%
#80	0.180	5%	5%	100.0%	0.0%
#100	0.150	4%	4%	100.0%	0.0%
#140	0.106		3%	100.0%	0.0%
#170	0.090		3%	100.0%	0.0%
#200	0.075	2.8%	2.8%	100.0%	0.0%



Comments:

Reviewed by: Mark Peterson

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Project: Q.C. - NPP Ring Dike
Project #: 18B011-15
Date Received: April 5, 2019
Date Tested: April 8, 2019

Client: Aspect Consulting

Sampled by: Client
Tested by: A. Eifrig

Moisture Content - AASHTO T-265

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B19-0190	TP-3 @ 2-3'	378.2	1652.5	1495.5	157.0	1117.3	14.1%
B19-0191	TP-3 @ 4-5'	380.1	1647.8	1462.8	185.0	1082.7	17.1%
B19-0193	TP-4 @ 2-3'	413.8	1475.8	1298.5	177.3	884.7	20.0%
B19-0196	TP-6 @ 3-4'	379.8	1362.8	1235.7	127.1	855.9	14.8%

Reviewed by: Meghan Blodgett Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Project: Q.C. - NPP Ring Dike
Project #: 18B110-15
Date Received: April 5, 2019
Date Tested: April 9, 2019

Client: Aspect Consulting
Sampled by: Client
Tested by: A. Eifrig

Moisture Content - AASHTO T-265

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B19-0192	TP-3 @ 6-7'	707.9	1807.8	1001.4	806.4	293.5	274.8%
B19-0194	TP-5 @ 5-6'	731.1	1896.0	1022.0	874.0	290.9	300.4%
B19-0199	TP-8 @ 7-8'	759.4	1830.2	1145.3	684.9	385.9	177.5%
B19-0200	TP-9 @ 5-6'	724.1	1879.1	1175.6	703.5	451.5	155.8%
B19-0201	TP-10 @ 6-8'	645.4	1752.4	863.1	889.3	217.7	408.5%
B19-0202	TP-11 @ 5'	688.8	2026.9	1139.4	887.5	450.6	197.0%

Organic Content - AASHTO T-267

Sample #	Location	Tare	Soil + Tare, Pre-Ignition	Soil + Tare, Post Ignition	% Organics
B19-0192	TP-3 @ 6-7'	49.9	68.8	58.5	54.5%
B19-0194	TP-5 @ 5-6'	52.7	63.3	57.3	56.6%
B19-0199	TP-8 @ 7-8'	51.7	70.1	65.5	25.0%
B19-0200	TP-9 @ 5-6'	51.5	82.6	77.6	16.1%
B19-0201	TP-10 @ 6-8'	49.1	63.0	55.2	56.1%
B19-0202	TP-11 @ 5'	46.4	76.1	72.7	11.4%

Reviewed by: Meghan Blodgett Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Project: Q.C. - NPP Ring Dike
Project #: 18B110-15
Date Received: April 5, 2019
Date Tested: April 15, 2019

Client: Aspect Consulting
Sampled by: Client
Tested by: A. Eifrig

Moisture Content - AASHTO T-265

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B19-0199 Re-test	TP-8 @ 7-8'	690.0	1250.5	893.7	356.8	203.7	175.2%
B19-0200 Re-test	TP-9 @ 5-6'	719.3	1621.9	1031.0	590.9	311.7	189.6%
B19-0202 Re-test	TP-11 @ 5'	686.9	1317.2	898.8	418.4	211.9	197.5%

Organic Content - AASHTO T-267

Sample #	Location	Tare	Soil + Tare, Pre-Ignition	Soil + Tare, Post Ignition	% Organics
B19-0199 Re-test	TP-8 @ 7-8'	68.5	106.2	95.9	27.3%
B19-0200 Re-test	TP-9 @ 5-6'	64.0	112.9	97.6	31.3%
B19-0202 Re-test	TP-11 @ 5'	68.1	122.0	112.9	16.9%

Reviewed by: Meghan Blodgett Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Sieve Report

Project: Q.C. - NPP Ring Dike
Project #: 18B011-15
Client: Aspect Consulting
Source: TP-1 @ 5-6'
Sample#: B19-0189

Date Received: 5-Apr-19
Sampled By: Client
Date Tested: 8-Apr-19
Tested By: A. Eifrig

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
Gray

Certificate #: 1366.01, 1366.02 & 1366.04

AASHTO T-176, AASHTO T-255, AASTHO T-335, AASHTO T-89, AASHTO T-90

Specifications
No Specs
Sample Meets Specs ? N/A

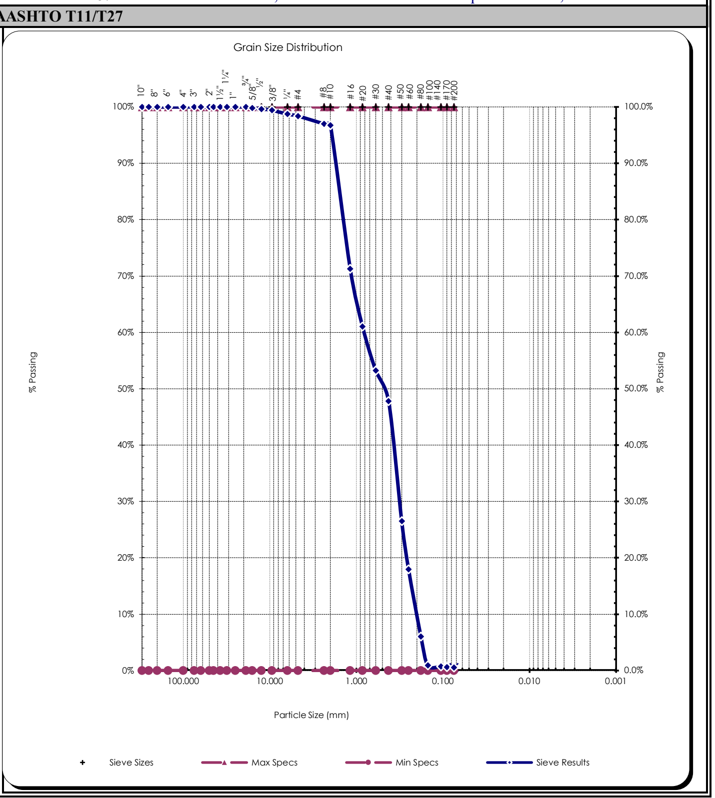
$D_{(5)}$ = 0.174 mm
$D_{(10)}$ = 0.203 mm
$D_{(15)}$ = 0.232 mm
$D_{(30)}$ = 0.320 mm
$D_{(50)}$ = 0.495 mm
$D_{(60)}$ = 0.817 mm
$D_{(90)}$ = 1.782 mm
Dust Ratio = 1/87

% Gravel = 1.6%
% Sand = 97.8%
% Silt & Clay = 0.6%
Liquid Limit = n/a
Plasticity Index = n/a
Sand Equivalent = n/a
Fracture %, 1 Face = n/a
Fracture %, 2+ Faces = n/a

Coeff. of Curvature, C_C = 0.62
Coeff. of Uniformity, C_U = 4.02
Fineness Modulus = 2.53
Plastic Limit = n/a
Moisture %, as sampled = n/a
Req'd Sand Equivalent =
Req'd Fracture %, 1 Face =
Req'd Fracture %, 2+ Faces =

ASTM C136 - AASHTO T11/T27

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	99%	99%	100.0%	0.0%
1/4"	6.30		99%	100.0%	0.0%
#4	4.75	98%	98%	100.0%	0.0%
#8	2.36		97%	100.0%	0.0%
#10	2.00	97%	97%	100.0%	0.0%
#16	1.18		71%	100.0%	0.0%
#20	0.850		61%	100.0%	0.0%
#30	0.600		53%	100.0%	0.0%
#40	0.425	48%	48%	100.0%	0.0%
#50	0.300		27%	100.0%	0.0%
#60	0.250		18%	100.0%	0.0%
#80	0.180		6%	100.0%	0.0%
#100	0.150	1%	1%	100.0%	0.0%
#140	0.106		1%	100.0%	0.0%
#170	0.090		1%	100.0%	0.0%
#200	0.075	0.6%	0.6%	100.0%	0.0%



Comments:

Reviewed by: Megh Blodgett Carillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Sieve Report

Project: Q.C. - NPP Ring Dike
Project #: 18B011-15
Client: Aspect Consulting
Source: TP-5 @ 8.5-9.5'
Sample#: B19-0195

Date Received: 5-Apr-19
Sampled By: Client
Date Tested: 8-Apr-19
Tested By: A. Eifrig

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
Gray

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04

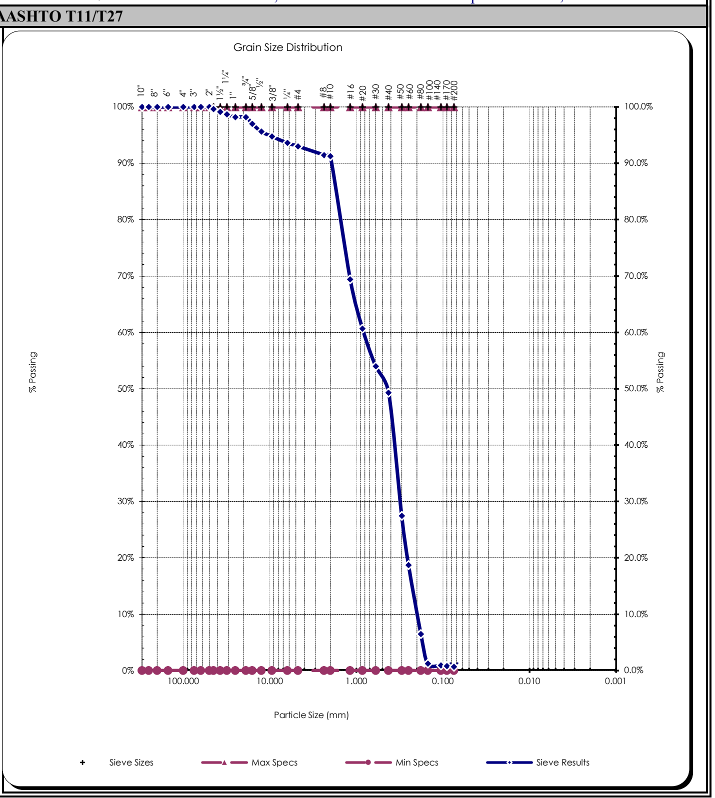
AASHTO T-176, AASHTO T-255, AASTHO T-335, AASHTO T-89, AASHTO T-90

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.172 mm	% Gravel = 7.0%	Coeff. of Curvature, C_C = 0.60
$D_{(10)}$ = 0.200 mm	% Sand = 92.3%	Coeff. of Uniformity, C_U = 4.13
$D_{(15)}$ = 0.229 mm	% Silt & Clay = 0.7%	Fineness Modulus = 2.70
$D_{(30)}$ = 0.315 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.450 mm	Plasticity Index = n/a	Moisture %, as sampled = n/a
$D_{(60)}$ = 0.826 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.953 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 1/71	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136 - AASHTO T11/T27

Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		99%	100.0%	0.0%
1.25"	31.50		99%	100.0%	0.0%
1.00"	25.00	98%	98%	100.0%	0.0%
3/4"	19.00	98%	98%	100.0%	0.0%
5/8"	16.00		97%	100.0%	0.0%
1/2"	12.50	96%	96%	100.0%	0.0%
3/8"	9.50	95%	95%	100.0%	0.0%
1/4"	6.30		94%	100.0%	0.0%
#4	4.75	93%	93%	100.0%	0.0%
#8	2.36		91%	100.0%	0.0%
#10	2.00	91%	91%	100.0%	0.0%
#16	1.18		69%	100.0%	0.0%
#20	0.850		61%	100.0%	0.0%
#30	0.600		54%	100.0%	0.0%
#40	0.425	49%	49%	100.0%	0.0%
#50	0.300		27%	100.0%	0.0%
#60	0.250		19%	100.0%	0.0%
#80	0.180		6%	100.0%	0.0%
#100	0.150	1%	1%	100.0%	0.0%
#140	0.106		1%	100.0%	0.0%
#170	0.090		1%	100.0%	0.0%
#200	0.075	0.7%	0.7%	100.0%	0.0%



Comments:

Reviewed by: Megh Blodgett Carillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Sieve Report

Project: Q.C. - NPP Ring Dike
Project #: 19B110
Client: Aspect Consulting
Source: TP-7 @ 2-3'
Sample#: B19-0197

Date Received: 5-Apr-19
Sampled By: Client
Date Tested: 8-Apr-19
Tested By: A. Eifrig

Unified Soil Classification System, ASTM-2487
SM, Silty Sand
Sample Color:
Brown

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04

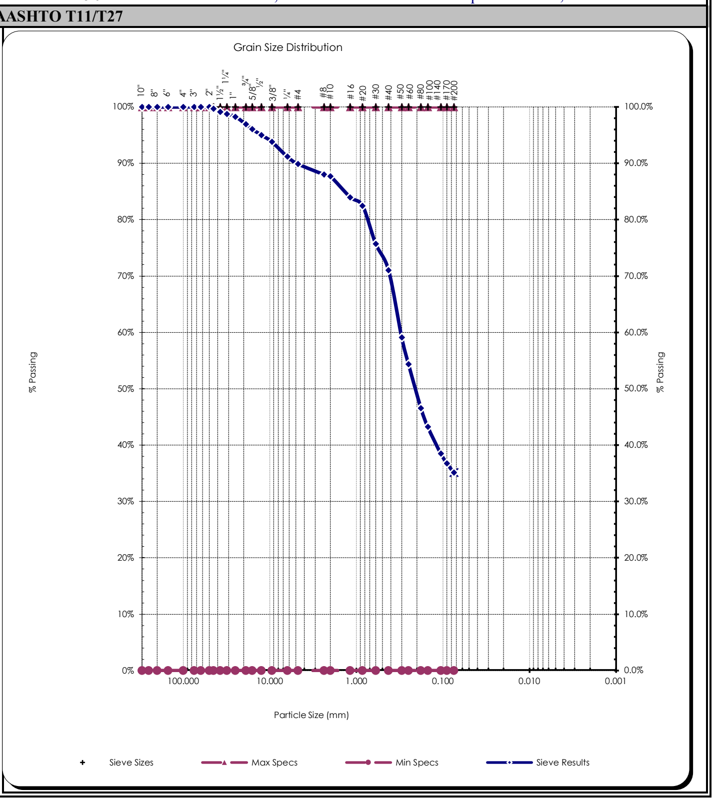
AASHTO T-176, AASHTO T-255, AASTHO T-335, AASHTO T-89, AASHTO T-90

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.011	mm	% Gravel =	10.1%	Coeff. of Curvature, C_C =	0.62
$D_{(10)}$ =	0.021	mm	% Sand =	54.8%	Coeff. of Uniformity, C_U =	14.49
$D_{(15)}$ =	0.032	mm	% Silt & Clay =	35.1%	Fineness Modulus =	1.69
$D_{(30)}$ =	0.064	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.211	mm	Plasticity Index =	n/a	Moisture %, as sampled =	15.5%
$D_{(60)}$ =	0.309	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	4.887	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	45/91		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136 - AASHTO T11/T27

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
US	Metric				
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		99%	100.0%	0.0%
1.25"	31.50		99%	100.0%	0.0%
1.00"	25.00	98%	98%	100.0%	0.0%
3/4"	19.00	97%	97%	100.0%	0.0%
5/8"	16.00		96%	100.0%	0.0%
1/2"	12.50	95%	95%	100.0%	0.0%
3/8"	9.50	94%	94%	100.0%	0.0%
1/4"	6.30		91%	100.0%	0.0%
#4	4.75	90%	90%	100.0%	0.0%
#8	2.36		88%	100.0%	0.0%
#10	2.00	88%	88%	100.0%	0.0%
#16	1.18		84%	100.0%	0.0%
#20	0.850	82%	82%	100.0%	0.0%
#30	0.600		76%	100.0%	0.0%
#40	0.425	71%	71%	100.0%	0.0%
#50	0.300		59%	100.0%	0.0%
#60	0.250	54%	54%	100.0%	0.0%
#80	0.180		47%	100.0%	0.0%
#100	0.150	43%	43%	100.0%	0.0%
#140	0.106		38%	100.0%	0.0%
#170	0.090		37%	100.0%	0.0%
#200	0.075	35.1%	35.1%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Proctor Report

Project: Q.C. - NPP Ring Dike
Project #: 19B110
Client: Aspect Consulting
Source: TP-7 @ 2-3'
Sample#: B19-0197

Date Received: 5-Apr-19
Sampled By: Client
Date Tested: 8-Apr-19
Tested By: A. Eifrig

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color
Brown

Sample Prepared: Moist: X
Dry:
Manual:
Mechanical: X

Test Standard: ASTM D698:
ASTM D 1557: X
AASHTO T 99:
AASHTO T 180:
Method
A

Assumed Sp. Gr.
2.70

Point Number	Percent Moisture	Dry Density
1	5.4 %	126.3
2	7.5 %	130.5
3	9.5 %	129.9
4	11.4 %	125.6

Certificate #: 1366.01, 1366.02 & 1366.04

Uncorrected Proctor Value

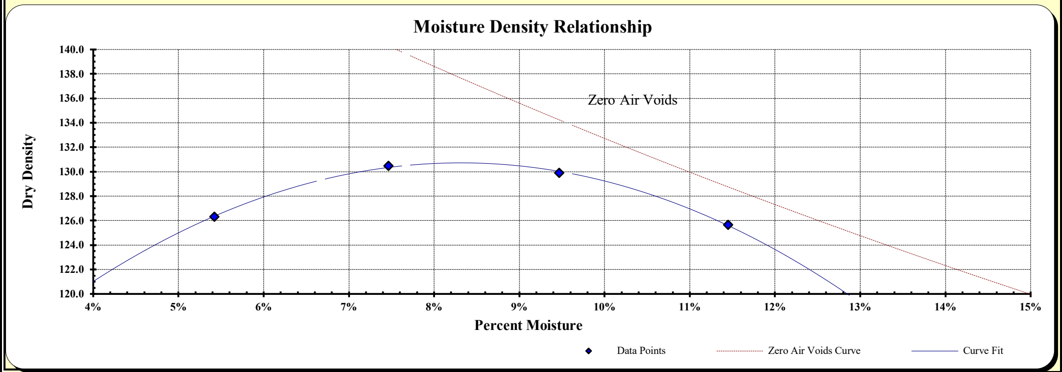
Max. Dry Density		Optimum Moist
130.7	**lbs/ft^3**	**8.3 %**

Value w/ Oversize Correction Applied

Max. Dry Density		Optimum Moist
133.8	**lbs/ft^3**	**7.5%**

AASHTO T11/T27

Sieve US	Size mm	Percent Passing	Specifications Max	Specifications Min
12.00"	300.00		100 %	0 %
10.00"	250.00		100 %	0 %
8.00"	200.00		100 %	0 %
6.00"	150.00		100 %	0 %
4.00"	100.00		100 %	0 %
3.00"	75.00		100 %	0 %
2.50"	63.00		100 %	0 %
2.00"	50.00	100 %	100 %	0 %
1.75"	45.00		100 %	0 %
1.50"	37.50		100 %	0 %
1.25"	31.50		100 %	0 %
1.00"	25.00	98 %	100 %	0 %
3/4"	19.00	97 %	100 %	0 %
5/8"	16.00		100 %	0 %
1/2"	12.50	95 %	100 %	0 %
3/8"	9.50	94 %	100 %	0 %
1/4"	6.30		100 %	0 %
#4	4.75	90 %	100 %	0 %
#8	2.36		100 %	0 %
#10	2.00	88 %	100 %	0 %
#16	1.18		100 %	0 %
#20	0.850	82 %	100 %	0 %
#30	0.600		100 %	0 %
#40	0.425	71 %	100 %	0 %
#50	0.300		100 %	0 %
#60	0.250	54 %	100 %	0 %
#80	0.180		100 %	0 %
#100	0.150	43 %	100 %	0 %
#140	0.106		100 %	0 %
#170	0.090		100 %	0 %
#200	0.075	35.1 %	100.0 %	0.0 %



Annex A1, Misc. Oversize Correction Values

% Oversize Mat'l: 10%

% Oversize Retained	Corrected Density	Optimum Moisture
5%	132.2	7.9%
10%	133.7	7.5%
15%	135.3	7.1%
20%	136.9	6.8%
25%	138.5	6.4%
30%	140.2	6.0%

Specs: No Specs
Meets Specs? N/A

% Gravel: 10.1%
% Sand: 54.8%
% Silt&Clay: 35.1%
C_C: 0.62
C_U: 14.49
FM: 1.69
$D_{(10)}$: 0.021
$D_{(30)}$: 0.064
$D_{(60)}$: 0.309

LL: n/a
PL: n/a
PI: n/a

Sand Equivalent: n/a
Req'd Sand Equivalent:

Fracture %, 1 Face: n/a
Fracture %, 2+ Faces: n/a
Req'd Fracture %, 1 Face:
Req'd Fracture %, 2+ Faces:

Comments:

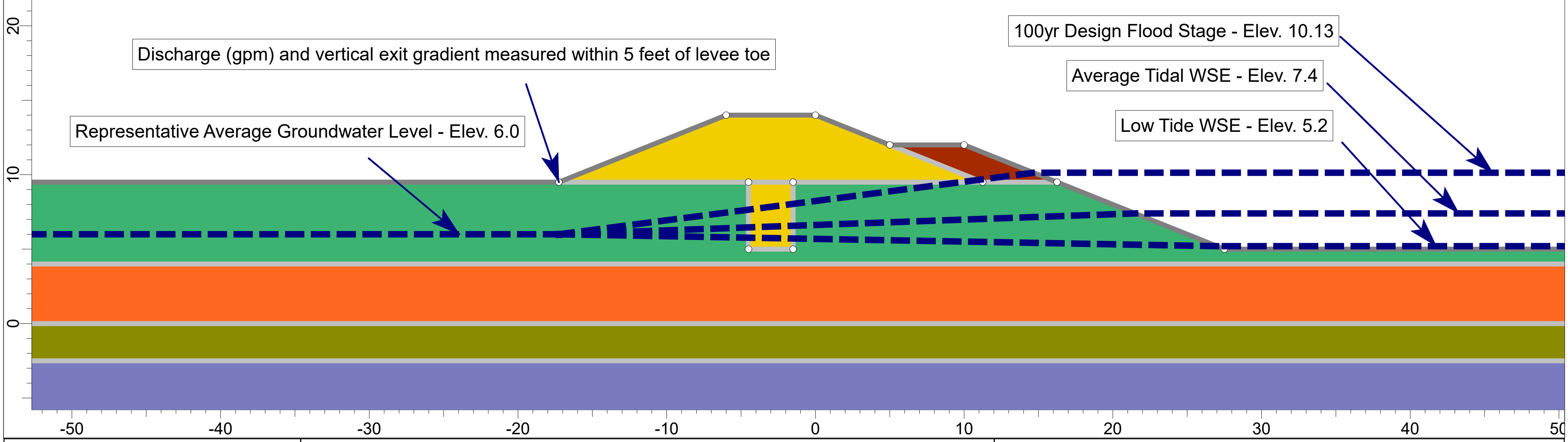
Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

APPENDIX C

Seepage and Slope Stability Analysis Results

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)
Levee Fill	🟨	120	Mohr-Coulomb	50	34		
Existing Fill	🟩	115	Mohr-Coulomb	25	32		
Wetland Deposits (Peat)	🟧	70	Mohr-Coulomb	250	20		
Beach Deposits	🟪	110	Mohr-Coulomb	0	30		
Beach Deposits (Liq)	🟫	110	Undrained	75		FDepth	5
Floodplain Fill	🟥	110	Mohr-Coulomb	0	33		

Material Name	Color	KS (cm/s)	K2/K1
Levee Fill	🟨	0.003	1
Existing Fill	🟩	0.05	1
Wetland Deposits (Peat)	🟧	0.1	0.1
Beach Deposits	🟪	0.5	0.1
Beach Deposits (Liq)	🟫	0.5	0.1
Floodplain Fill	🟥	0.05	1



Setup Model
Master Scenario

Seepage and Slope Stability Analysis

Geotechnical Basis of Design Memo
Norwegian Point Park Levee
Hansville, Washington

SLIDE 9.024

SCALE: 1:120

C:\Users\kspina\Desktop\Norwegian Pt Levee Seepage\Seepage and SSA 10.18.2023\Levee Waterward Failure.slmd

Aspect CONSULTING

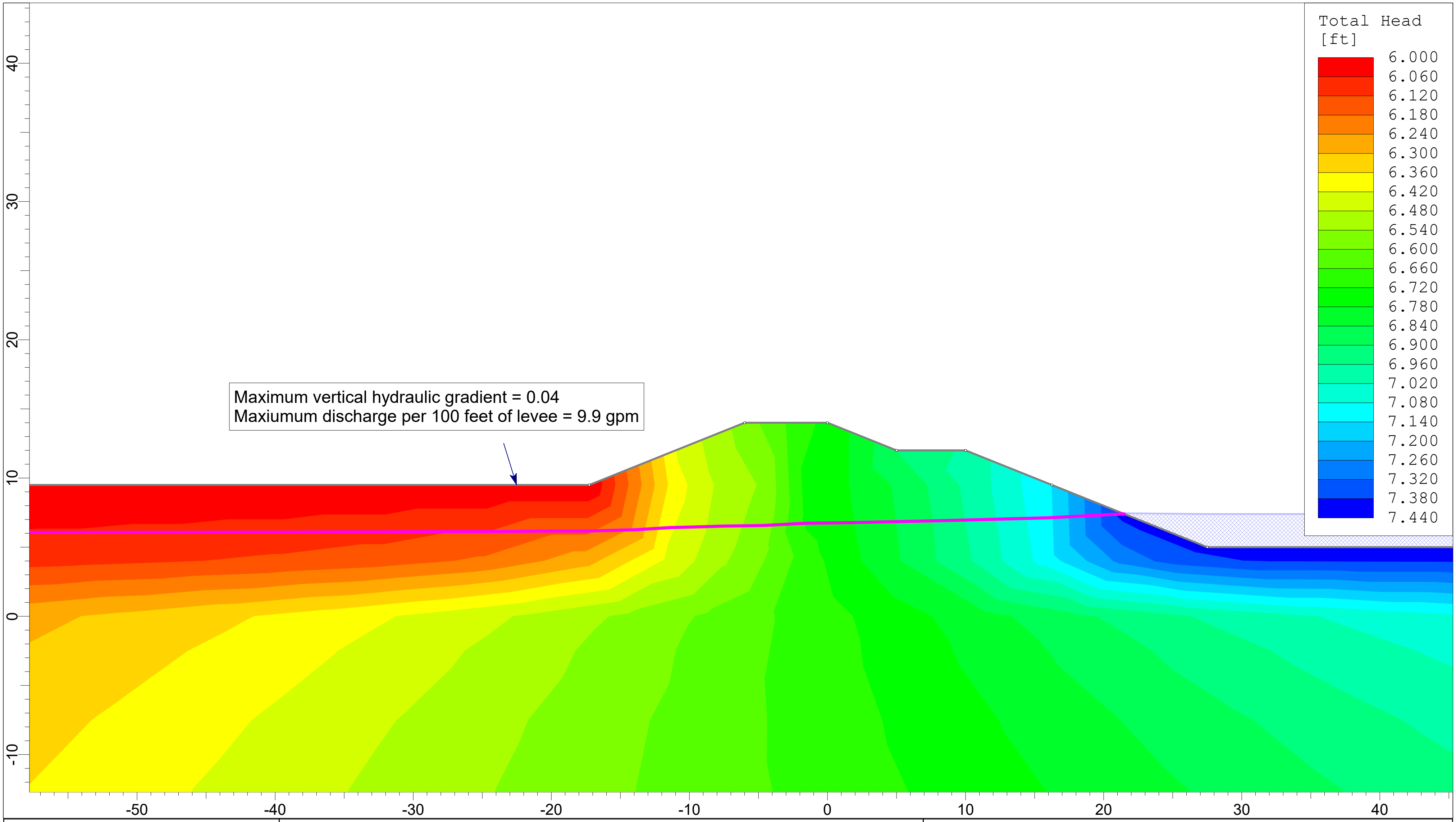
10/18/2023

PROJECT NO.
190092

BY:
KDS

REVIEWED BY:
AJH

APPENDIX:
C-1



Maximum vertical hydraulic gradient = 0.04
Maxiumum discharge per 100 feet of levee = 9.9 gpm

Average Tidal Conditions
Master Scenario

Seepage and Slope Stability Analysis

Geotechnical Basis of Design Memo
Norwegian Point Park Levee
Hansville, Washington

SLIDEINTERPRET 9.024

SCALE: 1:120

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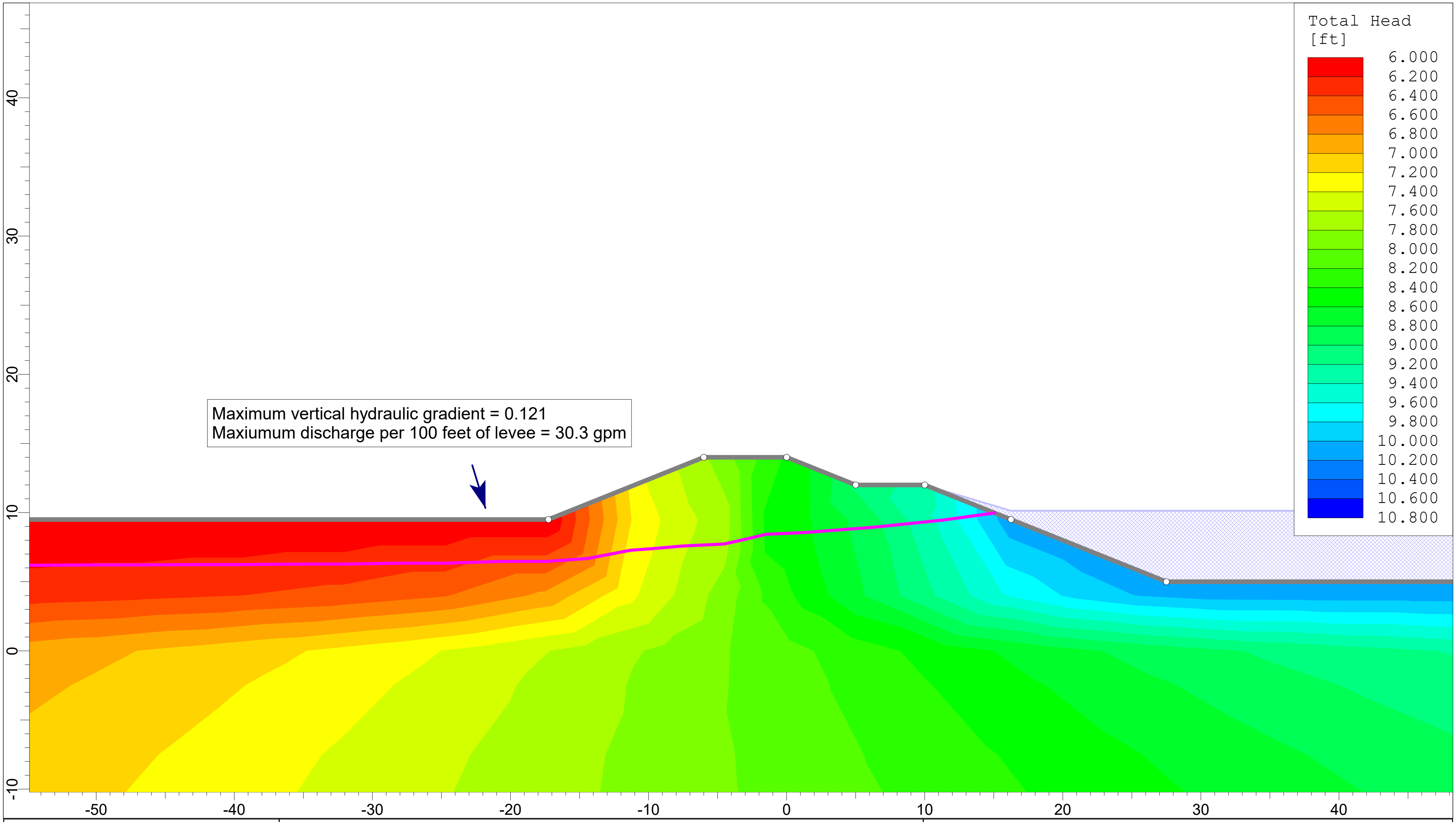
APPENDIX:
C-2



Maximum vertical hydraulic gradient = 0.121
Maxiumum discharge per 100 feet of levee = 30.3 gpm

100-yr Flood
Master Scenario

Seepage and Slope Stability Analysis

Geotechnical Basis of Design Memo
Norwegian Point Park Levee
Hansville, Washington

SLIDEINTERPRET 9.024

SCALE: 1:120

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BY:
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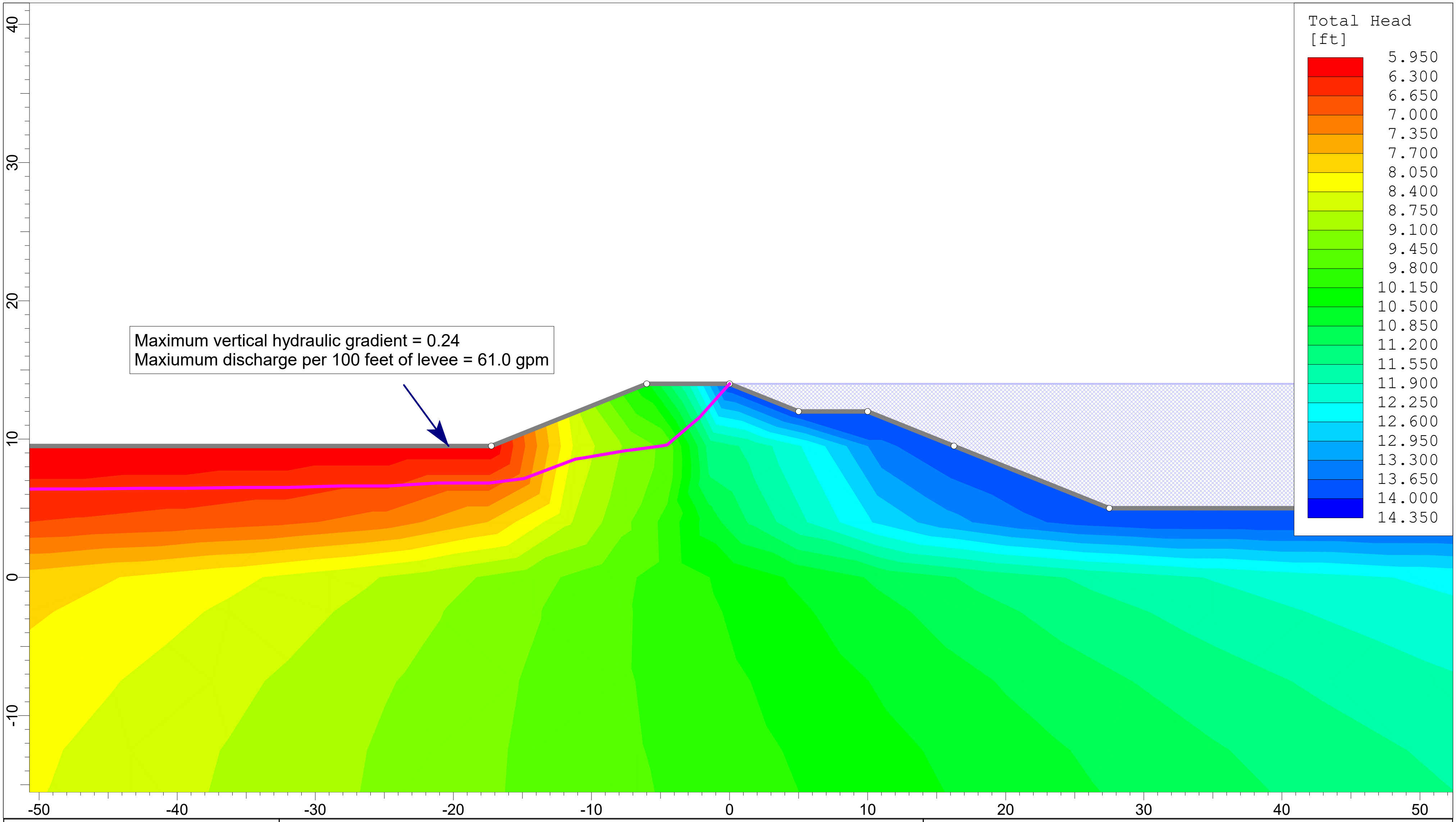
REVIEWED BY:
AJH

APPENDIX:
C-3



Maximum vertical hydraulic gradient = 0.24
Maxiumum discharge per 100 feet of levee = 61.0 gpm

Full Levee
Master Scenario

Seepage and Slope Stability Analysis

Geotechnical Basis of Design Memo
Norwegian Point Park Levee
Hansville, Washington

SLIDEINTERPRET 9.024

SCALE: 1:120

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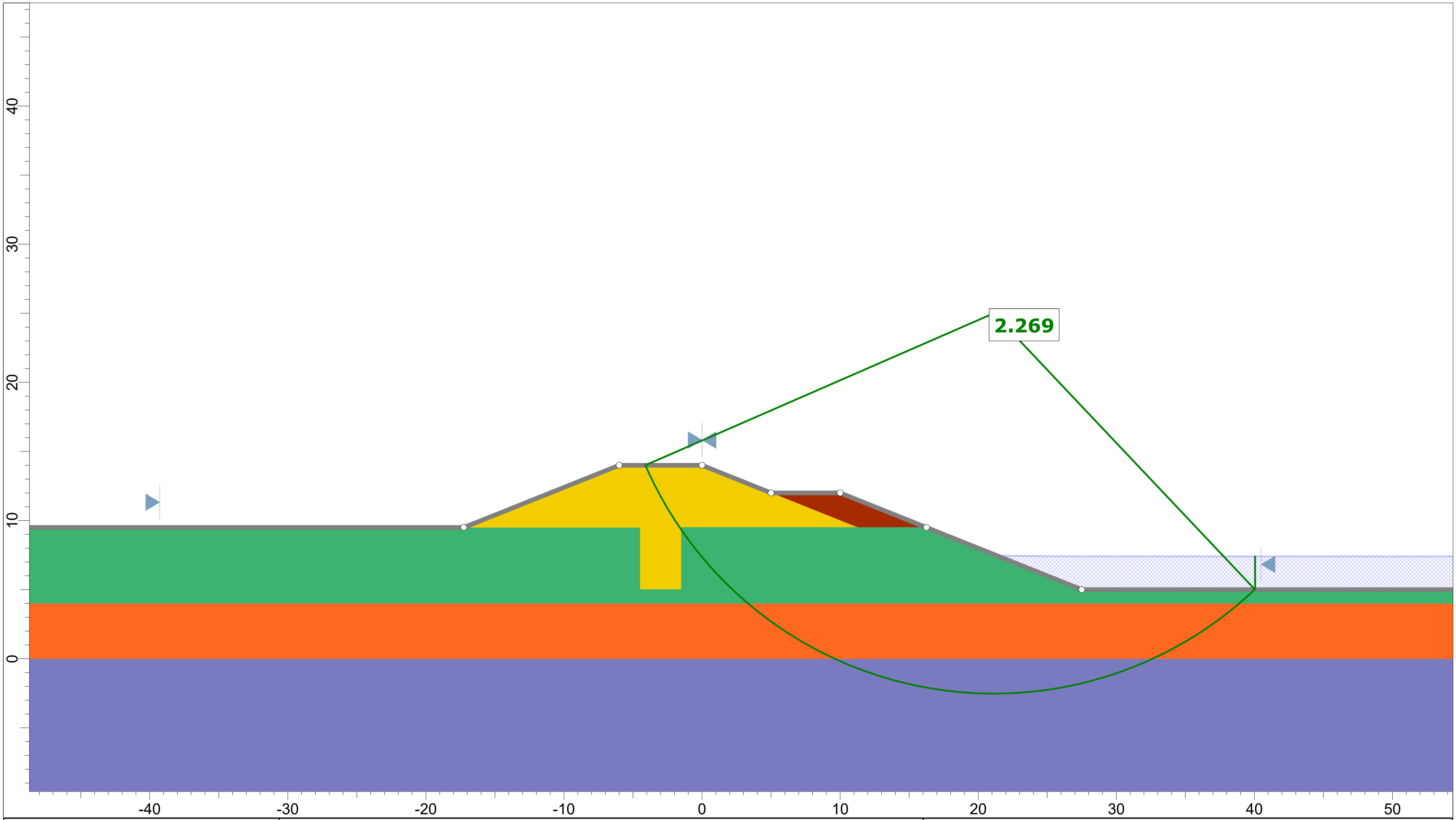
PROJECT NO.
190092

BY:
KDS

REVIEWED BY:
AJH

APPENDIX:
C-4



Average Tidal Conditions
Static

Seepage and Slope Stability Analysis

Geotechnical Basis of Design Memo
Norwegian Point Park Levee
Hansville, Washington

SLIDEINTERPRET 9.024

SCALE: 1:120

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190092

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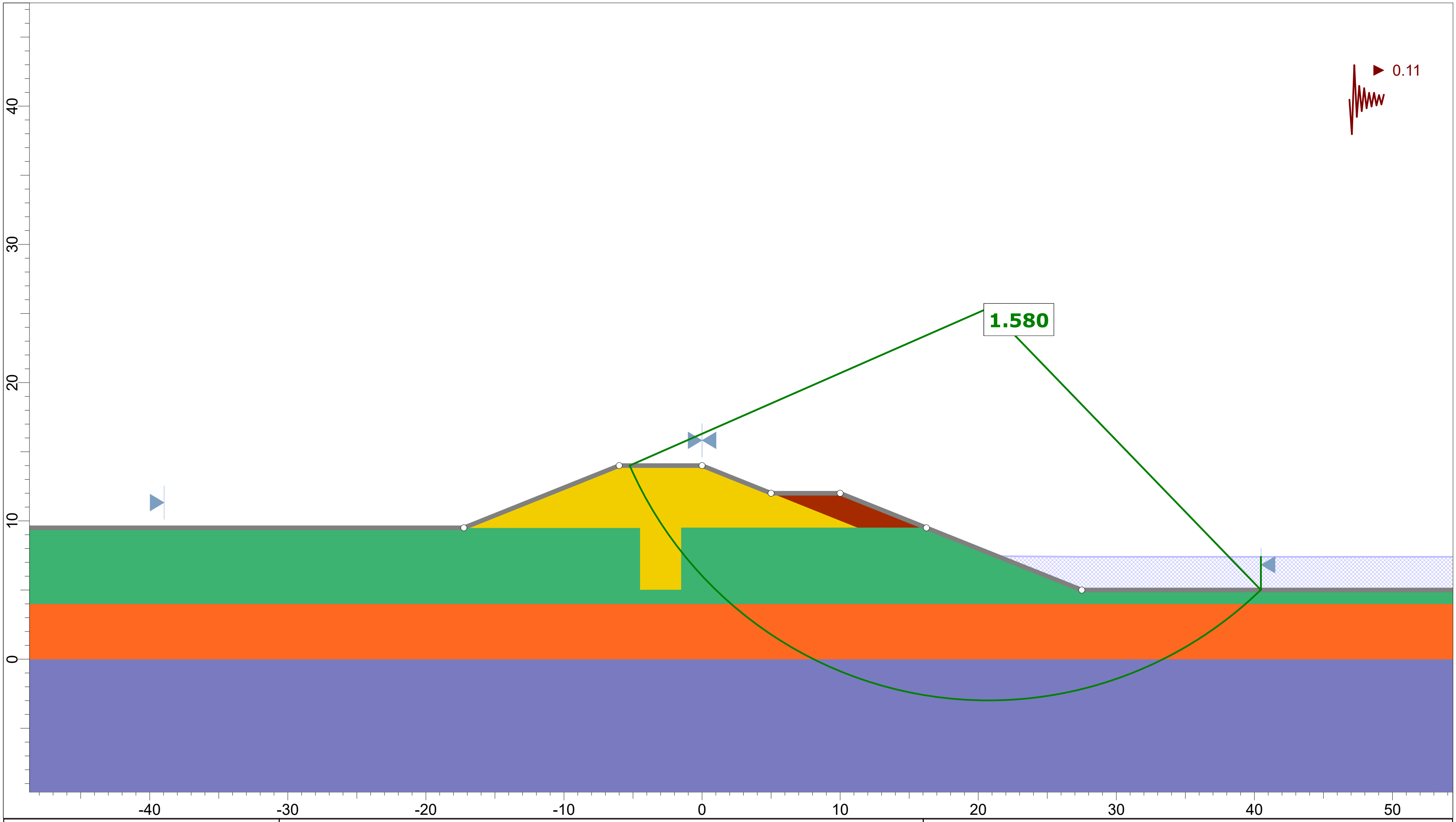
APPENDIX:
C-5



Average Tidal Conditions
Seismic

Seepage and Slope Stability Analysis

Geotechnical Basis of Design Memo
Norwegian Point Park Levee
Hansville, Washington

SLIDEINTERPRET 9.024

SCALE: 1:120

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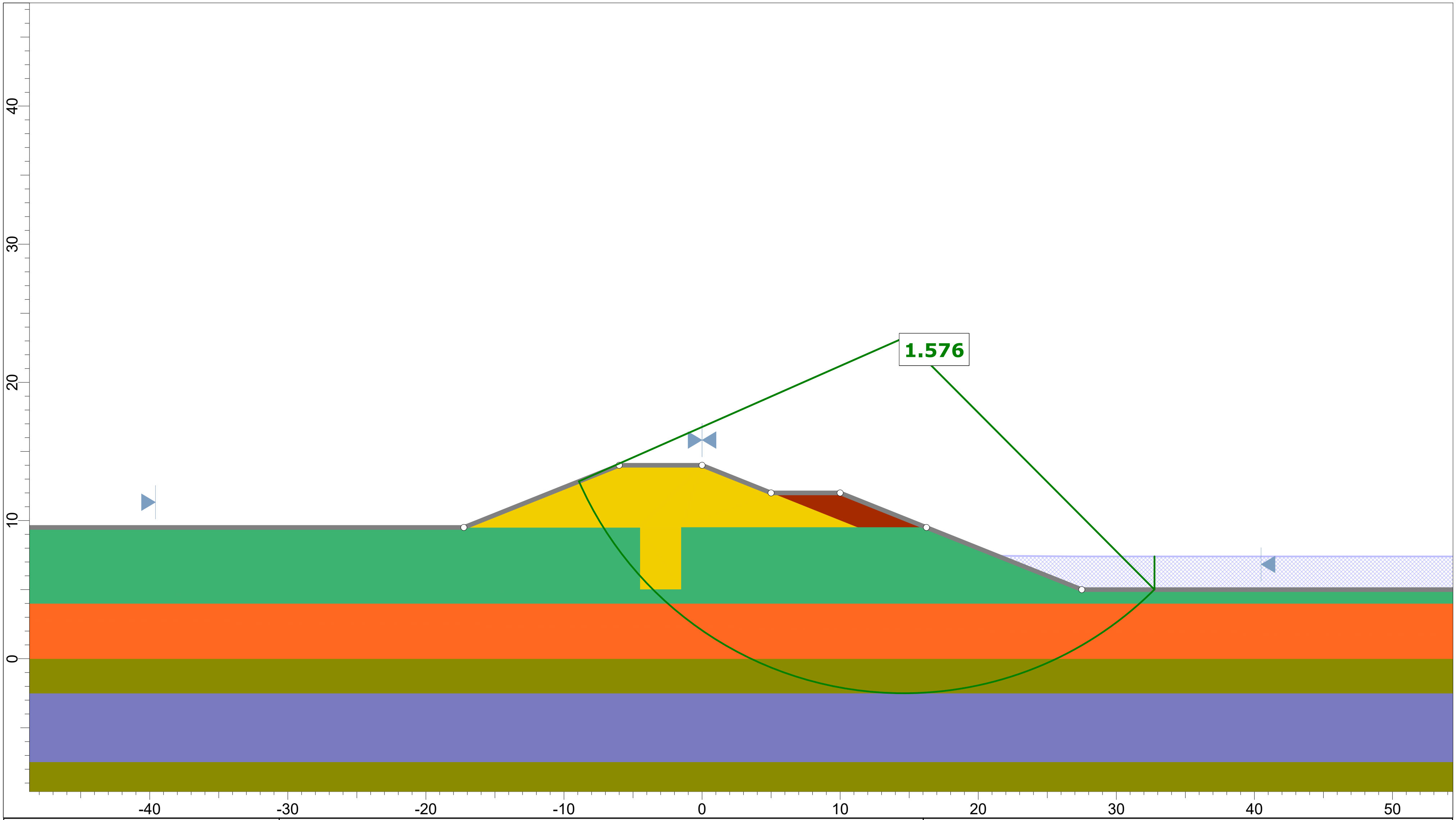
10/18/2023	BY: KDS	APPENDIX: **C-6**
PROJECT NO. 190092	REVIEWED BY: AJH	



Average Tidal Conditions Residual

Seepage and Slope Stability Analysis

Geotechnical Basis of Design Memo
Norwegian Point Park Levee
Hansville, Washington

SLIDEINTERPRET 9.024

SCALE: 1:120

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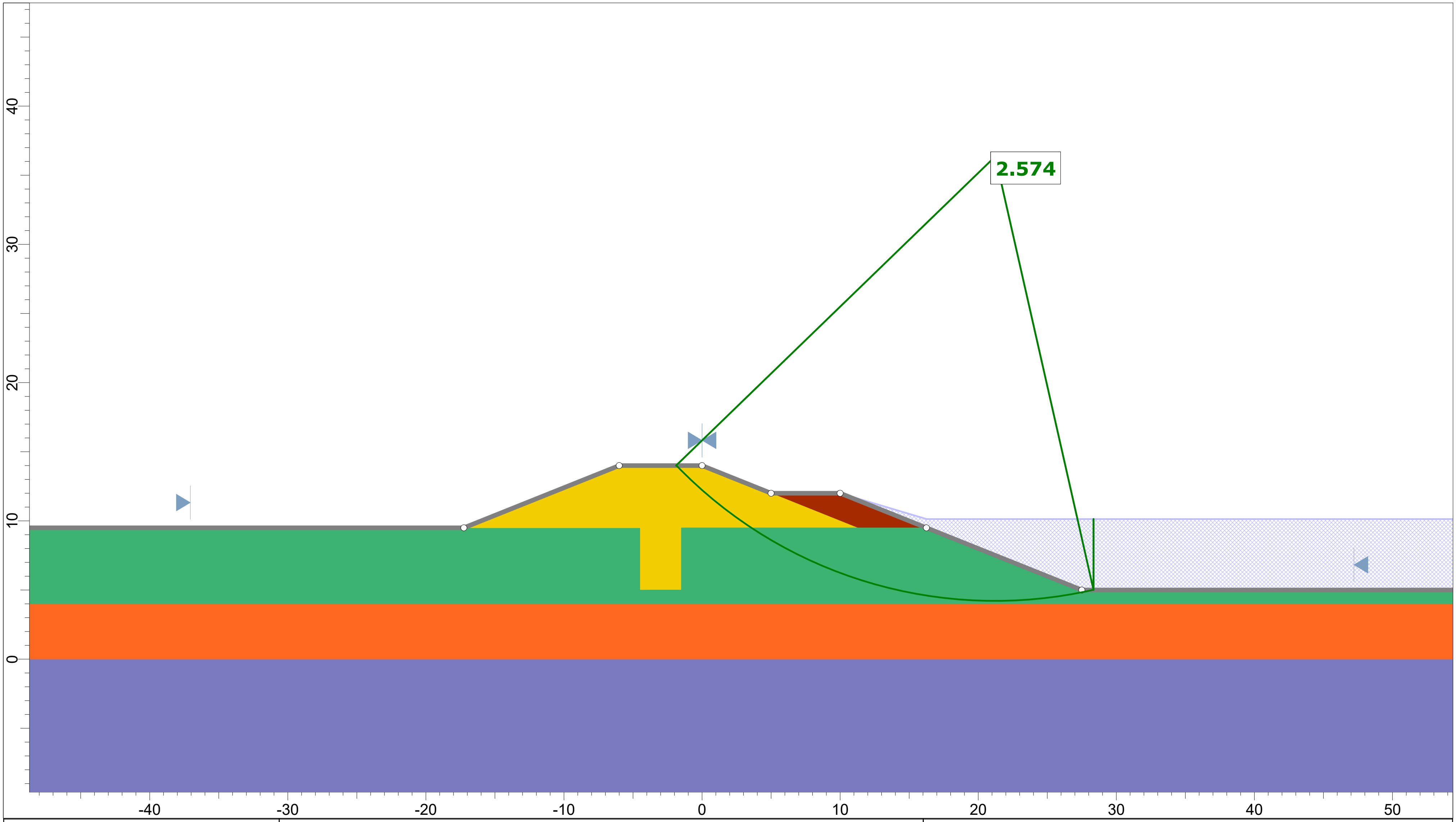
REVIEWED BY: AJH

APPENDIX: **C-7**



100-yr Flood
Static

Seepage and Slope Stability Analysis

Geotechnical Basis of Design Memo
Norwegian Point Park Levee
Hansville, Washington

SLIDEINTERPRET 9.024

SCALE: 1:120

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190092

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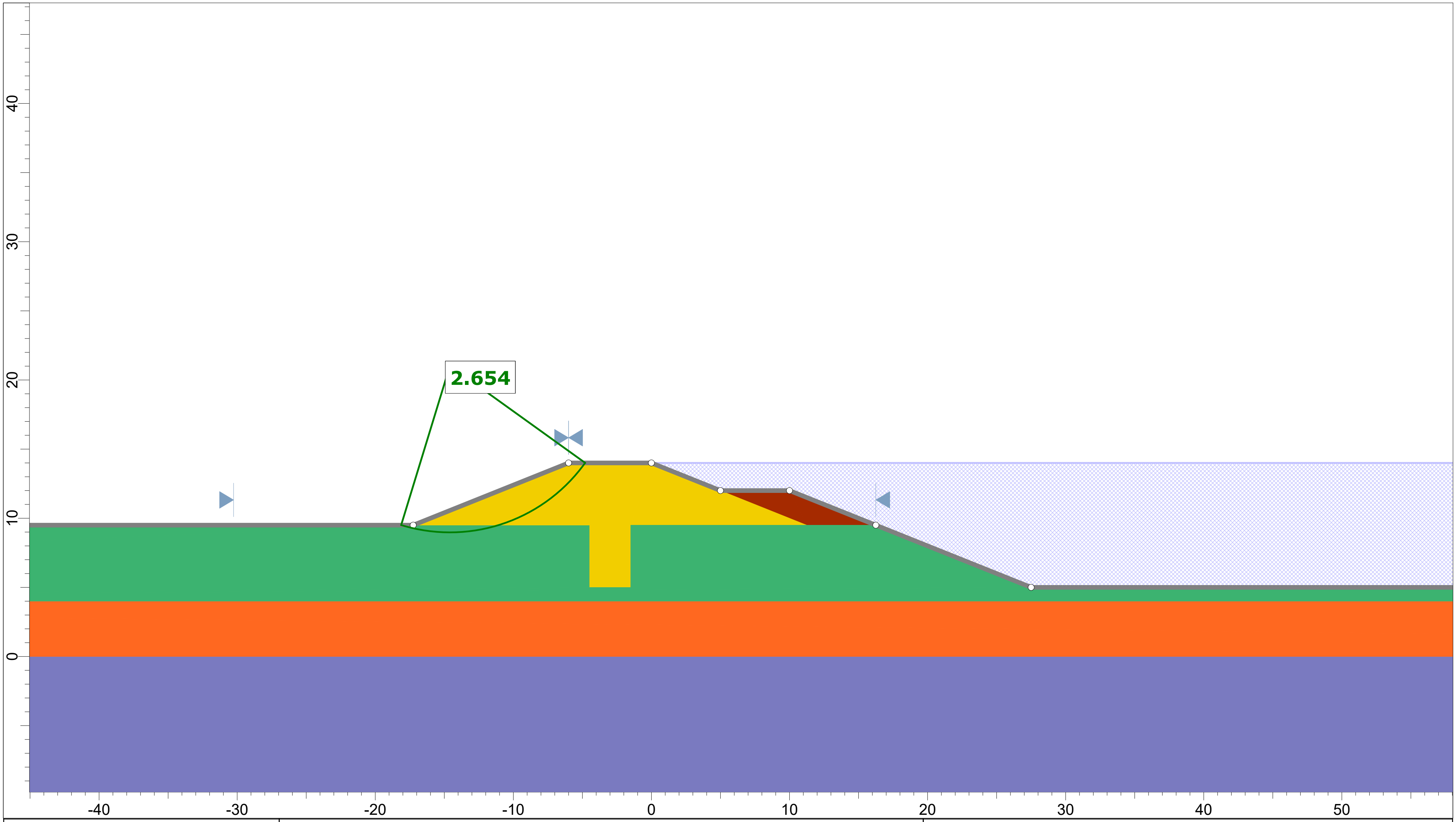
APPENDIX:
C-8



Full Levee
Static

Seepage and SLope Stability Analysis

Geotechnical Basis of Design Memo
Norwegian Point Park Levee
Hansville, Washington

SLIDEINTERPRET 9.024

SCALE: 1:120

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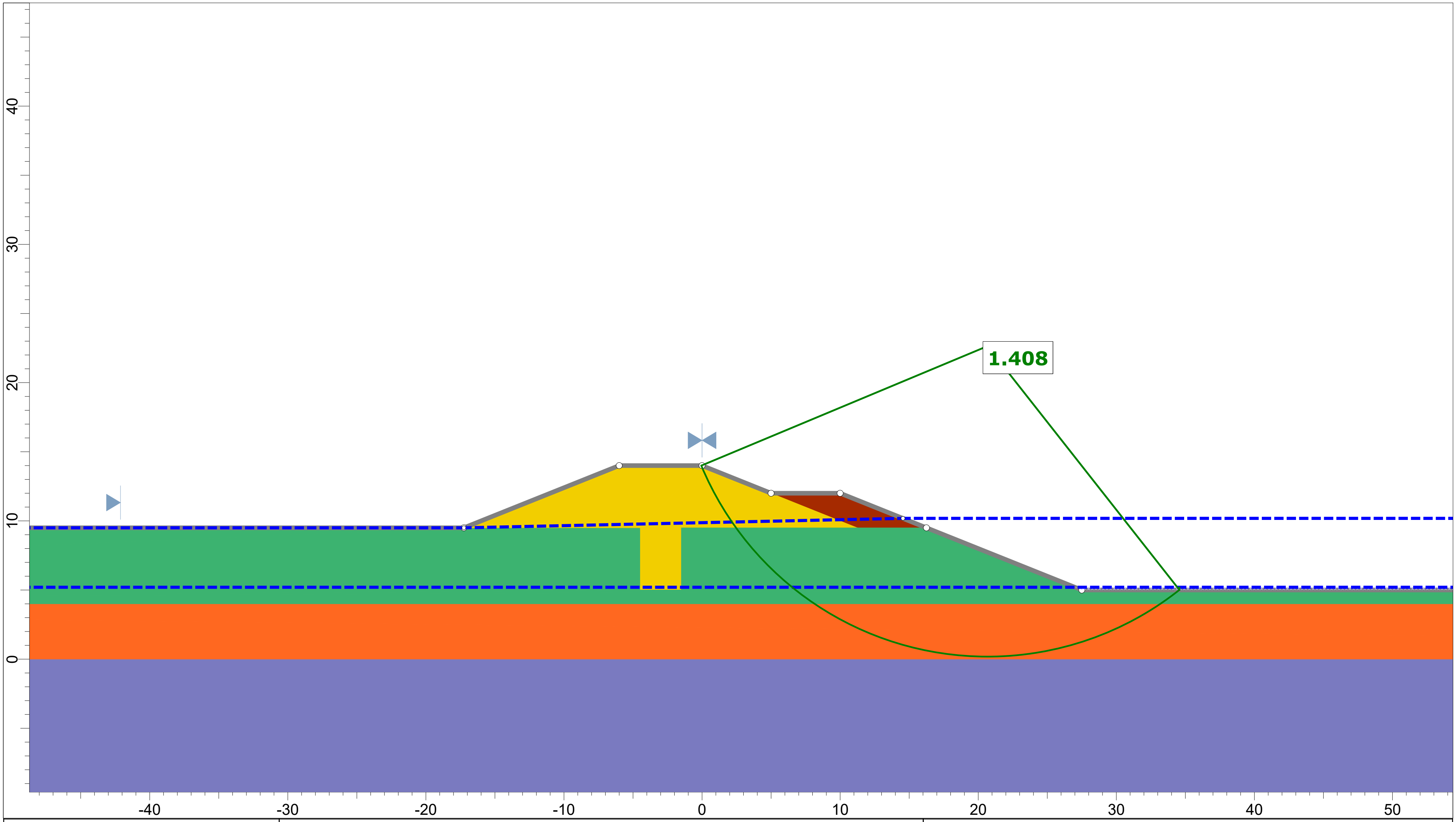
PROJECT NO.
190092

BY:
KDS

REVIEWED BY:
AJH

APPENDIX:
C-9



Rapid Drawdown
Static

Seepage and Slope Stability Analysis

Geotechnical Basis of Design Memo
Norwegian Point Park Levee
Hansville, Washington

SLIDEINTERPRET 9.024

SCALE: 1:120

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10/18/2023

PROJECT NO.
190092

BY:
KDS

REVIEWED BY:
AJH

APPENDIX:
C-10

APPENDIX D

Report Limitations and Guidelines for Use

REPORT LIMITATIONS AND GUIDELINES FOR USE

Geoscience is Not Exact

The geoscience practices (geotechnical engineering, geology, and environmental science) are far less exact than other engineering and natural science disciplines. It is important to recognize this limitation in evaluating the content of the report. If you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or property, you should contact Aspect Consulting (Aspect).

This Report and Project-Specific Factors

Aspect's services are designed to meet the specific needs of our clients. Aspect has performed the services in general accordance with our agreement (the Agreement) with the Client (defined under the Limitations section of this project's work product). This report has been prepared for the exclusive use of the Client. This report should not be applied for any purpose or project except the purpose described in the Agreement.

Aspect considered many unique, project-specific factors when establishing the Scope of Work for this project and report. You should not rely on this report if it was:

- Not prepared for you;
- Not prepared for the specific purpose identified in the Agreement;
- Not prepared for the specific subject property assessed; or
- Completed before important changes occurred concerning the subject property, project, or governmental regulatory actions.

If changes are made to the project or subject property after the date of this report, Aspect should be retained to assess the impact of the changes with respect to the conclusions contained in the report.

Reliance Conditions for Third Parties

This report was prepared for the exclusive use of the Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against liability claims by third parties with whom there would otherwise be no contractual limitations. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with our Agreement with the Client and recognized geoscience practices in the same locality and involving similar conditions at the time this report was prepared

Property Conditions Change Over Time

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by events such as a change in property use or occupancy, or by natural events, such as floods, earthquakes, slope instability, or groundwater fluctuations. If any of the described events may have occurred following the issuance of the report, you should contact Aspect so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Geotechnical, Geologic, and Environmental Reports Are Not Interchangeable

The equipment, techniques, and personnel used to perform a geotechnical or geologic study differ significantly from those used to perform an environmental study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually address any environmental findings, conclusions, or recommendations (e.g., about the likelihood of encountering underground storage tanks or regulated contaminants). Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding the subject property.

We appreciate the opportunity to perform these services. If you have any questions, please contact the Aspect Project Manager for this project.

Attachment B

Wave Runup Analysis Technical Memorandum

MEMORANDUM

Date: November 29, 2023
To: Project File, 2303_2101
From: Greg Curtiss, PE, Blue Coast Engineering
Project: Norwegian Point Park Estuary Restoration Project
Subject: Wave Run-up Update

INTRODUCTION

The purpose of this technical memorandum is to estimate the wave run-up and overtopping to inform design of the levee, a component of the Norwegian Point Park Estuary Restoration Project. Previously, Blue Coast initially completed a 1-D wind-wave hindcast for the site and a wave run-up analysis for the existing condition (nearshore beach slope) which is documented in the 60% Basis of Design (BOD) report (Blue Coast 2022). The wave run-up analysis has been updated to provide a more detailed analysis of wave run-up and overtopping conditions on the proposed levee embankment cross-section being designed by Aspect Consulting (Aspect). Recommendations for levee crest elevation and armoring are provided as a result of the analysis.

BACKGROUND AND DESIGN CRITERIA

A levee embankment will be constructed around the perimeter of the proposed estuary restoration area to prevent localized tidal flooding from the estuary onto the neighboring properties. The levee design will use compacted levee select fill and the side slopes may be lightly vegetated with grasses and occasional woody vegetation with stems less than 4” in diameter at maturity (Aspect 2019). The side slopes of the levee shall be 2.5H:1V or flatter. Based on Aspect’s evaluation (Aspect 2022), the levee can be constructed with soils excavated from within the proposed estuary area.

Design guidance used for coastal and hydraulic aspects of the levee design include the following:

- Design and Construction of Levees (USACE 2000);
- Hydrologic Analysis of Interior Areas (USACE 2018);
- EurOtop Manual on wave overtopping of sea defences and related structures (EurOtop 2018).

The hydraulic design criteria for the levee are provided below for coastal flooding and freshwater flooding at the site.

- The coastal levee is not designed to protect public or private property adjacent to the project site from coastal flooding (i.e., tides, storm surge and wave runup). The FEMA 100-year floodplain for the project area and vicinity (FEMA FIRM #53035C0050F) shows coastal flooding will occur over the entire project area and adjacent properties with and without the project (see FEMA flood hazard map layer, Figure 1). Coastal flooding and the FEMA designated extent of the coastal floodplain will not be impacted by the project.

- The levee and estuary were designed to prevent localized freshwater flooding from the estuary on to neighboring properties.
    - Water levels in the proposed estuary project will be dominated by the tidal water levels. The 100-year return period freshwater flow rate in the estuary (Finn Creek) does not affect the design levee height because coastal flooding dominates freshwater flood elevations (Blue Coast 2022).
- Based on a review of existing information and hydrodynamic modeling results, the levee elevation crown should be designed to 14 feet NAVD88.
    - The crest elevation provides 3 feet minimum freeboard from coastal overtopping during the highest astronomical tide conditions (10.1 feet NAVD88).
    - The crest elevation provides 2 feet of minimum freeboard above the design coastal flood elevation (11.8 feet NAVD88) (USACE 2005)
- The levee is designed for survivability against wave run-up and overtopping for a 50-year return interval wave event combined with a design coastal flood elevation (11.8 feet NAVD88).
    - The allowable overtopping rate before concerns of breaching is 0.1 cfs/feet (10 l/s/meter) for grass covered earthen levees (USACE 2018; EurOtop 2018). This is the design overtopping threshold used for this project.

The design of the levee is also limited by space constraints of the site which include the road and parking along the western and southern perimeter, the park on the northwestern perimeter, and private properties along the eastern perimeter.

WAVES AND WATER LEVELS

Table 1 summarizes tidal datums and potential extreme water level conditions which were previously documented in the BOD report (Blue Coast 2022). In addition, SLR in the year 2080 (approximately 50 years in the future) is expected to raise Puget Sound water levels by 1.7 ft higher than current conditions for the high emissions scenario (RCP 8.5) at Norwegian Point (Miller et al. 2018). The FEMA 1% annual chance is also included in the table which is a total water level and already includes wave run-up.

Table 1. Tidal Datums and Extreme Water Levels with SLR

Tidal Datum	Existing Conditions – Tidal Elevation (ft, NAVD88)	2080 High SLR1 – Elevation (ft, NAVD88)[1]
FEMA BFE (1% annual chance TWL)	13.0	14.7
FEMA 1% annual chance SWL[2]	12.3	14.0
December 2022 – Observed	11.8	13.5
Highest Astronomical Tide (HAT)	10.1	11.8
Mean Higher High Water (MHHW)	8.7	10.4
Mean Sea Level (MSL)	4.3	6.0
Mean Lower Low Water (MLLW)	-1.8	-0.1

NAVD88 – North American Vertical Datum of 1988
FEMA – Federal Emergency Management Agency
Notes:
1. High SLR assumes the 50% percentile SLR increase (1.7 feet), added to the current elevation, for the RCP 8.5 scenario (Miller et al. 2018).
2. Table 17 from Kitsap County FIS provided in an email to Kyle List (Blue Coast) by FEMA Region 10 RSC Lead on October 9, 2023.

Design wave parameters, significant wave height (H_s) and peak wave period (T_p), are provided in Table 2. The wave parameters were estimated using a 1-D wind-wave hindcast, following the United States Army Corps of Engineers (USACE) methodology (Leenknecht et al. 1992). Wind-waves from the north (the direction of the longest fetch) were determined to be the largest waves at the site based on the analysis documented in the preliminary design report. These values are revised from the preliminary design report and assume the following:

- Northerly fetch of 13.8 miles at 330°
- 3-hour storm duration.
- A deep water restricted fetch (which accounts for the geometry of the basin). Radial fetch lengths between 300° and 10° (in clockwise direction) were used in 10° increments.
- Anemometer height above sea level: 32 feet (height of Point No Point anemometer) and 56 feet (height of Whidbey NAS anemometer). The hindcast corrects for the difference in measurement heights.

Table 2. Design wind speeds at the Whidbey NAS and Point No Point meteorological stations for northerly wind directions and associated wind-wave hindcast estimates for Point No Point.

Return Period (years)	Northerly wind directions (300° to 40°)		
	Wind Speed (mph)	Significant wave height (ft)	Peak wave period (seconds)
Typical[1]	10	0.5	1.6
1	34	3.1	3.6
50	50	5.0	4.5
100	51	5.1	4.5

Notes:
N/A: not applicable;
1: Prevailing wind speed from the northerly sector which occurs approximately 15% of the time based on analysis of the Point No Point meteorological station data record (Blue Coast 2023b)

WAVE RUN-UP AND TOTAL WATER LEVEL SCENARIOS

This section provides a summary of the wave run-up analysis completed for three points (Sections A, B, and C) where wave energy is a potential concern along the levee alignment (Figure 2). Recommendations for levee armoring are provided as a result of the analysis.

Section A:

- Description: Slope at the termination of levee alignment, facing the beach (Figure 3).
- Summary of run-up and overtopping:
    - Wave run-up and overtopping on the levee are minimal for the design still water level plus typical wind-wave case (Scenario 1).
    - Wave run-up and overtopping on the levee are severe and require mitigation for the design still water level plus extreme wind-wave cases (Scenarios 2 and 3).
    - A gentler design slope (similar to the existing beach slope) would reduce the wave run-up and overtopping on the levee such that it is below the design overtopping threshold for all of the wind-wave cases (Scenario 4-6).
- Design recommendations:
    - Terminate the levee landward of the termination shown in the 60% design to move it landward of expected impacts from wave run-up. The toe of the levee slope should be at 12 feet NAVD88 on the landward side of the beach berm. This applies to the north and south ends of the levee.

Table 3. Wave run-up and overtopping for levee embankment, Section A.

Scenario and Description	Stillwater level, tide and storm surge (feet NAVD88)	Wave Condition	Wind-wave run-up $R_{2\%}$ (feet)	Total water level (feet NAVD88)	Overtopping discharge q (l/s/m)
(1) 2.5:1 slope embankment	11.8 (observed, 12/27/2022)	H_s = 0.5 feet, T_p = 1.6 seconds Typical condition	1.3	13.1	<0.1
(2) 2.5:1 slope embankment	11.8 (observed, 12/27/2022)	H_s = 3.1 feet, T_p = 3.6 seconds 1-year	7.2	19.0	37
(3) 2.5:1 slope embankment	11.8 (observed, 12/27/2022)	H_s = 5.0 feet, T_p = 4.5 seconds 50-year	13.1	24.9	187
(4) 8.9:1 beach slope	11.8 (observed, 12/27/2022)	H_s = 0.5 feet, T_p = 1.6 seconds Typical condition	0.4	12.2	<0.1
(5) 8.9:1 beach slope	11.8 (observed, 12/27/2022)	H_s = 3.1 feet, T_p = 3.6 seconds 1-year	2.0	13.8	<0.1
(6) 8.9:1 beach slope	11.8 (observed, 12/27/2022)	H_s = 5.0 feet, T_p = 4.5 seconds 50-year	3.2	15.0	2.6

Notes: N/A: not applicable;

Section B:

- Description: Slope on the south side of the channel entrance (Figure 4). Wide bench at 12 feet NAVD88 between channel and levee slope.
- Summary of run-up and overtopping:
  - Wave run-up and overtopping on the levee are non-existent for the design still water level due to waves breaking on the bench (Scenarios 1-3).
  - Wave overtopping is minimal (less than the design threshold) for the typical wave condition with SLR scenario (Scenario 4). Although waves are depth-limited across the bench for the 1-year and 50-year scenario with SLR (Scenarios 5 and 6), wave run-up and overtopping are significant (greater than the design threshold).
- Design recommendations:
  - No action along the north and south side of the levee where the bench at 12 feet NAVD88 is located.

- Sea level rise may require adaptive management along this portion of the levee alignment and may include armoring of the levee slope or raising of the levee crest elevation.

Table 4. Wave run-up and overtopping for levee embankment, Section B.

Scenario & Description	Stillwater level, tide and storm surge(feet NAVD88)	Wave Condition	Wind-wave run-up $R_{2\%}$ (feet)	Total water level (feet NAVD88)	Overtopping discharge q (l/s/m)
(1) 2.5:1 slope embankment	11.8 (observed, 12/27/2022)	H_s = 0.5 feet, T_p = 1.6 seconds Typical condition	No runup on levee embankment	N/A	0
(2) 2.5:1 slope embankment	11.8 (observed, 12/27/2022)	H_s = 3.1 feet, T_p = 3.6 seconds 1-year	No runup on levee embankment	N/A	0
(3) 2.5:1 slope embankment	11.8 (observed, 12/27/2022)	H_s = 5.0 feet, T_p = 4.5 seconds 50-year	No runup on levee embankment	N/A	0
(4) 2.5:1 slope embankment	13.5 (observed + 2080 SLR)	H_s = 0.5 feet, T_p = 1.6 seconds Typical condition	1.3	14.8	2
(5) 2.5:1 slope embankment	13.5 (observed + 2080 SLR)	H_s = 1.2 feet[1], T_p = 3.6 seconds 1-year	3.8	17.3	42.3
(6) 2.5:1 slope embankment	13.5 (observed + 2080 SLR)	H_s = 1.2 feet[1], T_p = 4.5 seconds 50-year	3.9	17.4	42.3

Notes: N/A: not applicable;
1: Assumes depth-limited wave height (0.78*water depth)

Section C:

- Levee along western slope of channel at pinch point turn and facing northeast towards the channel entrance (Figure 5).
- Calculation assumptions:
  - The location of the levee slope is more than 250 feet inland of the channel entrance and where the 1-D wind-wave hindcast is estimated. No adjustment has been made for the wind-wave parameters for refraction or diffraction within the channel entrance or surface roughness within the channel. To avoid being overly conservative, a wave angle correction factor (45°) is applied to the run-up and overtopping calculation. In

addition, the average depth across the channel was calculated and used to estimate the depth-limited wave height at the toe of the levee slope. The average depth at the design still water elevation is 3.3 feet.

- Summary of run-up and overtopping:
    - Wave run-up and overtopping on the levee are minimal for the design still water level and typical wind-wave case (Scenario 1).
    - Wave run-up and overtopping on the levee are severe and require mitigation for the design still water level and extreme wind wave case (Scenario 3).
    - Armoring the slope with rock (2-layers) reduces the overtopping in all cases (Scenarios 4-6) to below the design overtopping threshold (<10 l/s/m) and wave run-up is reduced to below the 14 foot crest elevation.
- Potential design recommendations:
    - Armor the levee slope with 2 layers of appropriately size armor rock and filter layer to protect the levee slope.

Table 5. Wave run-up and overtopping for levee embankment, Section C.

Scenario & Description	Stillwater level, tide and storm surge(feet NAVD88)	Wave Condition	Wind-wave run-up $R_{2\%}$ (feet)	Total water level (feet NAVD88)	Overtopping discharge q (l/s/m)
(1) 2.5:1 slope embankment	11.8 (observed, 12/27/2022)	H_s = 0.5 feet, T_p = 1.6 seconds Typical condition	0.5	12.3	<0.1
(2) 2.5:1 slope embankment	11.8 (observed, 12/27/2022)	H_s = 2.6 feet[1], T_p = 3.6 seconds 1-year	2.5	14.3	5
(3) 2.5:1 slope embankment	11.8 (observed, 12/27/2022)	H_s = 2.6 feet[1], T_p = 4.5 seconds 50-year	3.2	15.0	14.2
(4) 2.5:1 slope, 2-layer rock armor	11.8 (observed, 12/27/2022)	H_s = 0.5 feet, T_p = 1.6 seconds Typical condition	0.3	12.1	<0.1
(5) 2.5:1 slope, 2-layer rock armor	11.8 (observed, 12/27/2022)	H_s = 2.6 feet[1], T_p = 3.6 seconds 1-year	1.7	13.2	0.1
(6) 2.5:1 slope, 2-layer rock armor	11.8 (observed, 12/27/2022)	H_s = 2.6 feet[1], T_p = 4.5 seconds	1.5	13.5	0.9

Notes: N/A: not applicable;
1: Assumes depth-limited wave height (0.78*water depth)

ARMOR ROCK STABILITY

An assessment of rock armor stability was completed to calculate the stable rock size under the design wind-wave conditions that would be required for rock armoring of the levee at Section C. The assessment was completed using the formula for 2-layer riprap armor stability on a rubble mound revetment for irregular waves used by the United States Army Corps of Engineers (USACE) ACES software (Leenknecht et al. 1992). Assumptions used in the calculation include the following and are included on calculation sheets as Attachment A:

- Permeability coefficient (P): 0.1 (impermeable core)
- Damage level (S): 2 (initial damage[1])

---

[1] Defined as start of damage under the design event but no failure of the structure

- Structure slope (*cotϑ*): 2.5:1 (horizontal : vertical)

The waves at the toe of the levee were assumed to be depth-limited after passing through the channel entrance. An average elevation of the proposed channel cross-section at the entrance was calculated to be 8.5 feet NAVD88. At the design water surface elevation of 11.8 feet, the average depth is 3.3 feet which results in a depth-limited wave height of 2.6 feet (0.78 * water depth).

The resulting stable median diameter (D_{50}) rock size is 1.0 feet (median weight = 175 lb) with an armor layer thickness of 2.0 feet (Table 6). The recommended filter layer is 0.5 feet thick with a median rock diameter of 1.5" (0.13 feet). No geotextile fabric layer is recommended based on the coastal engineering design criteria for the slope protection, however, it is recommended that an evaluation be completed to assess the need for a geotextile based on geotechnical criteria. The WSDOT specification for Class A Rock for Erosion and Scour Protection, 9-13.4(2) appear to meet the gradation requirements for rock stability for the design wave scenario. The backside (landward side) of the levee slope should be lined with quarry spalls to prevent against erosion from overtopping waves.

Table 2. Summary of armor rock calculations (wave stability).

Wave Parameters			Armor Layer					Filter Layer	
Design Wave	H_s feet	T_p seconds	Median Stone Diameter, D_{50} feet	W_{15} lb	Median Stone Weight, W_{50} lb	W_{85} lb	2-Layer Thickness feet	Median Stone Diameter D_{50} feet	Layer Thickness feet
50-year, depth limited wave height	2.6	4.5	1.0 ft (12")	75	175	350	2.0 ft	0.13	0.5 – quarry spalls

CLOSURE

This document has been prepared by Blue Coast Engineering LLC in accordance with generally accepted scientific practices and is intended for the exclusive use and benefit of Wild Fish Conservancy and their authorized representatives for specific application to the Norwegian Point Park Estuary Restoration Project in Hansville, Washington. The contents of this document are not to be relied upon or used, in whole or in part, by or for the benefit of others without specific written authorization from Blue Coast Engineering LLC. No other warranty, expressed or implied, is made. Blue Coast Engineering LLC. and its officers, directors, employees, and agents assume no responsibility for the reliance upon this document or any of its contents by any parties other than Wild Fish Conservancy.

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Leenknecht, D.A., Szuwalski, A. and Sherlock, A.R. 1992. "Automated Coastal Engineering System (ACES): Technical Reference," U.S. Army Corps of Engineers, Coastal Engineering Research Center, Waterways Experiment Station, CPD-66, Vicksburg, MS. Volume II.

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USACE. 2018. Hydrologic Analysis of Interior Areas. USACE, Engineering Manual. EM 1110-2-1413, dated August 24, 2018.

FIGURES

Figure 1. FEMA flood hazard map layer for the Norwegian Point Park vicinity.

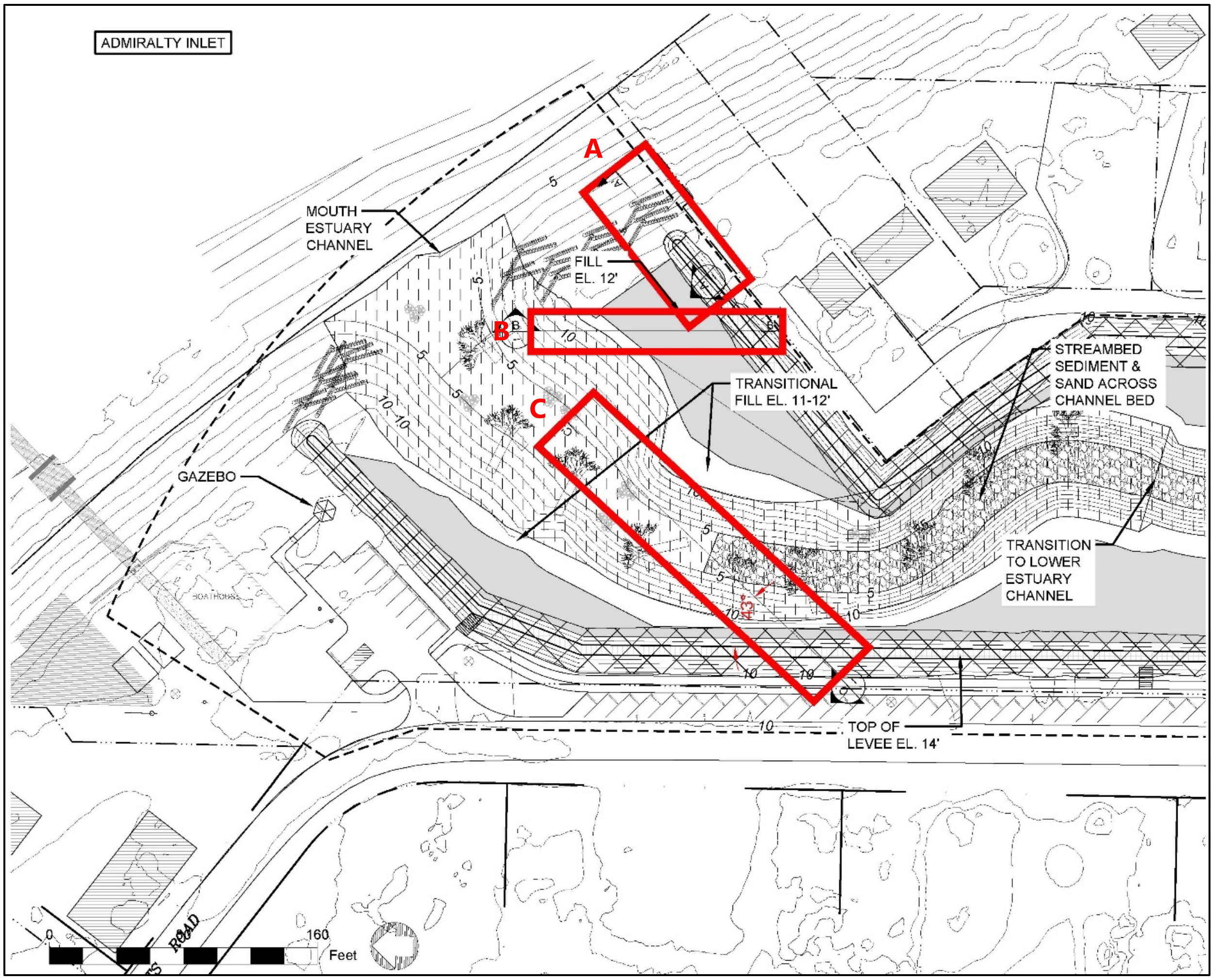


Figure 2. Site map overview of areas of wave run-up and overtopping analysis

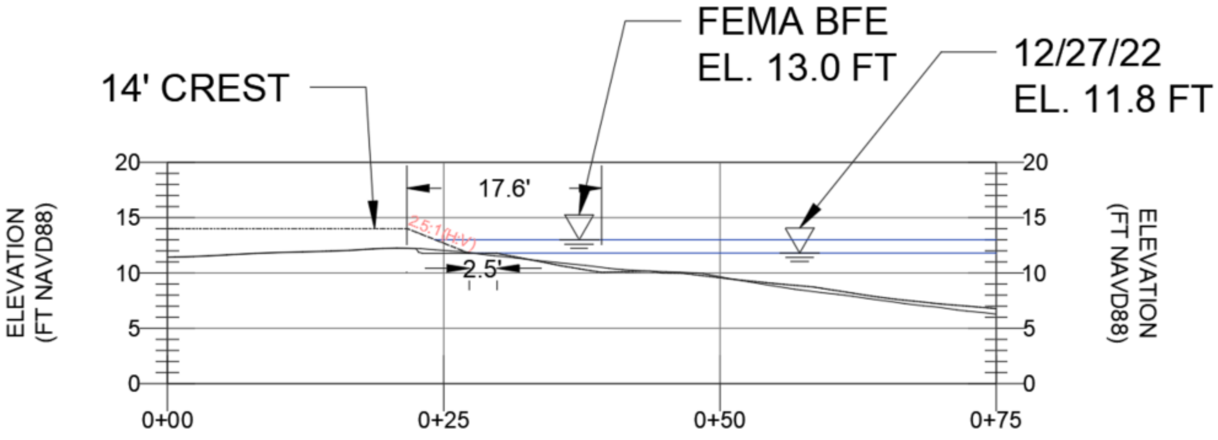


Figure 3. Section A (termination of levee).

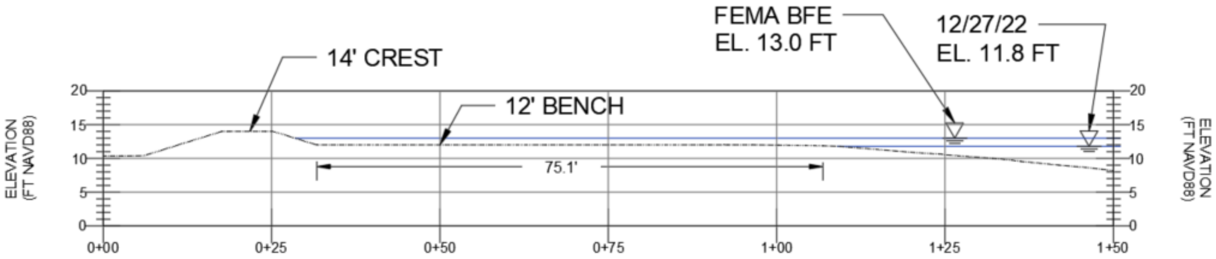


Figure 4. Section B (inside of levee channel entrance).

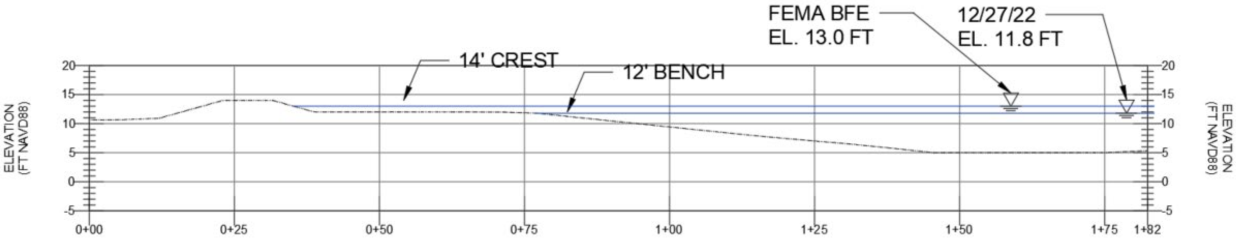


Figure 5. Section C (western slope of channel at pinch point turn).

Calculation Sheet
Designer: GC Date: 10-30-23
Calc #: ________
Sheet 1 of 2
Rev #: 0

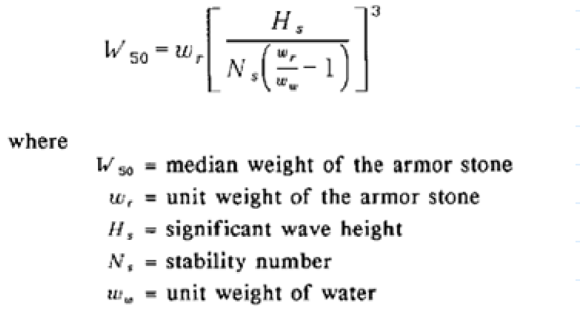
Project: 2303-2101 Finn Creek Final Design
Checked by: ________________
Checked date: _____
Subject: Armor Rock Sizing

Riprap armor stability formula for irregular wave conditions from USACE ACES software

Reference:

Leenknecht, D.A., Szuwalski, A. and Sherlock, A.R. 1992. "Automated Coastal Engineering System (ACES): Technical Reference," U.S. Army Corps of Engineers, Coastal Engineering Research Center, Waterways Experiment Station, CPD-66, Vicksburg, MS. Volume II.

where:
W_{50} = median weight of armor stone
w_r = unit weight of armor stone
H_s = significant wave height
T_s =significant wave period
N_s = stability number
w_w =unit weight of water
S =damage level
P=permeability coefficient
$cot\theta$ =structure slope
ζ =surf similarity parameter
N= number of wave events



$$W_{50} = w_r\left[\frac{H_s}{N_s\left(\frac{w_r}{w_w}-1\right)}\right]^3$$

where

W_{50} = median weight of the armor stone
w_r = unit weight of the armor stone
H_s = significant wave height
N_s = stability number
w_w = unit weight of water

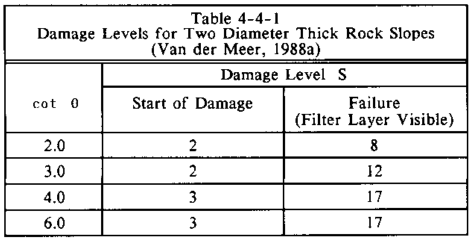


Table 4-4-1
Damage Levels for Two Diameter Thick Rock Slopes
(Van der Meer, 1988a)

cot θ	Damage Level S	
	Start of Damage	Failure (Filter Layer Visible)
2.0	2	8
3.0	2	12
4.0	3	17
6.0	3	17

INPUTS:

$H_s := 2.583\ ft$ $H_s = 0.79\ m$

$T_s := 4.5$ $P := .1$ $S := 2$ $cot\theta := 2.5$

$$T_z := T_s \cdot \left(\frac{.67}{.80}\right) = 3.769$$

$w_w := 1024\ \frac{kg}{m^3}$ $w_w = 63.9\ \frac{lb}{ft^3}$

$$\zeta := \frac{\left(\frac{1}{cot\theta}\right)}{\left(\frac{(2\cdot\pi\cdot H_s)}{g\cdot T_z^{\,2}}\right)^{0.5}} = 2.123\ \frac{1}{s}$$

$w_r := 2643\ \frac{kg}{m^3}$ $w_r = 165\ \frac{lb}{ft^3}$

$N := 1135$

$$\zeta := \frac{\zeta}{\text{UnitsOf}(\zeta)} = 2.123$$

$g = 9.807\ \frac{m}{s^2}$

CERC stability number

$$N_{szero} := \frac{1.45}{1.27}\cdot(cot\theta)^{\frac{1}{6}} = 1.33$$

Dutch stability number

$$N_{s\_surging} := 1.0\cdot P^{-0.13}\cdot\left(\frac{S}{\sqrt{N}}\right)^{0.2}\cdot\zeta^{P}\cdot\left(cot\theta^{0.5}\right) = 1.307$$

$$N_{s\_plunging} := 6.2\cdot P^{0.18}\cdot\left(\frac{S}{\sqrt{N}}\right)^{0.2}\cdot(\zeta)^{-0.5} = 1.598$$

$$\zeta_{ztp} := \left(6.2\cdot P^{0.31}\cdot\sqrt{\frac{1}{cot\theta}}\right)^{\left(\frac{1}{P+0.5}\right)} = 2.967$$

if $\zeta_{ztp} > \zeta_s$, use $N_{s\_plunging}$,
otherwise use $N_{s\_surging}$

UPDATE BASED ON LOGIC AT LEFT:
$N_s := 1.598$

Calculation Sheet
Designer: GC Date: 10-30-23
Calc #: ________
Sheet 2 of 2
Rev #: 0

Project: 2303-2101 Finn Creek Final Design
Checked by: _______________
Checked date: _____
Subject: Armor Rock Sizing

OUTPUT (ARMOR LAYER):

$$W_{50} := w_r \cdot \left(\frac{H_s}{N_s \cdot \left(\frac{w_r}{w_w} - 1 \right)} \right)^3 = 80\ kg \qquad W_{50} = 176\ lb$$

$$W_{85} := 1.96 \cdot W_{50} = 157\ kg \qquad W_{85} = 346\ lb$$

$$W_{15} := 0.4 \cdot W_{50} = 32\ kg \qquad W_{15} = 71\ lb$$

$$D_{n50} := \left(\frac{W_{50}}{w_r} \right)^{\frac{1}{3}} = 0.312\ m \qquad D_{n50} = 1.02\ ft$$

$$D_{15} := \left(\frac{W_{15}}{w_r} \right)^{\frac{1}{3}} = 0.23\ m \qquad D_{15} = 0.75\ ft$$

$$D_{50} := \frac{D_{n50}}{0.84} = 0.371\ m \qquad D_{50} = 1.22\ ft$$

square opening sieve size

$$t_{armor} := 2 \cdot \left(\frac{W_{50}}{w_r} \right)^{\frac{1}{3}} = 0.62\ m \qquad t_{armor} = 2.04\ ft$$

OUTPUT (FILTER LAYER):

$$t_{filter} := \frac{t_{armor}}{4} = 0.16\ m \qquad t_{filter} = 0.51\ ft$$

$$D_{85fil} := \frac{D_{15}}{4} = 0.06\ m \qquad D_{85fil} = 0.19\ ft$$

$$D_{50fil} := \frac{D_{85fil}}{e^{(0.01157 \cdot 85 - 0.5785)}} = 0.04\ m \qquad D_{50fil} = 0.13\ ft$$

Attachment C

Stormwater Design Report

Stormwater Management Report

FINN CREEK RESTORATION

Hansville, WA 98340

January 29, 2024

Prepared by:
Pacific Surveying and Engineering Services, Inc.
909 Squalicum Way, Suite 111
Bellingham, Washington 98226
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www.psesurvey.com

Prepared for:
Blue Coast Engineering
1504 24th Street
Bellingham, Washington 98225

1 TABLE OF CONTENTS

2 CERTIFICATION

ENGINEER'S DECLARATION

I, David P. Galbraith, a Professional Engineer registered in the State of Washington as a Civil Engineer, do hereby declare that the Storm Water Design Report titled “Storm Water Management Report – Finn Creek Restoration”, dated January 29, 2024, was prepared by me, or under my personal supervision, and that said Report was prepared in accordance with generally accepted engineering practices.

Respectfully,

44679

01-29-2024

David P. Galbraith, P.E.

Registration No. 44679

Pacific Surveying & Engineering

3 INTRODUCTION

3.1 PURPOSE AND OBJECTIVES

This stormwater management report has been prepared on behalf of Blue Coast Engineering for the Finn Creek Restoration Project. The proposed project will be constructed on an approximate 7-acre parcel of land and within Kitsap County road right of ways in Hansville, Washington. The project site is at Norwegian Point Park, which abuts the east side of Hansville Road NE and extends north approximately 900 LF from NE Point No Point Road to NE Twin Spits Road.

The proposed project includes restoration of the natural habitat on the site, constructing an approximate 2,165 LF berm, and impervious parking areas. As a result of the restoration improvements and levee construction, a private driveway at the east end of NE Point No Point Road will be relocated to maintain access to the four neighboring properties northeast of the project site.

The purpose of this report is to evaluate the effects upon the surrounding environment due to subsequent changes to the existing storm water runoff patterns, detail the methods and assumptions used for this evaluation, and present mitigation design recommendations. Proposed mitigation measures include implementation of best management practices (BMP's) designed to assure that post-development storm water quality is not degraded, and that runoff discharge flowrate limits are not exceeded.

This report functions as a combined ‘Storm Water Management Plan’ and ‘Storm Water Pollution Prevention Plan’ (SWPPP). The Storm Water Management Plan summarizes how the project will comply with the minimum requirements outlined in the Kitsap County Code (KCC) and applicable sections of the 2021 Kitsap County Stormwater Design Manual (KCSDM) and Washington State Department of Ecology “Stormwater Management Manual for Western Washington”, July 2019 publication (hereinafter referred to as the DOE Manual). A SWPPP has been developed within this report to detail temporary erosion control and stormwater pollution prevention requirements during construction.

3.2 PROJECT BACKGROUND

General information for this project is as follows:

PROJECT NAME:	Finn Creek Restoration
LOCATION:	Norwegian Point Park 39118 Hansville Rd NE Hansville, WA 98340
PROJECT SUMMARY:	The project proposes construction of a levee, gravel parking and driveway improvements.
CLIENT & CONTACT:	Jennifer Allen Blue Coast Engineering 1504 24th St Bellingham, WA 98225 Ph: (425) 218-4503
ENGINEER & CONTACT:	David Galbraith, P.E. Pacific Surveying & Engineering 909 Squalicum Way, Suite 111 Bellingham, WA. 98225 Ph: (360) 671-7387

3.3 METHOD OF APPROACH

The analyses utilized to create this report are based on computer aided modeling of rainfall runoff. Specifically, the continuous modeling software program “Western Washington Hydrology Model 2012” (WWHM), developed by Clear Creek Solutions. WWHM uses actual hourly historic rainfall data collected over an approximate 50-year period from long-term rain gages in the western Washington counties to simulate runoff based on soil and land use conditions. Precipitation to each site is scaled using rainfall map data provided by NOAA. From the site-specific data input, WWHM calculates flow frequencies and durations for the pre-developed and the post-developed mitigated site. This runoff data is summarized in a statistical report. The most current version of WWHM (4.2.17 released 2019/9/13) has been used for this report.

The above referenced analysis and design criteria meets or exceeds standards set forth under the KCSDM and is in accordance with generally accepted engineering practices.

4 EXISTING CONDITIONS

4.1 LAND USE & ZONING

The proposed project will be constructed on a 7.03-acre parcel of land located east of Hansville Road NE and north of NE Point No Point Road in Hansville, WA. The attached Existing Conditions plan sheets within the design drawings found in *Appendix 8.4* detail the existing surfacing and property boundaries for the project site. The parcels that are included in the site are zoned as P- Park. A Vicinity Map showing the project location is included in *Appendix 8.1.*

4.2 EXISTING SOILS CONDITIONS

Aspect Consulting prepared a Preliminary Geotechnical Engineering Report for the site dated July 15, 2019. Evaluation of the site included 11 test pits excavated to depths ranging between 6 feet and 10 feet below present grades. The soils found in the test pits are described as fill, older topsoil horizon, wetland deposits, and beach deposits. The report lists infiltration rates for multiple soil types found at the site, for purposes of this design work a value of 1.42 in/hr is being used. Detailed findings of the soil analysis are described in the geotechnical report provided in *Appendix 8.3.*

4.3 TOPOGRAPHY & DRAINAGE

The project site is relatively flat with elevation ranges between 9 and 12 feet and slopes between 0% and 5%. A gravel parking lot exists on the site. The remainder of the site consists mostly of vegetation including grass, weeds and trees. A 2-foot-tall, 290-foot-long berm sits east of the west property line.

A ditch begins at the southwest corner of the site, at the intersection of Hansville Road NE and NE Point No Point Road, and runs approximately 800 feet along the west property line. A 36-inch CMP culvert collects water from Finn Creek and enters the ditch. From there, the creek water is routed approximately 815 feet north to a 30-inch concrete culvert near the Norwegian Point Park entrance and then diverted northeast approximately 300 feet where it is dispersed into Puget Sound.

Another ditch exists along the east property line. Offsite stormwater enters the ditch via an 18-inch concrete culvert, a 6-inch PVC culvert and a 4-inch PVC culvert. The stormwater is carried along the ditch approximately 285 feet, where it enters an 18-inch CMP culvert and discharges into Puget Sound.

5 STORM WATER SYSTEM EVALUATION

5.1 SITE IMPROVEMENTS

The proposed project includes restoration of the natural habitat on the site, constructing an approximate 2,165 LF berm, off-site parking, and adjacent on-street parking. As a result of the restoration improvements and levee construction, a private driveway at the east end of NE Point No Point Road will be relocated to maintain access to the four neighboring properties northeast of the project site.

6 MINIMUM STORMWATER MANAGEMENT REQUIREMENTS

Storm water management for the site is designed in accordance with Kitsap County Code (KCC) Title 12 Stormwater Drainage and the 2021 Kitsap County Stormwater Design Manual (KCSDM). When evaluating the project using Figure I-4.1. Flow Chart for Determining Minimum Requirements for New Development Projects from the KCSDM, the project proposes to add 12,542 square feet of new hard surface and does not add more to the existing hard surface within the site. Therefore, all Minimum Requirements #1 through #9 apply to the project:

- Minimum Requirement #1: Preparation of Stormwater Site Plan
- Minimum Requirement #2: Construction SWPPP
- Minimum Requirement #3: Source Control of Pollution
- Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls
- Minimum Requirement #5: On-Site Stormwater Management
- Minimum Requirement #6: Runoff Treatment
- Minimum Requirement #7: Flow Control
- Minimum Requirement #8: Wetlands Protection
- Minimum Requirement #9: Operations and Maintenance

Each of the above Minimum Requirements for the project are addressed in the following sections.

6.1 REQUIREMENT #1 – PREPARE STORM WATER SITE PLANS

We have completed the requirements of a storm water site plan per the DOE Manual and the required steps have been performed as follows:

6.1.1 COLLECT AND ANALYZE EXISTING CONDITIONS INFORMATION

Site visits were performed to determine the existing on-site and off-site drainage conditions. Downstream conveyance was investigated utilizing field surveyed topographic maps as well as site visit observations and aerial imagery. See *Section 4* above for a detailed description of existing site conditions.

6.1.2 PREPARE PRELIMINARY DEVELOPMENT LAYOUT

A site development plan has been prepared which shows the proposed access, grading and drainage improvements. See *Appendix 8.4,* Project Drawings.

6.1.3 PERFORM OFF-SITE ANALYSIS

A qualitative off-site analysis has been completed in accordance with the DOE Manual supplemental guidelines for Off-site Analysis and Mitigation, Section I-3.5.3, Volume I. See *Section 4* above.

6.1.4 DETERMINE APPLICABLE MINIMUM REQUIREMENTS

In accordance with Figure I-4.2. Flow Chart for Determining Minimum Requirements for New Development Projects from the KCSDM, Minimum Requirements #1 through #9 apply to this project:

- MR #1 Preparation of Stormwater Site Plans
- MR #2 Construction SWPPP
- MR #3 Construction Stormwater Pollution Prevention Plan
- MR #4 Preserve Natural Drainage
- MR #5 On-site Stormwater Management
- MR #6 Runoff Treatment
- MR #7 Flow Control
- MR #8 Wetlands Protection
- MR #9 O&M

6.1.5 PREPARE A PERMANENT STORM WATER CONTROL PLAN

A permanent storm water control plan has been developed and presented herein, in accordance with the guidelines outlined in Section III-3.2, Step 5, Volume I of the DOE Manual.

6.1.5 (1)EXISTING SITE HYDROLOGY

Existing conditions are explained in detail in *Section 4*.

6.1.5 (2)DEVELOPED SITE HYDROLOGY

The proposed site development is discussed in detail in *Section 5,* and illustrated via Project Drawings in *Appendix 8.4*.

6.1.5 (3)PERFORMANCE STANDARDS AND GOALS

Th project will meet all applicable minimum stormwater requirements as defined in the BMC and DOE Manual.

6.1.5 (4)FLOW CONTROL SYSTEM

Flow control is required for the project. Flow control requirements will be met by fully infiltrating the stormwater onsite.

6.1.5 (5)WATER QUALITY SYSTEM

Water quality will be provided to pollution generating hard surfaces using Compost amended Vegetated Filter Strips adjacent to the pollution generating hard surfaces.

6.1.5 (6)CONVEYANCE SYSTEM ANALYSIS AND DESIGN

For reference, see the Project Drawings in *Appendix 8.4. WWHM models can be found in Appendix 8.5.*

6.1.6 PREPARE A CONSTRUCTION STORM WATER POLLUTION PREVENTION PLAN

Construction Storm Water Pollution Prevention Plan (SWPPP), and temporary erosion and sediment controls will be implemented during the construction of the project. See *Section 6.2* for more details.

6.1.7 COMPLETE THE STORM WATER SITE PLAN

The Storm Water Site Plan has been prepared in accordance with BMC 15.42 and the DOE Manual.

6.1.8 CHECK COMPLIANCE WITH ALL APPLICABLE MINIMUM REQUIREMENTS

The storm water management facilities proposed for this project comply with all applicable requirements of KCC and the DOE Manual.

6.2 REQUIREMENT #2 – CONSTRUCTION STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

A Storm Water Pollution Prevention Plan (SWPPP) has been developed and consists of two parts: a narrative, and a set of site plan drawings. The narrative consists of the thirteen SWPPP elements per the DOE Manual. Temporary Erosion and Sediment Control Plans are included in the project drawings found in *Appendix 8.4* and depict BMP location and type.

6.2.1 ELEMENT 1 – PRESERVE VEGETATION/MARK CLEARING LIMITS

Prior to beginning land-disturbing activities, including clearing and grading, all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area should be clearly marked, both in the field and on the plans, to prevent damage and off-site impacts. Plastic, metal, or stake wire fence may be used to mark the clearing limits. Retain the duff layer, native top soil, and natural vegetation in an undisturbed state to the maximum degree practicable.

Required BMP's include: C101 Preserving Natural Vegetation, C102 Buffer Zones, and C103 High Visibility Fence.

6.2.2 ELEMENT 2 – ESTABLISH CONSTRUCTION ACCESS

(A) The contractor shall limit the amount of construction access to the site. It is understood multiple access points may be required due to the nature of the project.

(B) Access points shall be stabilized with quarry spall or crushed rock to minimize the tracking of sediment onto public roads.

(C) Wheel wash or tire baths should be located on site if applicable.

(D) Public roads shall at a minimum be cleaned thoroughly at the end of each day. Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area. Street washing will be allowed only after sediment is removed in this manner.

(E) Street wash wastewater shall be controlled by pumping back on site, or otherwise be prevented from discharging into systems tributary to state surface waters.

(F) Control street wash wastewater by pumping back on site, or otherwise prevent it from discharging into systems tributary to waters of the state.

Required BMP's include: C105 Stabilized Construction Entrance.

6.2.3 ELEMENT 3 – CONTROL FLOW RATES.

Construction activities will not significantly increase the surface water runoff flow rates. During construction, stormwater runoff will be dispersed into natural undeveloped lands.

6.2.4 ELEMENT 4 – INSTALL SEDIMENT CONTROLS.

(A) The duff layer, native topsoil, and natural vegetation shall be retained in an undisturbed state to the maximum extent practicable.

(B) Prior to leaving a construction site, or prior to discharge to detention facility, stormwater runoff from disturbed areas shall pass through a sediment pond or other appropriate sediment removal BMP that is shown in the temporary erosion and sedimentation control plan. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of element 3 above. Full stabilization means concrete or asphalt paving; quarry spalls used as ditch lining; or the use of rolled erosion products, a bonded fiber matrix product, or vegetative cover in a manner that will fully prevent soil erosion. Sediment ponds, vegetated buffer strips, sediment barriers or filters, dikes, and other BMP's intended to trap sediment on-site shall be constructed as one of the first steps in grading. These BMP's shall be functional before other land disturbing activities take place.

(C) Earthen structures such as dams, dikes, and diversions shall be seeded and mulched according to the timing indicated in Element No. 5 below.

6.2.5 ELEMENT 5 – STABILIZE SOILS.

(A) All exposed and unworked soils shall be stabilized by application of effective BMPs that protect the soil from the erosive forces of raindrop impact and flowing water, and wind erosion.

(B) From October 1 through April 30 of each year, no soils shall remain exposed and unworked for more than 2 days. From May 1 to September 30 of each year, no soils shall remain exposed and unworked for more than 7 days. This condition applies to all soils on site, whether at final grade or not.

(C) Applicable practices include, but are not limited to, temporary and permanent seeding, sodding, mulching, plastic covering, soil application of polyacrylamide (pam), early application of gravel base on areas to be paved, and dust control.

(D) Soil stabilization measures selected should be appropriate for the time of year, site conditions, estimated duration of use, and potential water quality impacts that stabilization agents may have on downstream waters or ground water.

(E) Soil stockpiles must be stabilized and protected with sediment trapping measures.

(F) Work on linear construction sites and activities, including right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall not exceed the capability of the individual contractor for his portion of the project to install the bedding materials, roadbeds, structures, pipelines, and/or utilities, and to re-stabilize the disturbed soils, meeting the timing conditions listed above.

(G) In addition, at the discretion of the public works director those sites unable to maintain the quality of their stormwater discharge may be required to provide soil stabilization to all exposed soil areas regardless of the working status of the area. Upon written notification, the property owner shall provide full stabilization of all exposed soil areas within 24 hours.

Required BMP's include: C120 Temporary and Permanent Seeding, C125 Topsoiling / Composting, and C140 Dust Control.

6.2.6 ELEMENT 6 – PROTECT SLOPES

(A) Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness, and roughening slope surfaces (for example, track walking).

(B) Consider soil type and its potential for erosion.

(C) Reduce slope runoff velocities by reducing the continuous length of slope with terracing and diversions, reduce slope steepness, and roughen slope surface.

(D) Divert upslope drainage and run-on waters from off site with interceptors at top of slope. Off-site stormwater should be handled separately from stormwater generated on the site. Diversion of off-site stormwater around the site may be a viable option. Diverted flows shall be redirected to the natural drainage location at or before the property boundary.

(E) Contain down slope collected flows in pipes, slope drains, or protected channels to prevent erosion. Temporary pipe slope drains must handle the peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year one-hour flow rate predicted by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model to predict flows, bare soil areas should be modeled as "landscaped area."

(F) Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.

(G) Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.

(H) Check dams shall be placed at regular intervals within trenches that are cut down a slope.

(I) Stabilize soils on slopes, as specified in Element No. 5.

Required BMP's include: C120 Temporary and Permanent Seeding, C207 Check Dams, and C208 Triangular Silt Dike.

6.2.7 ELEMENT 7 – PROTECT DRAIN INLETS.

(A) All storm drain inlets made operable during construction shall be protected so that stormwater runoff shall not enter the conveyance system without first being filtered or treated to remove sediment.

(B) All approach roads shall be kept clean, and all sediment and street wash water shall not be allowed to enter storm drains without prior and adequate treatment unless treatment is provided before the storm drain discharges to waters of the state.

Required BMP's include: C220 Inlet Protection.

6.2.8 ELEMENT 8 – STABILIZE CHANNELS AND OUTLETS

(A) All temporary on-site conveyance channels shall be designed, constructed and stabilized to prevent erosion from expected peak flows. Channels must handle the peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, one-hour flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis shall use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model to predict flows, bare soil areas should be modeled as "landscaped area."

(B) Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream reaches shall be provided at the outlets of all conveyance systems.

Required BMP's include: C207 Check Dams and C209 Outlet Protection.

6.2.9 ELEMENT 9 – CONTROL POLLUTANTS

(A) Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants.

(B) All pollutants, including waste materials and demolition debris, that occur on site during construction shall be handled and disposed of in a manner that does not cause contamination of stormwater.

(C) Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and noninert wastes present on the site (see Chapter 173-304 WAC, as currently enacted or hereafter modified, for the definition of inert waste, which is incorporated herein by this reference).

(D) Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on site using temporary plastic placed beneath and, if raining, over the vehicle.

(E) Wheel wash, or tire bath wastewater, shall be discharged to a separate on-site treatment system or to the sanitary sewer.

(F) Application of agricultural chemicals, including fertilizers and pesticides, shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations shall be followed for application rates and procedures.

(G) Management of pH-modifying sources shall prevent contamination of runoff and stormwater collected on the site. These sources include, but are not limited to, bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, and concrete pumping and mixer washout waters.

(H) Adjust the pH of stormwater if necessary to prevent violations of water quality standards.

(I) Assure that washout of concrete trucks is performed off site or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams. Do not dump excess concrete on site, except in designated concrete washout areas. Concrete spillage or concrete discharge to surface waters of the state is prohibited.

(J) Obtain written approval from Ecology before using chemical treatment other than CO2 or dry ice to adjust pH.

Required BMP's include: C151 Concrete Handling, C152 Sawcutting and Surfacing Pollution Prevention

6.2.10 ELEMENT 10 – CONTROL DEWATERING

(A) All foundation, vault, and trench dewatering water, which have similar characteristics to stormwater runoff at the site, shall be discharged into a controlled conveyance system, prior to discharge to a sediment trap or sediment pond. Channels must be stabilized, as specified in Element No. 8.

(B) Clean, non-turbid dewatering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, as specified in Element No. 8, provided the dewatering flow does not cause erosion or flooding of the receiving waters. These clean waters should not be routed through sediment ponds with stormwater.

(C) Highly turbid or otherwise contaminated dewatering water, such as from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam, shall be handled separately from stormwater at the site.

(D) Other disposal options, depending on site constraints, may include, by way of example: (1) infiltration, (2) transport off site in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters, (3) on-site treatment using Ecology approved chemical treatment or other suitable treatment technologies, (4) sanitary or combined sewer discharge with local sewer district approval, or there is no other option, (5) use of a sedimentation bag that discharges to a ditch or swale for small volumes of localized dewatering.

Based on the geotechnical investigation, dewatering is not anticipated for this project.

6.2.11 ELEMENT 11 – MAINTAIN BMPS

(A) All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. All maintenance and repair shall be conducted in accordance with BMPs.

(B) Sediment control BMPs shall be inspected weekly or after a runoff-producing storm event during the dry season and daily during the wet season. All projects that disturb an area greater than one acre shall have a certified erosion control lead available to the site. This erosion control lead shall be responsible to provide overview of ongoing day-to-day erosion control requirements. The erosion control lead shall (within 24 hours) report to the city and Department of Ecology any site discharges that exceed state water quality standards that have or are likely to have entered waters of the state.

(C) All temporary erosion and sediment control BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil areas resulting from removal of BMPs or vegetation shall be permanently stabilized.

Required BMP's include: C160 Certified Erosion and Sediment Control Lead.

6.2.12 ELEMENT 12 – MANAGE THE PROJECT

(A) Phasing of Construction. Development projects shall be phased where feasible in order to prevent, to the maximum extent practicable, the transport of sediment from the development site during construction. Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase.

(B) When establishing these permitted clearing and grading areas, consideration should be given to minimizing removal of existing trees and minimizing disturbance/compaction of native soils except as needed for building purposes. Permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas, shall be delineated on the site plans and the development site.

(C) Coordination with Utilities and Other Contractors. The primary project proponent shall evaluate, with input from utilities and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the construction SWPPP.

(D) Inspection and Monitoring. All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function.

(E) For any project disturbing more than one acre, a certified professional in erosion and sediment control shall be identified in the construction SWPPP and shall be on site or on call at all times. Certification may be through the Washington State Department of Transportation/Associated General Contractors (WSDOT/AGC) Construction Site Erosion and Sediment Control Certification Program or any equivalent local or national certification and/or training program, in the city's discretion.

(F) Whenever inspection and/or monitoring reveals that the BMPs identified in the construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, the SWPPP shall be modified, as appropriate, in a timely manner.

(G) Maintenance of the Construction SWPPP. The construction SWPPP shall be retained on site. The construction SWPPP shall be modified whenever there is a significant change in the design, construction, operation, or maintenance of any BMP.

Required BMP's include: C160 Certified Erosion and Sediment Control Lead.

6.2.13 ELEMENT 13 – PROTECT LOW IMPACT DEVELOPMENT BMPS

(A) Protect all bioretention and rain garden BMPs from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into the bioretention and/or rain garden BMPs. Restore the BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the BMP must include removal of sediment and any sediment-laden bioretention/rain garden soils, and replacing the removed soils with soils meeting the design specification.

(B) Prevent compacting bioretention and rain garden BMPs by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction due to construction equipment.

(C) Control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff onto permeable pavements or base materials.

(D) Pavement fouled with sediments or no longer passing an initial infiltration test must be cleaned using procedures in accordance with the Ecology Manual or the manufacturer's procedures.

(E) Keep all heavy equipment off existing soils under LID facilities that have been excavated to final grade to retain the infiltration rate of the soils.

Required BMP's include: C207 Check Dams, C208 Triangular Silt Dike, and C233 Silt Fence.

6.3 REQUIREMENT #3- SOURCE CONTROL OF POLLUTION

The following construction site source control Best Management Practices (BMP's) have been selected as requirements on this project, obtained from the DOE Manual, Volume 2:

- ☐ BMP C101: Preserving Natural Vegetation
- ☐ BMP C102: Buffer Zones
- ☐ BMP C103: High Visibility Construction Fencing
- ☐ BMP C105: Stabilized Construction Access
- ☐ BMP C120: Temporary and Permanent Seeding
- ☐ BMP C121: Mulching
- ☐ BMP C125: Topsoiling
- ☐ BMP C140: Dust Control

The following runoff conveyance and treatment BMPs are required to be implemented during the construction of the project to minimize erosion and sedimentation impacts associated with construction activities:

- ☐ BMP C233: Silt Fence
- ☐ BMP C235: Straw Wattles

Detailed descriptions of each of the above BMP's are included in Appendix 8.6 Construction BMP's. The above construction source control, runoff conveyance, and treatment BMP's are the minimum requirements for anticipated site conditions during the construction period. Additional BMP's may be required at the discretion of the engineer for unexpected storm events or site conditions encountered during construction that may include but are not limited to the following:

- ☐ BMP C107: Construction Road/Parking Area Stabilization
- ☐ BMP C122: Nets & Blankets
- ☐ BMP C130: Surface Roughening

Upon completion of construction, the following pollutant source control BMPs are required for implementation associated with the management and maintenance of the development, obtained from the WSDOE Manual, Volume 4:

- ☐ S410 BMPs for Correcting Illicit Discharges to Storm Drains
- ☐ S453 BMPs for Formation of a Pollution Prevention Team
- ☐ S454 BMPs for Preventative Maintenance / Good Housekeeping
- ☐ S455 BMPs for Spill Prevention and Cleanup
- ☐ S456 BMPs for Employee Training
- ☐ S457 BMPs for Inspections
- ☐ S458 BMPs for Record Keeping
- ☐ S411 BMPs for Landscape & Vegetation Management

Upon completion of construction, the following pollutant source control BMPs are recommended for implementation as applicable with the management and maintenance of the development, obtained from the DOE Manual, Volume 4

- ☐ S411 BMPs for Landscape & Vegetation Management
- ☐ S415 BMPs for Maintenance of Public and Private utility Corridors and Facilities

- ☐ S416 BMPs for Maintenance of Roadside Ditches
- ☐ S417 BMPs for Maintenance of Storm Water Drainage and Treatment Systems
- ☐ S421 BMPs for Parking and Storage of Vehicles & Equipment
- ☐ S431 BMPs for Washing and Steam Cleaning Vehicles / Equipment / Building Structures

Detailed descriptions of each of the above Pollution Source-Specific BMPs are included in Appendix 8.7, Pollution Source Control BMP's.

6.4 REQUIREMENT #4 – PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS

Runoff from the site will be infiltrated as in the native condition. Rainfall events exceeding the modeled 100-year storm and infiltration system capacity will result in standing water adjacent to parking areas that will outfall overland to the Puget Sound maintaining the natural drainage system.

6.5 REQUIREMENT #5- ON-SITE STORMWATER MANAGEMENT

This project will meet the On-Site Stormwater Management requirement by meeting the LID performance standard. All the new plus replaced pollution generating hard surface areas on the site will direct stormwater runoff to a Compost Amended Vegetated Filter Strip (CAVFS) and infiltration trench. The CAVFS system and adjacent infiltration trench fully infiltrate the 100-year storm event for each of the three project areas that propose new plus replaced hard surfacing including the Parking Lot, Roadside Parking, and Gravel Driveway.

The WWHM report files are included in Appendix 8.5 that support the full infiltration for each area.

6.6 REQUIREMENT #6- RUNOFF TREATMENT

The Pollution generating surfaces on the project that require runoff treatment are in three distinct areas of the site: the gravel parking lot, roadside parking, and gravel driveway. Each of these areas are graded to direct surface sheet flow runoff to adjacent CAVFS systems to meet enhanced runoff treatment requirements.

GRAVEL PARKING LOT: The gravel parking lot basin directed to the CAVFS includes the onsite gravel parking area, gravel walkways, roof areas, and offsite gravel areas and a portion of the existing paved County Road. Two covered picnic shelters are included in the CAVFS calculations although runoff from the roof surfaces is expected to infiltrate prior to reaching the CAVFS facilities.

ROADSIDE PARKING: Gravel parking will be added to the east side of Hainsville Road between NE Point No Point Road and the park entrance. Since the road is crowned, the CAFVS have been sized to provide runoff treatment to the additional gravel parking areas as well as the eastern half of the public road that will contribute runoff.

GRAVEL DRIVEWAY: The relocated gravel driveway east of the project will be installed with a CAVFS facility constructed adjacent to meet runoff treatment requirements.

The following table provides a summary of each area and the CAVFS system performance. The % Treated column also represents the percentage of the runoff directed to the facility that was infiltrated into the native soil beneath the CAVFS. The complete WWHM reports can be found in Appendix 8.5.

	CAVFS LENGTH (FT)	CAVFS WIDTH (FT)	% TREATED (91% REQ'D)
GRAVEL PARKING LOT	72 ft	4.0 ft	93.2
ROADSIDE PARKING	670 ft	4.0 ft	99.2 %
GRAVEL DRIVEWAY	385 ft	3.5 ft	99.1 %

6.7 REQUIREMENT #7- FLOW CONTROL

Flow control for the project is provided by infiltrating the runoff generated from the new plus replaced hard surface areas under the CAFVS and the adjacent infiltration trenches. Each of the CAVFS systems is designed to meet the runoff treatment requirement and also provide infiltration into the native soils. In addition to the infiltration provided by the CAVFS system, each of the three CAVFS facilities have an adjacent infiltration trench filled with washed rock that provides additional storage and infiltration capabilities. The combination of the CAVFS and the infiltration trench for each of the three areas infiltrated 100% of the runoff per the WWHM.

GRAVEL PARKING LOT: The gravel parking lot includes a 72-foot-long infiltration trench that is 18-inch wide x 18-inch deep along with a 1,017 square foot infiltration gallery to fully infiltrate the runoff from the gravel parking lot basin. The 1,125 square feet of infiltration gallery provided exceeds the required 1,085 square feet of infiltration gallery required per the WWHM model.

ROADSIDE PARKING: The roadside parking includes an 18-inch wide x 18-inch deep infiltration trench adjacent to the CAVFS and includes the perforated pipe at then north end of the parking to provide 685 feet of trench, exceeding the required 680 feet of infiltration gallery required by the WWHM model.

GRAVEL DRIVEWAY: The gravel driveway includes an 18-inch wide x 18-inch deep infiltration trench adjacent to the 385 foot long CAVFS that in conjunction with the CAVFS fully infiltrates the 100-year storm event meeting flow control requirements.

The complete WWHM reports for each of the three areas described is included in Appendix 8.5.

6.8 REQUIREMENT #8 – WETLANDS PROTECTION

The wetland field reconnaissance indicates there are no wetlands within the project footprint.

6.9 REQUIREMENT #9 – OPERATION AND MAINTENANCE

Operation and maintenance of the proposed storm water management facilities located outside the public right-of-way shall be the responsibility of property owners. Stormwater facilities constructed within the public right-of-way will be owned and maintained by Kitsap County. A recommended schedule for the operation and maintenance of the proposed private storm water management facilities is included in *Appendix 8.8.*

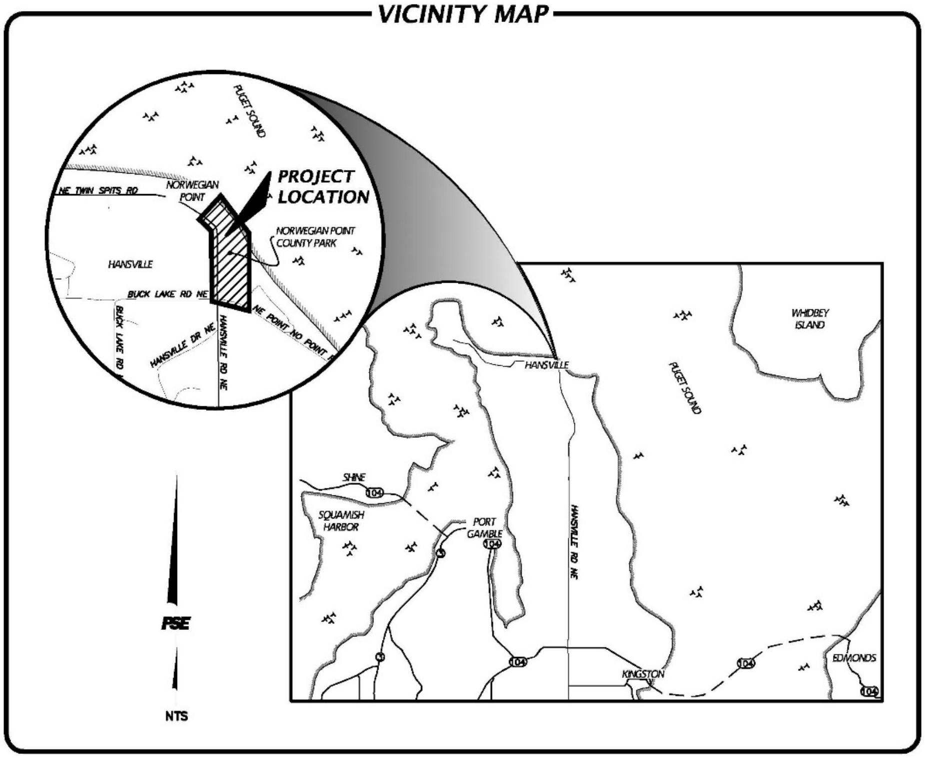
7 PRINCIPAL FINDINGS AND RECOMMENDATIONS

Detailed analysis concludes all applicable stormwater requirements can be met for the proposed project site in accordance with the Kitsap County Stormwater Standards.

All storm water management associated with the proposed project will be in accordance with applicable local, state, and federal regulations.

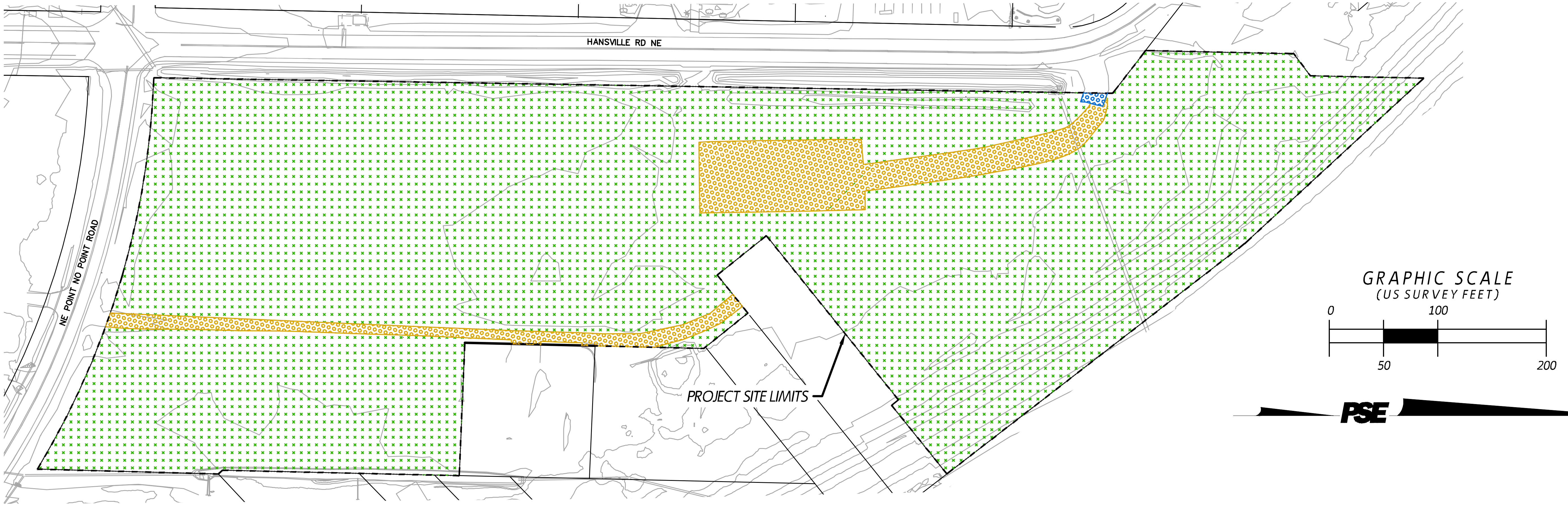
8 APPENDIX

8.1 VICINITY MAP



APPENDIX

8.2 BASIN EXHIBITS



PRE-DEVELOPMENT SURFACE AREA SUMMARY

🟦	ASPHALT SURFACE AREA=	218 SF	0.005 AC
🟧	GRAVEL SURFACE AREA=	21,943 SF	0.504 AC
🟩	LANDSCAPE AREA=	284,200 SF	6.52 AC
	TOTAL PROJECT AREA=	306,361 SF	7.03 C

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FINN CREEK RESTORATION

NORWEGIAN POINT PARK
HANSVILLE, WA

PRE-DEVELOPMENT BASIN EXHIBIT

DRAWN: SH
CHECKED: DG
DATE: 01/26/2024
SCALE: 1"=100'
JOB#: 2022336
DWG: 2022336_ecP_SP.dwg

SHEET 01 OF 02

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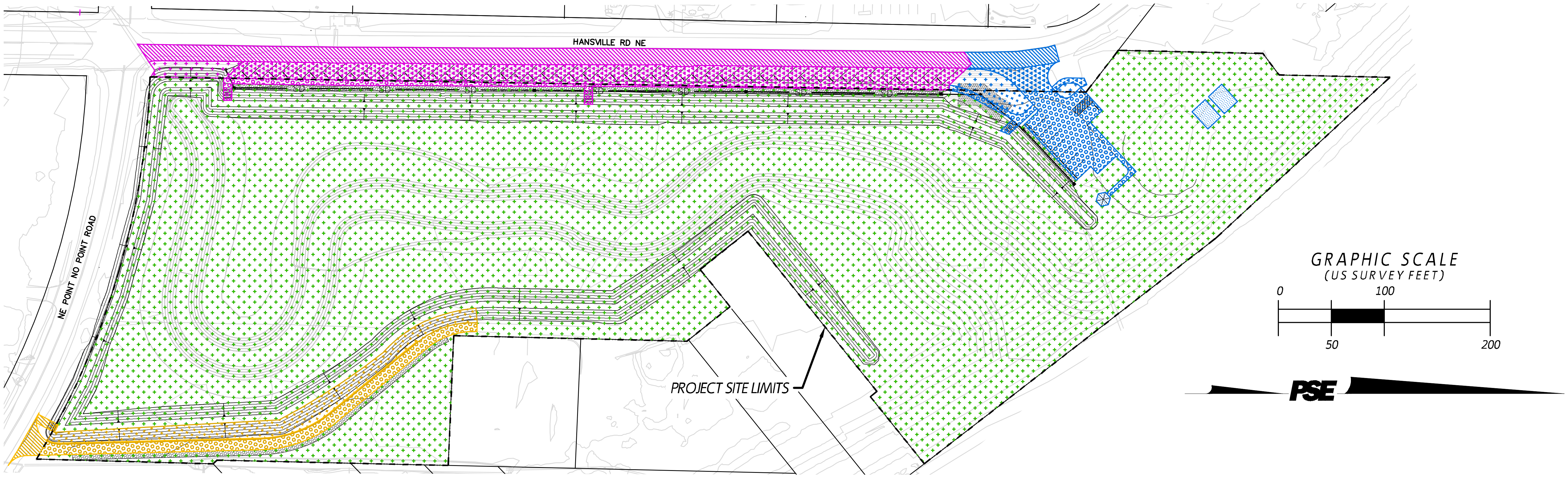

POST DEVELOPMENT SURFACE AREA SUMMARY

PARKING LOT BASIN

▨	ON–SITE GRAVEL SURFACE AREA=	5,176 SF	0.119 AC
▨	ON–SITE ROOF SURFACE AREA=	873 SF	0.020 AC
▨	ON–SITE LANDSCAPE AREA=	818 SF	0.018 AC
	TOTAL ON–SITE PARKING LOT BASIN AREA=	6,867 SF	0.16 AC
▨	OFF–SITE ASPHALT SURFACE AREA=	1,320 SF	0.030 AC
▨	OFF–SITE GRAVEL SURFACE AREA=	1,236 SF	0.029 AC
▨	OFF–SITE LANDSCAPE AREA=	1,055 SF	0.024 AC
	TOTAL OFF–SITE PARKING LOT BASIN AREA=	3,611 SF	0.08 AC
	TOTAL PARKING LOT BASIN AREA=	10,478 SF	0.24 AC

OTHER ON-SITE PERVIOUS SURFACE AREA

▨	ON–SITE LANDSCAPE AREA=	286,589 SF	6.58 AC
	TOTAL ON–SITE LANDSCAPE AREA=	286,589 SF	6.58 AC

ROAD PARKING BASIN

▨	ON–SITE GRAVEL SURFACE AREA=	2,058 SF	0.047 AC
	TOTAL ON–SITE ROAD EXPANSION BASIN AREA=	2,058 SF	0.05 AC
▨	OFF–SITE EXISTING ASPHALT SURFACE AREA=	11,896 SF	0.273 AC
▨	OFF–SITE GRAVEL SURFACE AREA=	12,359 SF	0.284 AC
▨	OFF–SITE LANDSCAPE AREA=	1,224 SF	0.028 AC
	TOTAL OFF–SITE ROAD EXPANSION BASIN AREA=	25,479 SF	0.58 AC
	TOTAL ROAD EXPANSION BASIN AREA=	27,537 SF	0.63 AC

DRIVEWAY BASIN

▨	ON–SITE GRAVEL SURFACE AREA=	4,435 SF	0.102 AC
▨	ON–SITE LANDSCAPE AREA=	6,412 SF	0.147 AC
	TOTAL ON–SITE DRIVEWAY BASIN AREA=	10,847 SF	0.25 AC
▨	OFF–SITE GRAVEL SURFACE AREA=	665 SF	0.015 AC
	TOTAL OFF–SITE DRIVEWAY BASIN AREA=	665 SF	0.02 AC
	TOTAL DRIVEWAY BASIN AREA=	11,514 SF	0.27 AC
	TOTAL ON–SITE PROJECT AREA=	306,361 SF	7.03 AC

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FINN CREEK RESTORATION

NORWEGIAN POINT PARK
HANSVILLE, WA

POST DEVELOPMENT BASIN EXHIBIT

DRAWN:	SH	SCALE:	1"=100'
CHECKED:	DG	JOB#:	2022336
DATE:	01/26/2024	DWG:	2022336_ecP_SP.dwg

SHEET 02 OF 02

APPENDIX

8.3 GEOTECHNICAL REPORT

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

Norwegian Point Park Ring Levee
Kitsap County, Washington

Prepared for: Wild Fish Conservancy

Project No. 190092 • July 15, 2019 Final

Aspect
CONSULTING

earth + water

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

Norwegian Point Park Ring Levee
Kitsap County, Washington

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Aspect Consulting, LLC

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7/15/2019

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1 Introduction

This report presents the results of a geotechnical engineering study by Aspect Consulting, LLC (Aspect) for the Norwegian Point Park Ring Levee (Project) located on Kitsap County Parcels 162802-4-097-2000 and 162802-4-086-2003, -2102, -2201, -2300, -2409, -2508, -2607 in Hansville, Washington (Site; Figure 1).

This report summarizes the completed subsurface explorations at the Site and presents Aspect's preliminary geotechnical engineering conclusions and recommendations for the Project. Based on our evaluations, the Project levee can be constructed while meeting all seepage and stability requirements.

1.1 Scope of Services and Authorization

Our scope of work included reviewing readily available data near the Site, excavating and sampling test pits, performing laboratory testing, completing geotechnical engineering analyses in support of preliminary Project design, and preparing this report. Specific objectives of this preliminary study included developing a typical levee section that meets the seepage and stability requirements of the U.S. Army Corp of Engineers (USACE), evaluating the suitability of the on-site soils for use in levee construction, and providing associated preliminary design criteria. At the time of this report, the Project was in the conceptual design phase and we understand our recommendations will be used to develop the preliminary Project design.

Our work was completed in general accordance with our subconsultant agreement with Wild Fish Conservancy authorized on March 1, 2019.

1.2 Project Description

The Project is part of the greater fish habitat restoration and naturalization of the mouth of Finn Creek (creek) at the Site. The creek is currently ditched across the Site and culverted to Puget Sound. To naturalize the mouth of the creek, the culvert and tide gate will be removed and a new creek channel will be graded through the Site. During high tides, the Site will become inundated, necessitating a levee to provide flood protection to the adjacent properties.

Based on preliminary levee and creek alignments developed by Wild Fish Conservancy (WFC; Attachment 1), the levee will form a ring around the Site, extending from Puget Sound to the upstream end of the Project at the intersection of Hansville Road NE and NE Point No Point Road. We assume the levee will be designed in general accordance with the guidance provided by the USACE EM 1110-2-1913, *Design and Construction of Levees* (USACE, 2000).

2 Site Conditions

2.1 Surface Conditions

The Site consists of eight undeveloped Kitsap County (County) parcels, which include County-owned parcels and the parcels that WFC has proposed the County acquire as part of the Project. The Site is delineated by Puget Sound to the north, NE Point No Point Road to the south, single family residences to the east, and Hansville Road NE to the west (Figure 1).

Site topography is relatively level with ground surface elevations ranging between about 5 to 8.5 feet.[1] The topographically high part of the Site is a 4-foot-tall berm along the east side of the ditched portion of Finn Creek and Hansville Road NE. With exception to a gravel parking lot in the northern portion of the Site, the Site is vegetated with short grass and a few scattered shrubs and trees. At the time of our subsurface explorations, we observed water ponded at the ground surface of the central portion of the Site.

Finn Creek enters the Site via a 3-foot-diameter corrugated metal pipe (CMP) that carries the creek below the intersection of Hansville Road NE and NE Point No Point Road and into a ditch at the southwest corner of the Site. The ditch runs along the east side of Hansville Road NE and carries the creek to a 3.5-foot-diameter concrete culvert and tide gate structure at the northwest corner of the Site. The culvert redirects the creek to the northeast and carries it below Norwegian Point Park to Puget Sound.

An unnamed stream enters the Site via an 18-inch-diameter concrete culvert pipe that carries the stream below NE Point No Point Road at the southeast corner of the Site. The stream remains culverted for about 200 feet before it discharges into a ditch along the east side of the Site. The ditch carries the creek north to another 12- or 18-inch-diameter culvert and tide gate structure and eventually to Puget Sound.

2.2 Subsurface Conditions

2.2.1 Geology

The Geologic map of the Port Ludlow and southern half of the Hansville 7.5-minute quadrangle (Polenz et al., 2015) indicates the Site is located at the contact of beach deposits (Qb) and modified land (Qm). Alluvium deposited by Finn Creek is mapped to the south of the Site on the south side of NE Point No Point Road. Glacial deposits mapped in the Site area include glacial till (Qgt) to the northwest and recessional glacial delta deposits (Qgod) to the south and southwest.

Based on the completed explorations, the Site is underlain by fill which is in general agreement with the mapped Qm unit in the Site area. Anecdotal information suggests the fill at the Site was derived from road cuts for Hansville Road NE approximately 0.25 miles south of the Site where glacial till (Qgt) is mapped. Below the fill, we encountered wetland deposits (peat) and/or beach deposits. The wetland deposits indicate the inland portions of the Site were formerly a tidal bog.

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[1] All elevations reference National Geodetic Vertical Datum of 1929 (NGVD29)

2.2.2 Subsurface Explorations

We explored the Site subsurface conditions with eleven test pits, designated TP-1 through TP-11 (Figure 2). The test pits were located along the proposed regraded creek channel and levee alignment based on a conceptual site plan provided by Wild Fish Conservancy.

The test pits were completed to depths ranging from 6 to 10 feet below the ground surface (bgs). Detailed descriptions of the subsurface conditions encountered in our explorations, as well as the depths where characteristics of the soils changed, are indicated on the exploration logs presented in Appendix A. A general description of the exploration and sampling methods are also included in Appendix A.

2.2.3 Laboratory Testing

We submitted select soil samples for laboratory testing for classification purposes and to characterize their engineering (physical) properties. Laboratory testing included determination of moisture content, determination of organic content, grain-size distribution, and compaction characteristics (proctor). The laboratory tests were conducted in general accordance with ASTM International (ASTM) test methods. The laboratory testing results are provided in Appendix B.

2.2.4 Stratigraphy

The soils encountered in our test pits can be grouped into four engineering/geologic units: fill, older topsoil horizon, wetland deposits, and beach deposits. The general characteristics of each of these units are described in further detail below.

Fill

We encountered fill below the surficial topsoil in each test pit. The fill extended to depths ranging from about 3 to 5.25 feet bgs. The fill typically consisted of loose to medium dense, slightly moist to very moist, silty SAND and silty SAND with gravel (SM) and varying amounts of cobbles. We infer the fill to be glacial till borrow that was placed during historic grading activities at the Site.

In addition to the fill observed in the test pits, we infer the 4-foot-tall berm along Hansville Road NE is composed of fill of similar composition. We presume that the berm fill material was placed at around the same time as the fill in the test pits and was derived from the excavation for the adjacent ditch.

We evaluated the compaction of the fill in the test pits with a 3-foot-long, ½-inch-diameter steel T-probe. Based on our evaluations, the fill varied from poor to moderate in the degree of compaction. The fill is expected to have moderate shear strength, moderate compressibility, low to moderate permeability, and moderate to high moisture sensitivity.

Older Topsoil Horizon

Below the fill in TP-1, TP-2, TP-10, and TP-11, we observed a 3- to 8-inch-thick layer of black silty SAND (SM) with organics. We inferred this to be an older topsoil layer over which the fill was placed.

Wetland Deposits

Below the fill or older topsoil horizon in TP-3 through TP-10, and below the beach deposits in TP-11, we encountered wetland deposits that typically consisted of soft, moist, brown, PEAT (PT). Organic content of the PEAT ranged from about 17 to 57 percent.

The wetland deposits are expected to have low shear strength and moderate to high compressibility.

Beach Deposits

Below the fill or older topsoil horizon in TP-1, TP-2, and TP-11, and below the wetland deposits in TP-5, TP-7, and TP-9, and interbedded with wetland deposits in TP-8 and TP-11, we encountered beach deposits that typically consisted of very loose, moist to wet, SAND (SP) with trace silt.

The beach deposits are expected to have low shear strength and moderate to high compressibility.

2.2.5 Groundwater

We encountered groundwater ranging from about 4.7 to 9 feet bgs in the test pits. We also observed seepage emanating from the sidewalls in many of the test pits, which are indicative of perched groundwater. Depth to groundwater is expected to increase away from the shoreline and generally coincided with the depths where the beach deposits were encountered in the test pits.

Groundwater levels at the Site are expected to vary with precipitation, Site and near-Site usage, creek levels, and tidal fluctuations.

3 Levee Embankment Analyses

Based on our understanding of the Site soil and groundwater conditions and our experience with levee design, we completed preliminary analyses for the proposed ring levee. The following sections present our design assumptions and results along with our preliminary recommendations for the levee.

3.1 General Design Assumptions and Recommendations

We developed a list of design assumptions and recommendations based on conversations with Wild Fish Conservancy, our experience with levee design, the results of our subsurface explorations, and our engineering judgement. The general assumptions and recommendations used in our design analyses include:

- The soil and groundwater conditions detailed in Section 2.2 of this report are generally representative of those along the levee alignment.
- The laboratory test results are generally representative of the respective soil units.
- The levees will be designed for a design flood water surface elevation (WSE) of 8.5 feet.
- The design flood is expected to occur in combination with a high tide and will be tidally controlled.
- The levees will be designed with a freeboard of at least 2 feet above the design flood WSE, corresponding to a minimum levee crest elevation of 10.5 feet.
- The levee embankments will be comprised of Site-derived fill (see Section 4.3.4) and are assumed to be uniform (both geometrically and compositionally).
- Long-term creek channel migration may push the creek channel towards and alongside the toe of the levee in some locations. To account for this, we assumed a 3H:1V (horizontal:vertical) or flatter creek channel sideslope (approximate angle of repose for saturated soil) from the waterside toe of the levee down to the creek thalweg.
- The levee crown will be at least 6 feet wide to accommodate a pedestrian path.
- The levee will have sidelopes of 2.5H:1V or flatter.
- The maximum levee height required to reach the crest elevation of 10.5 feet will be approximately 5 feet above the surrounding grade.
- Seismic design of the levee will be based on guidance provided by the USACE EC 1110-2-6067, *Process for the National Flood Insurance Program (NFIP) Levee System Evaluation* (USACE, 2010).

3.2 Seismic Evaluation

3.2.1 General

USACE (2010) specifies that if the peak ground acceleration (PGA) for the 100-year earthquake ground motion is less than 0.10g (where g is the acceleration of gravity), seismic evaluation of the levee system is not required. The U.S. Geological Survey (USGS) Earthquake Hazards Program (USGS, 2019) indicates the PGA associated with the 100-year ground motion at the Site is approximately 0.17g. With this, we assume seismic evaluation of the levee system is required.

3.2.2 Liquefaction Susceptibility

Liquefaction occurs when loose, saturated, and relatively cohesionless soil deposits temporarily lose strength and stiffness as a result of earthquake shaking. Potential effects of soil liquefaction include temporary loss of shallow foundation bearing capacity, loss of deep foundation axial and lateral capacity, vertical ground settlement, creekbank slope failure, slope failure, and lateral ground movement towards creek banks or shoreline areas. Primary factors controlling the triggering of liquefaction include intensity and duration of strong ground motion, characteristics of subsurface soils, *in situ* stress conditions, and the depth to groundwater.

The potential for the triggering of liquefaction is typically evaluated using simplified empirical methods and *in situ* test data, such as the Standard Penetration Test (SPT) or the Cone Penetrometer Test (CPT). The subsurface exploration program at the Site did not include *in situ* testing; therefore, our evaluation of the potential for liquefaction triggering at the Site is preliminary and based on our experience with *in situ* testing in similar geologic settings.

To evaluate the potential for the triggering of liquefaction at the Site, we used the Washington State Department of Transportation (WSDOT) Liquefaction Hazards Evaluation System (WSliq; WSDOT, 2009). For our evaluation, we made the following assumptions:

- The stratigraphy observed in TP-1 and TP-2, where we observed the beach deposits to be the shallowest, represents the worst-case condition for liquefaction potential at the Site.
- Based on our engineering judgement and experience, we assumed a relative density of loose to medium dense for the beach deposits.
- The wetland deposits are not susceptible to liquefaction.

Based on these assumptions, our evaluations indicate the beach deposits could liquefy during the 100-year earthquake ground motion event.

3.2.3 Liquefaction-Induced Ground Deformation

An evaluation of the potential magnitudes of liquefaction-induced ground deformation (vertical ground settlement and lateral ground movement) are presented below.

3.2.3.1 Vertical Ground Settlement

We used WSliq to evaluate the potential magnitude of liquefaction-induced vertical ground settlement at the Site for the 100-year earthquake ground motion event. Due to the limited nature of our explorations, the total depth of the beach deposits at the Site is not known. For the purpose of our evaluation, we assumed the beach deposits are at least 15 feet thick. With this, our evaluations indicate vertical ground settlement of up to 1 inch could occur at the Site. We expect that the settlement would be relatively widespread in nature and would occur over the greater Site area.

3.2.3.2 Lateral Spreading and Flow Failure

In our opinion, lateral spreading is not a design consideration due to the relatively small size of the levee, the design earthquake event, and geologic setting of the greater Site area. An evaluation of the potential for liquefaction-induced flow failures is presented in Section 3.5.

3.2.4 Levee Seismic Design

Based on the results of our seismic evaluations, we recommend the levee be evaluated for potential instability caused by the horizontal inertial forces generated during earthquake shaking prior to liquefaction (i.e., pseudostatic evaluation) and by potential instability caused by liquefaction of the levee foundation soils once shaking has stopped (i.e., flow failure evaluation under fully-liquefied conditions). An evaluation of stability for these conditions is presented in Section 3.5.

3.3 Soil Engineering and Hydrogeologic Properties

Based on the completed subsurface explorations, results of laboratory testing, guidance provided in geotechnical engineering literature, our experience with the local geology, and the general design assumptions and recommendations listed above, we developed and assigned engineering and hydrogeologic properties to the soil units used in our engineering analyses.

Literature used to develop engineering and hydrogeologic properties of the soil units included:

- **To estimate hydraulic conductivity (K_{sat}) of the soil units:** WSDOT WA-RD 872.1, *Stormwater Infiltration in Highway Embankments – Saturated Hydraulic Conductivity Estimation for Uncompacted and Compacted Soils* (WSDOT, 2017).
- **To estimate engineering and hydrogeologic properties of the wetland deposits:** *Engineering Properties of Fibrous Peats* (Mesri and Ajlouni, 2007).

Undrained strengths of the fully-liquefied beach deposits were estimated based on our experience with liquefaction evaluation and design in similar geologic materials.

The soil engineering and hydrogeologic properties assigned to each soil unit are shown in Table 1.

Table 1. Soil Engineering Units and Assigned Properties

Soil Unit	Unit Weight (pcf)	Shear Strength Parameters			K_{sat} (cm/s)[1]
		Friction Angle (deg)	Cohesion (psf)	Undrained Strength (psf)	
Existing Fill	115	32	25	-	1 x 10^{-3}
Older Topsoil Horizon	100	29	0	-	1 x 10^{-2}
Wetland Deposits	70	20	250	-	1 x 10^{-3}
Beach Deposits	110	30	0	-	5 x 10^{-2}
Levee Embankment Fill	120	34	50	-	3 x 10^{-4}
Beach Deposits (Fully Liquefied)	110	-	-	100 increasing at 5 psf/ft of depth	-

Notes:

1. K_{sat} values presented are the baseline values assigned to each soil unit based on the results of laboratory testing and literature.

To account for the potential variability of the soil units, we varied the engineering properties used in our analyses for sensitivity scenarios.

3.4 Seepage Analysis

3.4.1 General

We used the general design assumptions and recommendations presented in Section 3.1, the soil engineering and hydrogeologic parameters presented in Section 3.2, and the computer program Slide (Rocscience, 2018) to analyze seepage through and under the levee embankments. We considered three typical levee sections to account for the varying subsurface conditions (represented by TP-1, TP-3, and TP-5) below the levee alignment.

We used the finite element groundwater seepage module within Slide which computes the pressure head based on the modeled conditions and determines flow directions, gradients, and seepage potential. We made the following assumptions in developing our seepage model:

- Seepage occurs under steady state conditions. These conditions occur when flood levels remain at or near the assumed WSE long enough so that the levee embankment becomes saturated and the pore water pressures and seepage velocities are constant.
- The hydraulic conductivity of each soil unit is equal in the horizontal and vertical direction.
- A constant head boundary equal to the design WSE exists on the water side of the levee embankment and a constant head boundary equal to the ground surface elevation exists along the landside edge of the model.

- Potential seepage surfaces exist along the landside ground surface of the levee embankment.
- A no-flow boundary exists along the bottom edge of the model.
- To reduce the potential for numerical errors due to boundary effects, the seepage model was extended 2,000 feet landward from the creek thalweg.

In accordance with guidance from USACE ETL 1110-2-569, *Design Guidance for Levee Underseepage* (USACE, 2005), we recommend a maximum exit/uplift gradient of 0.5 (dimensionless).

3.4.2 Seepage Analysis Results

The results of our seepage analyses show a maximum exit/uplift gradient of about 0.4 (dimensionless) near the ground surface on the landslide toe of the levee at the critical levee section. This value is less than the 0.5 (dimensionless) threshold recommended in USACE (2005). The results of the seepage analyses for the critical levee section are presented in Appendix C.

3.5 Slope Stability Analysis

3.5.1 General

We used the general design assumptions and recommendations presented in Section 3.1, the soil unit engineering parameters presented in Section 3.2, and the computer program Slide to conduct two-dimensional limit equilibrium slope stability analyses of three levee sections under base-flow and steady-state seepage conditions. Base-flow conditions were conservatively assumed to occur when the creek channel is flowing full and the water surface elevation is the same elevation as the toe/base of the levee embankment. Seepage through the embankment does not occur under these conditions.

Specifically, we evaluated stability under four conditions:

1. Static, base-flow conditions.
2. Static, steady state seepage conditions through the levee embankment during the design flood event. We used the finite element groundwater module within Slide to develop the steady state pore water pressures for this condition.
3. Pseudostatic (during earthquake shaking and prior to the triggering of liquefaction), base-flow conditions. For this condition, we applied a pseudostatic coefficient of 0.086, equal to one-half of the PGA for the 100-year ground motion.
4. Fully-liquefied, base-flow conditions after earthquake shaking has stopped. For fully-liquefied conditions, we used the residual strengths presented in Table 1.

Due to the composition of the existing soils at the Site and anticipated levee embankment materials, combined with the tidally influenced flood conditions, it is our opinion that the materials can be expected to dissipate excess pore water pressures at or near the rate of their generation; therefore, end-of-construction and rapid drawdown analyses were not conducted.

The Slide program performs slope stability computations based on the modeled slope conditions and calculates a factor of safety (FOS) against slope failure. A factor of safety is defined as the ratio of the destabilizing forces acting on a slide mass to the resisting forces provided by the shear strength of the soils. A factor of safety of 1.0 indicates a "just stable" condition and a factor of safety of less than 1.0 indicates unstable conditions. For each of the conditions evaluated, we recommend the following minimum FOS against slope failure:

1. Static, base-flow conditions: 1.5
2. Static, steady state seepage conditions: 1.4 (as recommended in USACE [2000])
3. Pseudostatic, base-flow conditions: 1.1
4. Fully-liquefied, base-flow conditions: 1.1

3.5.2 Slope Stability Analysis Results

The computed minimum FOS against slope failure under each condition is shown in Table 2. Each of the computed minimum FOS exceeds the minimum recommended values and confirms the levee will maintain acceptable level of stability for each condition. The results of the slope stability analyses are presented in Appendix C.

Table 2. Summary of Slope Stability Analysis Results

Condition	Critical Section Location	FOS
Static (Base Flow)	TP-1	1.7
Static (Steady-State Seepage, Landslide of Levee)	TP-1	1.8
Static (Steady-State Seepage, Waterside of Levee)	TP-1	2.1
Pseudostatic (Base Flow)	TP-1	1.3
Fully-Liquefied (Base Flow)	TP-1	1.1

3.6 Static Settlement Analysis

The proposed levee alignment is underlain by a combination of relatively loose, granular fill and beach deposits, and relatively soft, organic-rich wetland deposits. These deposits exhibit compressibility characteristics that range from moderate to high. We anticipate that any settlement of the levee will consist primarily of 1) rapid elastic settlement of the granular deposits and the wetland deposits during the placement of levee fill, and 2) long-term secondary compression of the wetland deposits (primarily from organic decay) that occurs for some time after levee construction. In our opinion, the wetland deposits will experience elastic compression (rather than consolidation due to pore pressure generation and dissipation) due to their fibrous composition and unsaturated conditions.

For a 5-foot tall typical levee section, we estimate total static settlements will be less than 6 inches.

4 Conclusions and Recommendations

4.1 General

Based on our evaluations, the levee can be constructed while meeting all seepage and stability requirements. The primary geotechnical considerations for the Project are the presence of compressible wetland deposits below the proposed levee alignment and the suitability of the existing soils for reuse as levee embankment fill. The following sections present our recommended typical levee section based on our evaluations and our geotechnical engineering recommendations for levee earthwork and construction.

4.2 Typical Levee Embankment Section

Based on the results of our engineering analyses, guidance from USACE (2000and 2005), and discussions with Wild Fish Conservancy, we recommend that a typical levee embankment section consist of the following:

1. A minimum crown width of 6 feet
2. A crown cross slope of 2 percent towards the creek for surface drainage
3. Side slopes of 2.5H:1V or flatter
4. A minimum of 2 feet of freeboard above the design flood WSE

The recommended typical levee section is shown below on Figure 3.

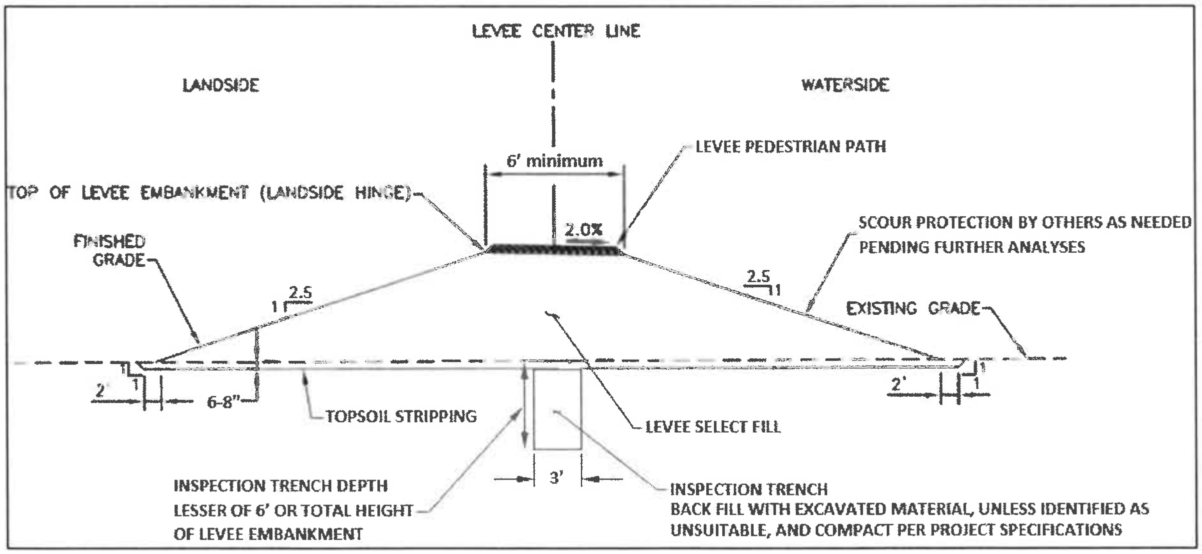

Figure 3. Recommended Typical Setback Levee Section (NTS)

To account for the estimated static settlements (Section 3.6) and liquefaction-induced ground settlements (Section 3.2.3.1), we recommend the levee be overbuilt by a height of 6 inches, corresponding to a post-construction top of levee elevation at the landside hinge of 11 feet NGVD29. The pedestrian path gravel should not be considered part of the levee height.

We recommend the levee embankment be uniform and comprised of the same material type throughout. We recommend the levee fill consist of levee select fill that can be derived from on-site soils and is defined below in Section 4.3.4.

4.3 Earthwork Recommendations

4.3.1 General

The Project will include excavations for channel creation, preparing the levee footprint, habitat area creation, and the removal of the culvert and tide gate. It is our opinion that the Contractor should be able to complete all required excavation and earthwork activity with relatively standard construction equipment. The Contractor should be prepared to encounter some debris and oversized materials, such as cobbles within the existing fill and logs within the wetland deposits.

Shallow groundwater conditions should be expected within the lower portions of the proposed excavations during the dry season, and shallow groundwater or ponded water may be present near or at the ground surface during the wet season. The Contractor should anticipate wet excavations and soil conditions that may not support excavation equipment. We recommend maintaining working platforms for equipment a minimum of 2 feet above the groundwater level and strategically planning excavations to allow for elevated working platforms and access/haul routes. Other strategies for completing wet excavations include:

- Using long-reach excavators and/or wide-tracked and low-pressure equipment.
- Use hog fuel, spalls, and/or geosynthetics to create stabilized temporary access/haul roads and working pads.

4.3.2 Temporary Excavation Slopes

Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the Contractor. All temporary cuts in excess of 4 feet in height that are not protected by trench boxes or otherwise shored, should be sloped in accordance with Part N of Washington Administrative Code (WAC) 296-155 (WAC, 2009).

In general, the soils within the anticipated excavation depths classify as Occupational Safety and Health Administration (OSHA) Soil Classification Type C. Temporary excavation side slopes within Type C soils are anticipated to stand as steep as 1.5H:1V, up to a maximum height of 20 feet. The cut slope inclinations estimated above are for planning purposes only and are applicable to excavations without inflowing groundwater or stormwater.

With time and the presence of seepage and/or precipitation, the stability of temporary unsupported cut slopes can be significantly reduced. Therefore, all temporary slopes should be protected from erosion by installing a surface water diversion ditch or berm at the top of the slope. In addition, the Contractor should monitor the stability of the temporary cut slopes and adjust the construction schedule and slope inclination accordingly. Vibrations created by traffic and construction equipment may cause caving and raveling of the cut slopes. In such an event, the cut slopes should be flattened by the Contractor to prevent loss of ground support.

4.3.3 Levee Earthwork

4.3.3.1 Subgrade Preparation

Subgrade preparation should consist of clearing and grubbing of the ground surface along the levee alignment to remove objectionable material and obstructions, such as vegetation and debris. The levee subgrade should then be stripped to an appropriate depth to remove the topsoil zone and other objectionable materials. We estimate a typical stripping depth (topsoil zone) of approximately 6 to 8 inches for the levee footprint. The stripping depth and overexcavation of unsuitable subgrade soils determined by the geotechnical engineer may extend up to about 12 inches below the levee subgrade in limited portions of the levee alignment. Based on our evaluations, the older topsoil horizon present below the existing fill can be left in-place and is not expected to adversely impact the levee performance.

4.3.3.2 Known Relic Features

During our subsurface investigation, we attempted to excavate a test pit near the waterside toe of the existing 4-foot-tall berm near the northeast corner of the Site. The excavation encountered a shallow layer of clean, rounded rock which indicated a drain could be present. The excavation was terminated to avoid damaging the potential drain. Upon further reconnaissance of the berm, we observed a corrugated plastic pipe daylighting from the waterside toe of the berm and into the ditch. With this, we conclude a French drain is present along portions of the waterside toe of the existing berm. The locations and extent of the French drain should be further evaluated during construction and depending on its location relative to the levee embankment alignment, it should be properly removed and backfilled with levee select fill.

4.3.3.3 Inspection Trench

While our investigations indicate relatively uniform subgrade conditions along the setback levee alignment, it is standard practice recommended by USACE guidance to complete an inspection trench below the levee. An inspection trench is typically used to verify subgrade conditions, check for relic development features and to confirm that adverse seepage conditions are not present beneath the levee. Given the historical grading that occurred at the Site, the presence of fill and buried topsoil, and evidence of buried utilities and/or drains, we recommend an inspection trench for the levee.

If used, the depth of the inspection trench should be 6 feet deep or equal to the height of the levee embankment, whichever is less. The inspection trench may be backfilled with excavated soil, provided the soil meets the requirements for levee select fill and can be placed back into the inspection trench to achieve compaction and permeability conditions equal to or better than the surrounding soils.

4.3.4 Fill Materials

4.3.4.1 Reuse of On-Site Soils

In our opinion, the existing granular fill soils comprised of silty SAND (SM) with gravel and present to depths between about 2 and 5 feet bgs across the Site are suitable for reuse for the Project, provided they meet the material requirements described below. The organic-rich wetland deposits present below the fill are not suitable for reuse due to their low shear strength and high compressibility characteristics. For planning purposes, we recommend assuming the average thickness of suitable, on-site soils is about 3.5 feet across the Site.

Based on the results of laboratory testing and our observations of the materials, the moisture content of the suitable on-site soils is above the optimum moisture content. With this, the suitable on-site soils will require moisture conditioning (drying) prior to their use as fill for the Project.

While not explored extensively, we anticipate the soils that comprise the existing berm along Hansville Road NE at the Site may be suitable for reuse. We recommend the berm soils be evaluated during construction to observe their composition and moisture content and verify their suitability for reuse.

4.3.4.2 Levee Select Fill

Levee select fill (fill used to construct the levee) may consist of materials derived from the on-site excavations or imported granular materials, if needed. Levee select fill shall consist of relatively well-graded soil free of organic and deleterious material, and meet the USCS soil type classification of ML, SM, and SP-SM. If zones of sandy soils with relatively low fines content are encountered in the on-site excavations, we anticipate they can be mixed with soils of higher fines content to produce a composite material that meets the specification for Levee Select Fill. The gradation of the material should have a maximum particle size of 3 inches and a minimum fines content of 15 percent.

Levee select fill should be compacted to at least 90 percent of the material maximum dry density as determined by ASTM D1557, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort* (ASTM International, 2018). Levee select fill shall be placed in horizontal lifts that do not exceed 12 inches in loose lift thickness.

4.3.4.3 Crushed Surfacing

A gravel walking trail will be constructed atop the levee crown. The gravel walking trail material shall consist of imported, crushed rock meeting the requirements of WSDOT Standard Specification 9-03.9(3) for Crushed Surfacing Base Course (CSBC) (WSDOT, 2018). We recommend the CSBC be a minimum of 4 inches thick. The CSBC should be compacted to a minimum of 95 percent of the material maximum dry density as determined by ASTM D1557. If the walking trail is required to meet Americans with Disabilities Act (ADA) standards, the upper 2 inches of the CSBC should be replaced with Crushed Surfacing Top Course (CSTC) meeting the requirements of WSDOT Standard Specification 9-03.9(3) or similar aggregate.

4.3.5 Fill Placement and Compaction

The procedure to achieve the specified minimum relative level of compaction for a material depends on the size and type of compacting equipment, the number of passes, thickness of the layer being compacted, and certain properties of the material. When size of the excavation restricts the use of heavy equipment, smaller equipment can be used, but the soil must be placed in thin enough lifts to achieve the required compaction. A sufficient number of in-place density tests should be performed as the fill is placed to verify the required relative compaction is being achieved.

Generally, loosely compacted soils are a result of poor construction technique or improper moisture content. Soils with a high percentage of silt or clay are particularly susceptible to becoming too wet, and coarse-grained materials easily become too dry, for proper compaction. Silty or clayey soils with a moisture content too high for adequate compaction should be dried as necessary, or moisture conditioned by mixing with drier materials, or other methods. Based on the results of laboratory testing, we anticipate the majority of the on-site soils will have to be dried prior to use as fill for the Project.

Fill within the setback levee embankment should be placed in lifts with a maximum thickness of 12 inches (or less if needed to facilitate proper compaction) to help ensure consistent and uniform material placement and compaction. Fill placed near the face of the levee embankment should be overbuilt a minimum of 1 foot (horizontally) and fine graded back to the final configuration to ensure adequate compaction throughout the embankment fill.

4.4 Levee Vegetation

We recommend vegetation management on the levee be planned and established in accordance with guidance from USACE ETL 1110-2-583, *Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures* (USACE, 2014). The vegetation on and near the levee must not adversely affect the seepage- and stability-related performance of the levee. The levee crown should be left unvegetated for a gravel-surface trail. The sides slopes of the levee may be lightly vegetated with grasses and occasional woody vegetation with stems that are less than 4 inches in diameter at maturity. The vegetation on the levee side slopes must allow for regular visual inspection of the condition of the levee surface.

5 Recommendations for Future Studies

The engineering analyses completed for this report were done with careful consideration of the existing data, the completed test pit investigations, and the current status of the conceptual design. Our recommendations are limited to support of preliminary project design and we made several reasonable assumptions about the project design and Site that require verification through further study. The following sections provide a brief summary of the identified data gaps and recommendations for additional studies that are pertinent to the geotechnical components of the project.

5.1 Data Gaps

Following our preliminary evaluations, we have identified two data gaps:

- **The project grading plan** should be advanced to delineate the proposed creek channel excavations, depths, and geometry along with the layout of the planned levee embankment fitting the recommendations of this report. Surface water controls on the landside of the levee should also be included in the grading plan, where needed.
- **Hydraulic analyses** should be completed to determine the potential for creek channel migration and scour potential. Depending on the outcome of these analyses, scour protection design for the levee embankment should be completed, as needed.

5.2 Additional Studies

Depending on project requirements from the various review agencies, additional geotechnical investigations and studies may be required to support final design. These may include:

- Drilled soil borings with *in-situ* testing and undisturbed sample collection.
- Additional lab testing to verify the assumed soil engineering properties and characteristics.
- Monitoring-well installation and development.
- Slug testing to confirm assumed soil hydraulic conductivity characteristics.
- Updated earthquake engineering analyses evaluating liquefaction potential, lateral spread, seismic settlement, and levee seismic stability.
- Geotechnical recommendations for other project elements such as pavements, hardscapes, and utility considerations.
- The levee may be adjacent to existing improvements such as roadways and driveways. Surface water controls to collect and divert surface water flow away from the landside toe of the levee should be included in the design and evaluated for their impact on the levee during final design.

6 Additional Services

Recommendations for additional geotechnical services are summarized below.

6.1 Additional Design and Consultation Services

As the project design progresses from preliminary to final and before construction begins, we recommend that Aspect:

- Continue to meet with the design team as needed to address geotechnical questions that may arise throughout the remainder of the design process.
- Conduct additional studies as required by the applicable agency reviews.
- Review the geotechnical elements of the project plans to see that the geotechnical engineering recommendations are properly interpreted.

6.2 Additional Construction Services

We are available to provide geotechnical engineering and monitoring services during construction. The integrity of the geotechnical elements depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent.

During the construction phase of the Project, we recommend that Aspect be retained to perform the following tasks:

- Review applicable submittals.
- Observe and evaluate levee subgrade preparation and fill placement.
- Attend meetings, as needed.
- Address other geotechnical engineering considerations that may arise during construction.

The purpose of our observations is to verify compliance with design concepts and recommendations, and to allow design changes or evaluation of appropriate construction methods in the event that subsurface conditions differ from those anticipated prior to the start of construction.

7 References

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Mesri, G. and M.Ajlouni, 2007, Engineering Properties of Fibrous Peats, Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 133, No. 7.

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U.S. Army Corps of Engineers (USACE), 2010, Process for the National Flood Insurance Program (NFIP) Levee System Evaluation, USACE Engineering Circular EC 1110-2-6067, dated August 31, 2010.

U.S. Army Corps of Engineers (USACE), 2014, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures, USACE Technical Letter ETL 1110-2-583, dated April 30, 2014.

U.S. Geological Survey (USGS) Earthquakes Hazards Program, 2019, Unified Hazard Tool, https://earthquake.usgs.gov/hazards/interactive/

Washington State Department of Transportation (WSDOT), 2009, WSDOT Liquefaction Hazard Evaluation System (WSliq).

Washington State Department of Transportation (WSDOT), 2017, Stormwater Infiltration in Highway Embankments – Saturated Hydraulic Conductivity Estimation for Uncompacted and Compacted Soils, WA-RD 872.1.

Washington State Department of Transportation (WSDOT), 2018, Standard Specifications for Road, Bridge and Municipal Construction, Document M 41-10.

Washington State Legislature, 2009, Washington Administrative Code (WAC), April 1, 2009.

8 Limitations

Work for this project was performed for Wild Fish Conservancy (Client), and this report was prepared consistent with recognized standards of professionals in the same locality and involving similar conditions, at the time the work was performed. No other warranty, expressed or implied, is made by Aspect Consulting, LLC (Aspect).

Recommendations presented herein are based on our interpretation of site conditions, geotechnical engineering calculations, and judgment in accordance with our mutually agreed-upon scope of work. Our recommendations are unique and specific to the project, site, and Client. Application of this report for any purpose other than the project should be done only after consultation with Aspect.

Variations may exist between the soil and groundwater conditions reported and those actually underlying the site. The nature and extent of such soil variations may change over time and may not be evident before construction begins. If any soil conditions are encountered at the site that are different from those described in this report, Aspect should be notified immediately to review the applicability of our recommendations.

Risks are inherent with any site involving slopes and no recommendations, geologic analysis, or engineering design can assure slope stability. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the client.

It is the Client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, and agents, are made aware of this report in its entirety. At the time of this report, design plans and construction methods have not been finalized, and the recommendations presented herein are based on preliminary project information. If project developments result in changes from the preliminary project information, Aspect should be contacted to determine if our recommendations contained in this report should be revised and/or expanded upon.

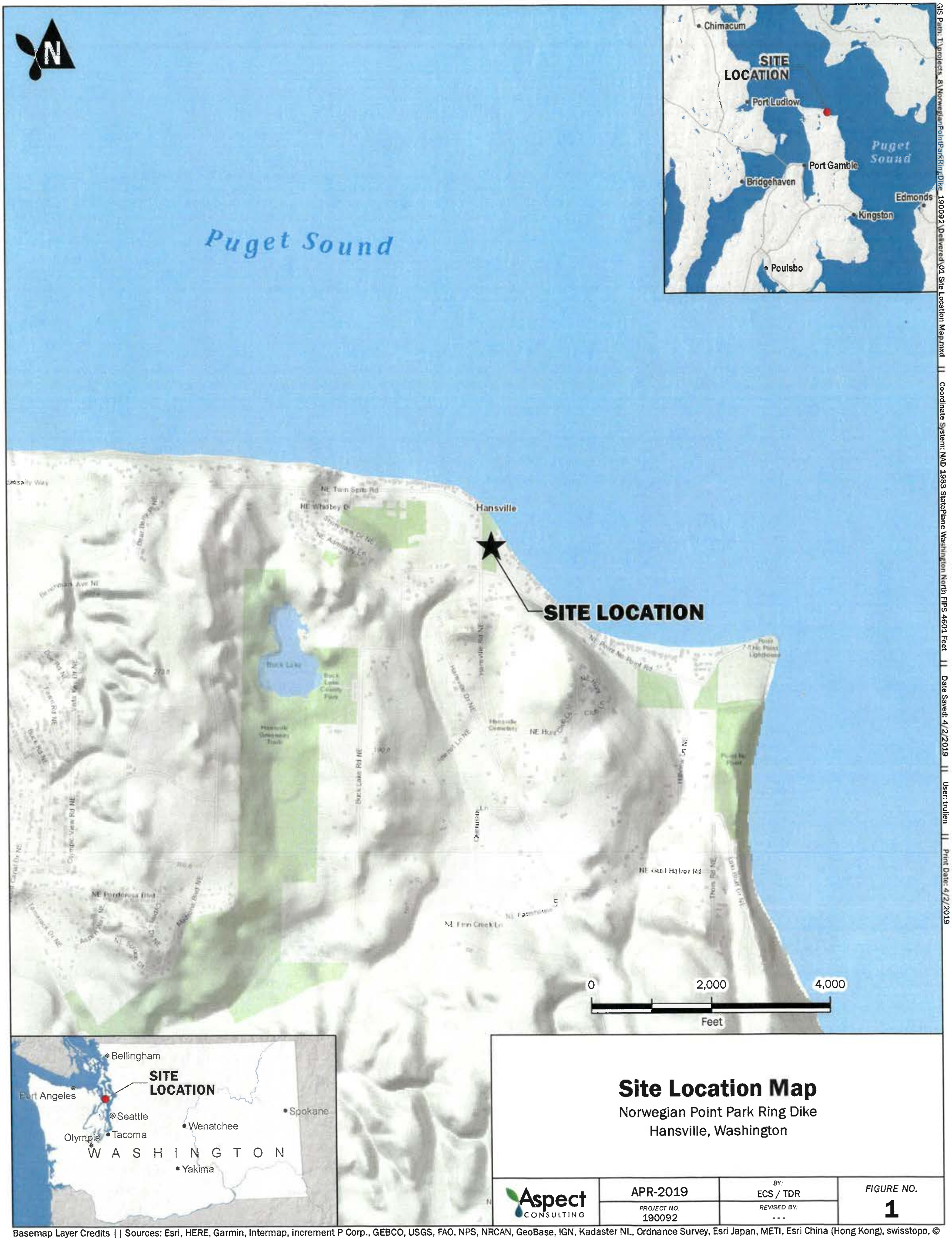
The scope of work does not include services related to construction safety precautions. Site safety is typically the responsibility of the contractor, and our recommendations are not intended to direct the contractor's site safety methods, techniques, sequences, or procedures. The scope of our work also does not include the assessment of environmental characteristics, particularly those involving potentially hazardous substances in soil or groundwater.

All reports prepared by Aspect for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect. Aspect's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Please refer to Appendix D titled "Report Limitations and Guidelines for Use" for additional information governing the use of this report.

We appreciate the opportunity to perform these services. If you have any questions please call Andrew Holmson, Associate Geotechnical Engineer at (206) 780-7731.

FIGURES



Site Location Map

Norwegian Point Park Ring Dike
Hansville, Washington

Aspect CONSULTING	APR-2019	BY: ECS / TDR	FIGURE NO.
	PROJECT NO. 190092	REVISED BY: - - -	1

GIS Path: T:\projects_8\NorwegianPointParkRingDike_190092\Delivered\01 Site Location Map.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 4/2/2019 || User: trullen || Print Date: 4/2/2019

Basemap Layer Credits || Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

Exploration Location Map

Norwegian Point Park Ring Dike
Hansville, Washington

Aspect CONSULTING

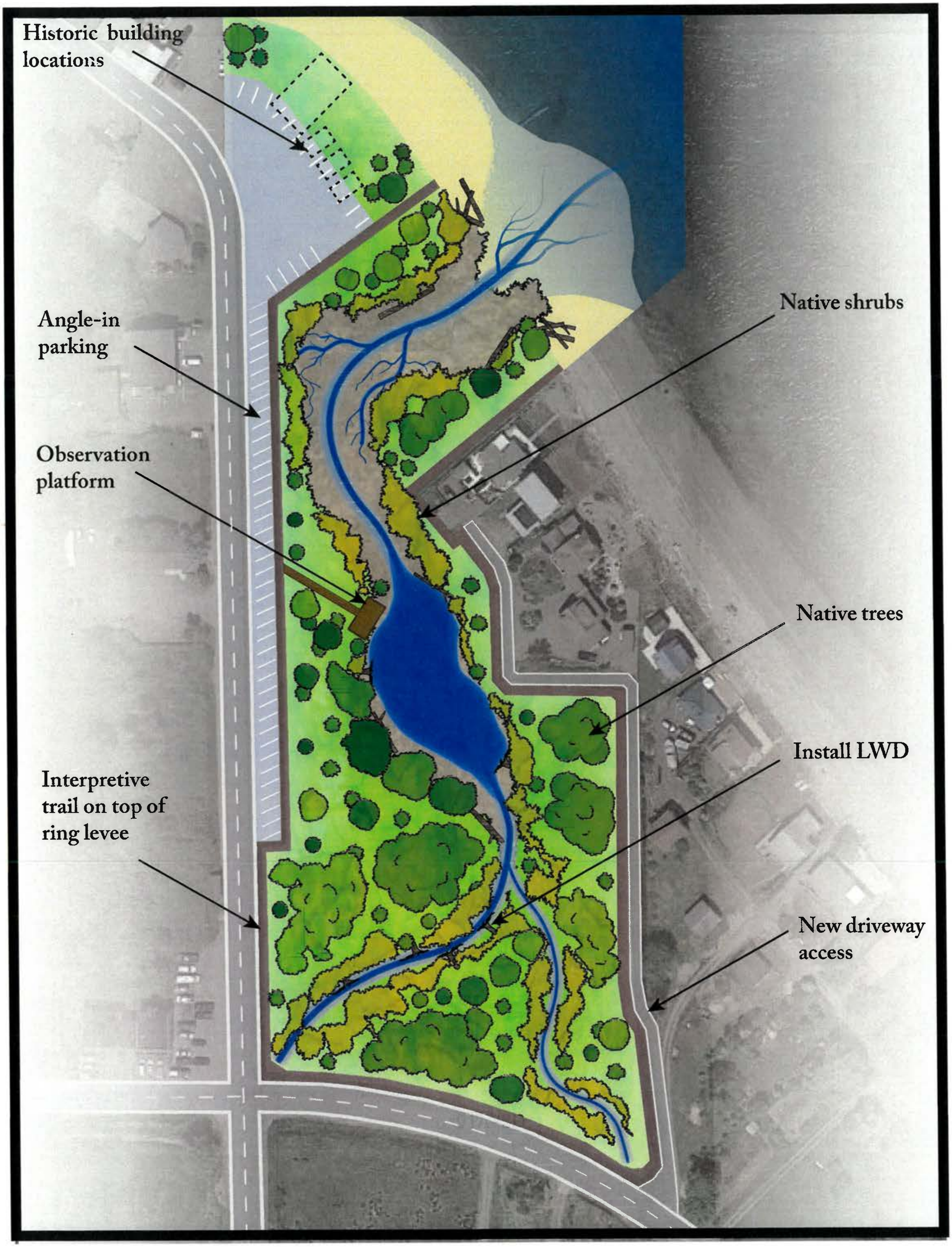
APR-2019	BY: ECS / TDR	FIGURE NO.
PROJECT NO. 190092	REVISED BY: ---	2

GIS Path: T:\projects_8\NorwegianPointParkRingDike_190092\Delivered\02 Exploration Location Map.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 4/2/2019 || User: trullen || Print Date: 4/2/2019

Basemap Layer Credits || Copyright (C) 2015 - Kitsap County, Puget Sound Aerial Mapping Project

ATTACHMENT 1

Finn Creek Low Tide (Preliminary Creek and Levee Alignments)


Historic building locations
Angle-in parking
Observation platform
Interpretive trail on top of ring levee
Native shrubs
Native trees
Install LWD
New driveway access

N

APPENDIX A

Subsurface Explorations

A. Field Exploration Program

A.1. Test Pits

On March 27, 2019, Aspect Consulting, LLC (Aspect) completed eleven test pits, designated TP-01 through TP-11, at the Site in the locations shown on Figure 2. The test pits were advanced with a mini excavator with a 3-foot-wide bucket operated by High Meadows under subcontract to Aspect.

In the test pits, grab samples were obtained from select soil units and placed in air-tight containers. The samples were transported to the Aspect laboratory for further classification and laboratory testing to determine their physical and engineering properties. The relative density/consistency of the soils in the test pits were evaluated qualitatively with a 3-foot long, ½-inch diameter steel T-probe and observation of digging effort.

An Aspect project engineer was present throughout the exploration program to observe the soils and stratigraphy, obtain samples, and prepare descriptive logs of the test pits. The soils were classified in general accordance with ASTM D2488, *Standard Practice for Description and Identification of Soils* (*Visual-Manual Procedure)* (ASTM, 2018). Detailed descriptions of the subsurface conditions encountered in our explorations, as well as the depths where characteristics of the soils changed, are indicated on the exploration logs presented in Appendix A. The exploration logs represent our interpretation of the contents of the field logs. The stratigraphic contacts shown on the individual summary logs represent the approximate boundaries between soil types; actual transitions may be more gradual. The subsurface conditions depicted are only for the specific date and locations reported, and therefore, are not necessarily representative of other locations and times.

Upon completion, the test pits were backfilled with the excavated soils that were tamped in-place to a relatively firm condition.

Coarse-Grained Soils - More than 50%[1] Retained on No. 200 Sieve	Gravels - More than 50%[1] of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines	**GW**	Well-graded GRAVEL Well-graded GRAVEL WITH SAND
			GP	Poorly-graded GRAVEL Poorly-graded GRAVEL WITH SAND
		≥15% Fines	**GM**	SILTY GRAVEL SILTY GRAVEL WITH SAND
			GC	CLAYEY GRAVEL CLAYEY GRAVEL WITH SAND
	Sands - 50%[1] or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines	**SW**	Well-graded SAND Well-graded SAND WITH GRAVEL
			SP	Poorly-graded SAND Poorly-graded SAND WITH GRAVEL
		≥15% Fines	**SM**	SILTY SAND SILTY SAND WITH GRAVEL
			SC	CLAYEY SAND CLAYEY SAND WITH GRAVEL
Fine-Grained Soils - 50%1 or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50%		**ML**	SILT SANDY or GRAVELLY SILT SILT WITH SAND SILT WITH GRAVEL
			CL	LEAN CLAY SANDY or GRAVELLY LEAN CLAY LEAN CLAY WITH SAND LEAN CLAY WITH GRAVEL
			OL	ORGANIC SILT SANDY or GRAVELLY ORGANIC SILT ORGANIC SILT WITH SAND ORGANIC SILT WITH GRAVEL
	Silts and Clays Liquid Limit 50% or More		**MH**	ELASTIC SILT SANDY or GRAVELLY ELASTIC SILT ELASTIC SILT WITH SAND ELASTIC SILT WITH GRAVEL
			CH	FAT CLAY SANDY or GRAVELLY FAT CLAY FAT CLAY WITH SAND FAT CLAY WITH GRAVEL
			OH	ORGANIC CLAY SANDY or GRAVELLY ORGANIC CLAY ORGANIC CLAY WITH SAND ORGANIC CLAY WITH GRAVEL
Highly Organic Soils			**PT**	PEAT and other mostly organic soils

"WITH SILT" or "WITH CLAY" means 5 to 15% silt and clay, denoted by a "-" in the group name; e.g., SP-SM • "SILTY" or "CLAYEY" means >15% silt and clay • "WITH SAND" or "WITH GRAVEL" means 15 to 30% sand and gravel. • "SANDY" or "GRAVELLY" means >30% sand and gravel. • "Well-graded" means approximately equal amounts of fine to coarse grain sizes • "Poorly graded" means unequal amounts of grain sizes • Group names separated by "/" means soil contains layers of the two soil types; e.g., SM/ML.

Soils were described and identified in the field in general accordance with the methods described in ASTM D2488. Where indicated in the log, soils were classified using ASTM D2487 or other laboratory tests as appropriate. Refer to the report accompanying these exploration logs for details.

1. Estimated or measured percentage by dry weight
2. (SPT) Standard Penetration Test (ASTM D1586)
3. Determined by SPT, DCPT (ASTM STP399) or other field methods. See report text for details.

GEOTECHNICAL LAB TESTS

MC = Natural Moisture Content
GS = Grain Size Distribution
FC = Fines Content (% < 0.075 mm)
GH = Hydrometer Test
AL = Atterberg Limits
C = Consolidation Test
Str = Strength Test
OC = Organic Content (% Loss by Ignition)
Comp = Proctor Test
K = Hydraulic Conductivity Test
SG = Specific Gravity Test

CHEMICAL LAB TESTS

Organic Chemicals

BTEX = Benzene, Toluene, Ethylbenzene, Xylenes
TPH-Dx = Diesel and Oil-Range Petroleum Hydrocarbons
TPH-G = Gasoline-Range Petroleum Hydrocarbons
VOCs = Volatile Organic Compounds
SVOCs = Semi-Volatile Organic Compounds
PAHs = Polycyclic Aromatic Hydrocarbon Compounds
PCBs = Polychlorinated Biphenyls

Metals

RCRA8 = As, Ba, Cd, Cr, Pb, Hg, Se, Ag, (d = dissolved, t = total)
MTCA5 = As, Cd, Cr, Hg, Pb (d = dissolved, t = total)
PP-13 = Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn (d=dissolved, t=total)

FIELD TESTS

PID = Photoionization Detector
Sheen = Oil Sheen Test
SPT[2] = Standard Penetration Test
NSPT = Non-Standard Penetration Test
DCPT = Dynamic Cone Penetration Test

COMPONENT DEFINITIONS

Descriptive Term		***Size Range and Sieve Number***
Boulders	=	Larger than 12 inches
Cobbles	=	3 inches to 12 inches
Coarse Gravel	=	3 inches to 3/4 inches
Fine Gravel	=	3/4 inches to No. 4 (4.75 mm)
Coarse Sand	=	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	=	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	=	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	=	Smaller than No. 200 (0.075 mm)

ESTIMATED[1] PERCENTAGE

% by Weight		***Modifier***	***% by Weight***		***Modifier***
<1	=	Subtrace	15 to 25	=	Little
1 to <5	=	Trace	30 to 45	=	Some
5 to 10	=	Few	>50	=	Mostly

MOISTURE CONTENT

Dry = Absence of moisture, dusty, dry to the touch
Slightly Moist = Perceptible moisture
Moist = Damp but no visible water
Very Moist = Water visible but not free draining
Wet = Visible free water, usually from below water table

RELATIVE DENSITY

Non-Cohesive or Coarse-Grained Soils

Density[3]		***SPT[2] Blows/Foot***	***Penetration with 1/2" Diameter Rod***
Very Loose	=	0 to 4	≥ 2'
Loose	=	5 to 10	1' to 2'
Medium Dense	=	11 to 30	3" to 1'
Dense	=	31 to 50	1" to 3"
Very Dense	=	> 50	< 1"

CONSISTENCY

Cohesive or Fine-Grained Soils

Consistency[3]		***SPT[2] Blows/Foot***	***Manual Test***
Very Soft	=	0 to 1	Penetrated >1" easily by thumb. Extrudes between thumb & fingers.
Soft	=	2 to 4	Penetrated 1/4" to 1" easily by thumb. Easily molded.
Medium Stiff	=	5 to 8	Penetrated >1/4" with effort by thumb. Molded with strong pressure.
Stiff	=	9 to 15	Indented ~1/4" with effort by thumb.
Very Stiff	=	16 to 30	Indented easily by thumbnail.
Hard	=	> 30	Indented with difficulty by thumbnail.

GEOLOGIC CONTACTS

Observed and Distinct —— Observed and Gradual —— Inferred – – –

Aspect CONSULTING

Exploration Log Key

Aspect CONSULTING	Norwegian Point Park Ring Levee - 190092		Geotechnical Exploration Log	
	Project Address & Site Specific Location Norwegian Point Park, Hansville, WA, See Figure 2		*Coordinates* NA	*Exploration Number* **TP-01**
Contractor High Meadows Excavating	*Equipment* Mini Excavator	*Sampling Method* Grab	*Ground Surface (GS) Elev. (NGVD29)* 7'	
Operator Andrew	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 3/27/2019	*Top of Casing Elev. (NGVD29)* NA	*Depth to Water (Below GS)* 4.67' (Static)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Blows/foot ▲ Water Content (%) ● 0 10 20 30 40 50	Blows/6'	Tests	Material Type	Description	Depth (ft)
								TOPSOIL; (4 inches thick)	
								FILL SILTY SAND (SM); loose, moist, gray; fine to coarse sand; fine to coarse, subrounded to rounded gravel. Becomes brown	
1	6								1
2	5	T-probe = 3-6 inches							2
3	4		🖑					**OLDER TOPSOIL HORIZON** SILTY SAND (SM); loose, moist, black; fine to medium sand; some organics.	3
								BEACH DEPOSITS SAND (SP); loose, wet, gray; mostly medium sand with few fine and coarse sand.	
4	3	Seepage and sidewall caving observed below 4 feet ▼ 3/27/2019							4
5	2		🖑			PS FC=1%			5
6	1								6
7	0	Test pit backfilled with excavated soils.						Bottom of exploration at 7 ft. bgs.	7
8	-1								8
9	-2								9
10	-3								10

Legend

Sample Type: 🖑 Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log
TP-01
Sheet 1 of 1

Aspect CONSULTING

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

	Project Address & Site Specific Location Norwegian Point Park, Hansville, WA, See Figure 2		*Coordinates* NA	*Exploration Number* **TP-02**
Contractor High Meadows Excavating	*Equipment* Mini Excavator	*Sampling Method* Grab	*Ground Surface (GS) Elev. (NGVD29)* 7'	
Operator Andrew	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 3/27/2019	*Top of Casing Elev. (NGVD29)* NA	*Depth to Water (Below GS)*

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Material Type	Description	Depth (ft)
								TOPSOIL; (2 inches thick)	
								FILL SILTY SAND WITH GRAVEL (SM); loose, moist, brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel.	
1	6							SAND WITH SILT (SP-SM); loose, moist, gray; mostly medium sand with few fine and coarse sand; few fine to coarse, subrounded to rounded gravel.	1
2	5							**OLDER TOPSOIL HORIZON** SILTY SAND (SM); loose, moist, dark gray; some organics and roots.	2
								BEACH DEPOSITS SAND (SP); very loose, moist, gray; mostly medium sand with some fine and coarse sand.	
3	4	T-probe = 2 inches							3
4	3	Moderate sidewall caving from 3 to 5 feet. ♀ 3/27/2019	☝					Becomes very moist	4
5	2							Becomes wet	5
6	1							SAND WITH GRAVEL (SP); very loose, wet; mostly medium sand with some fine and coarse sand; fine to coarse, rounded gravel; occassional cobbles.	6
7	0	Test pit backfilled with excavated soils.						Bottom of exploration at 7 ft. bgs.	7
8	-1								8
9	-2								9
10	-3								10

Legend

Sample Type
- ☝ Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level
- ♀ Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

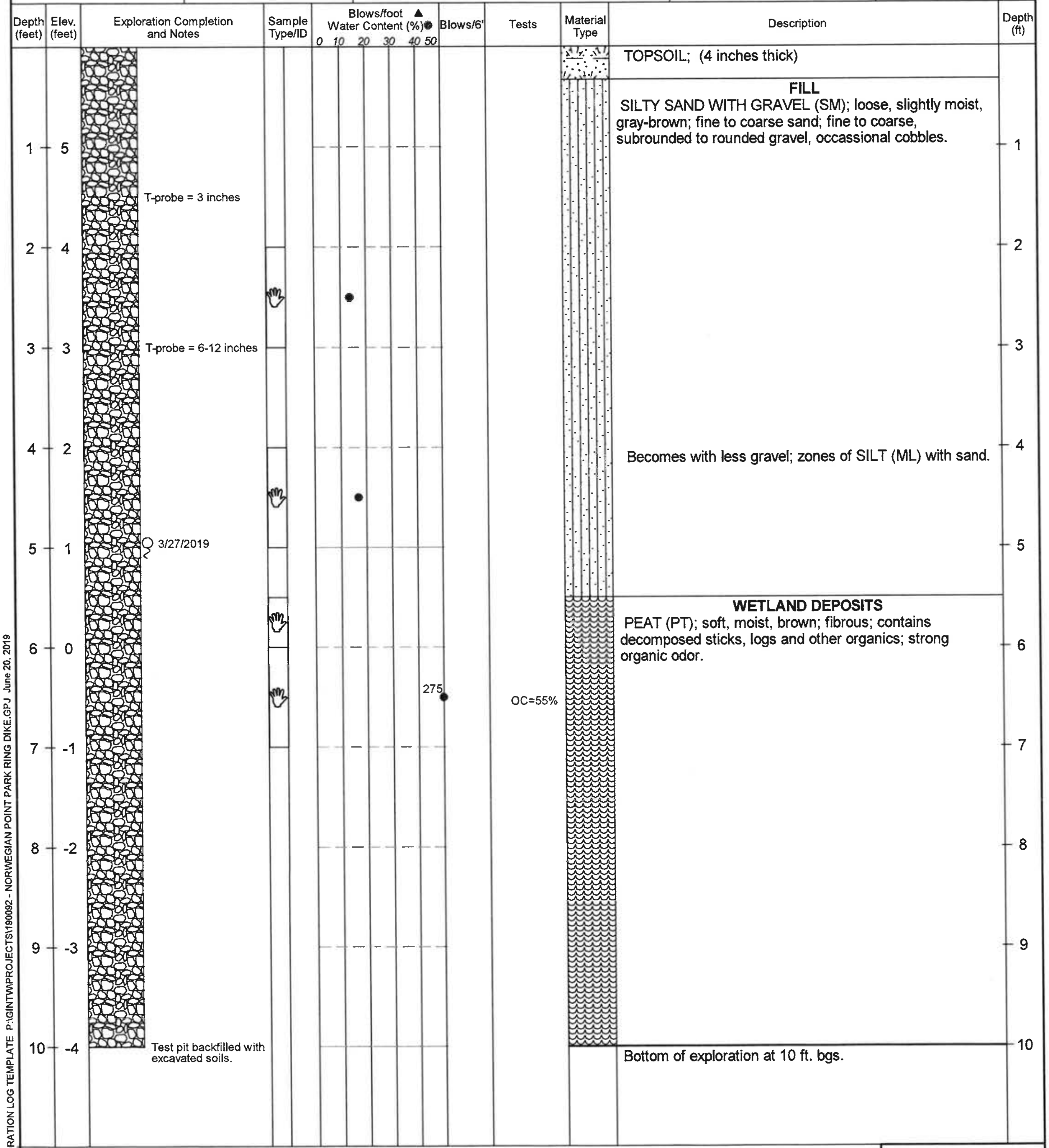
Exploration Log
TP-02
Sheet 1 of 1

Aspect CONSULTING

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location Norwegian Point Park, Hansville, WA, See Figure 2			*Coordinates* NA	*Exploration Number* **TP-03**
Contractor High Meadows Excavating	*Equipment* Mini Excavator	*Sampling Method* Grab	*Ground Surface (GS) Elev. (NGVD29)* 6'	
Operator Andrew	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 3/27/2019	*Top of Casing Elev. (NGVD29)* NA	*Depth to Water (Below GS)*



TOPSOIL; (4 inches thick)

FILL

SILTY SAND WITH GRAVEL (SM); loose, slightly moist, gray-brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel, occassional cobbles.

Becomes with less gravel; zones of SILT (ML) with sand.

WETLAND DEPOSITS

PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics; strong organic odor.

Bottom of exploration at 10 ft. bgs.

Legend

Sample Type: 🖐 Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: Water Level (Seepage)

See Exploration Log Key for explanation of symbols

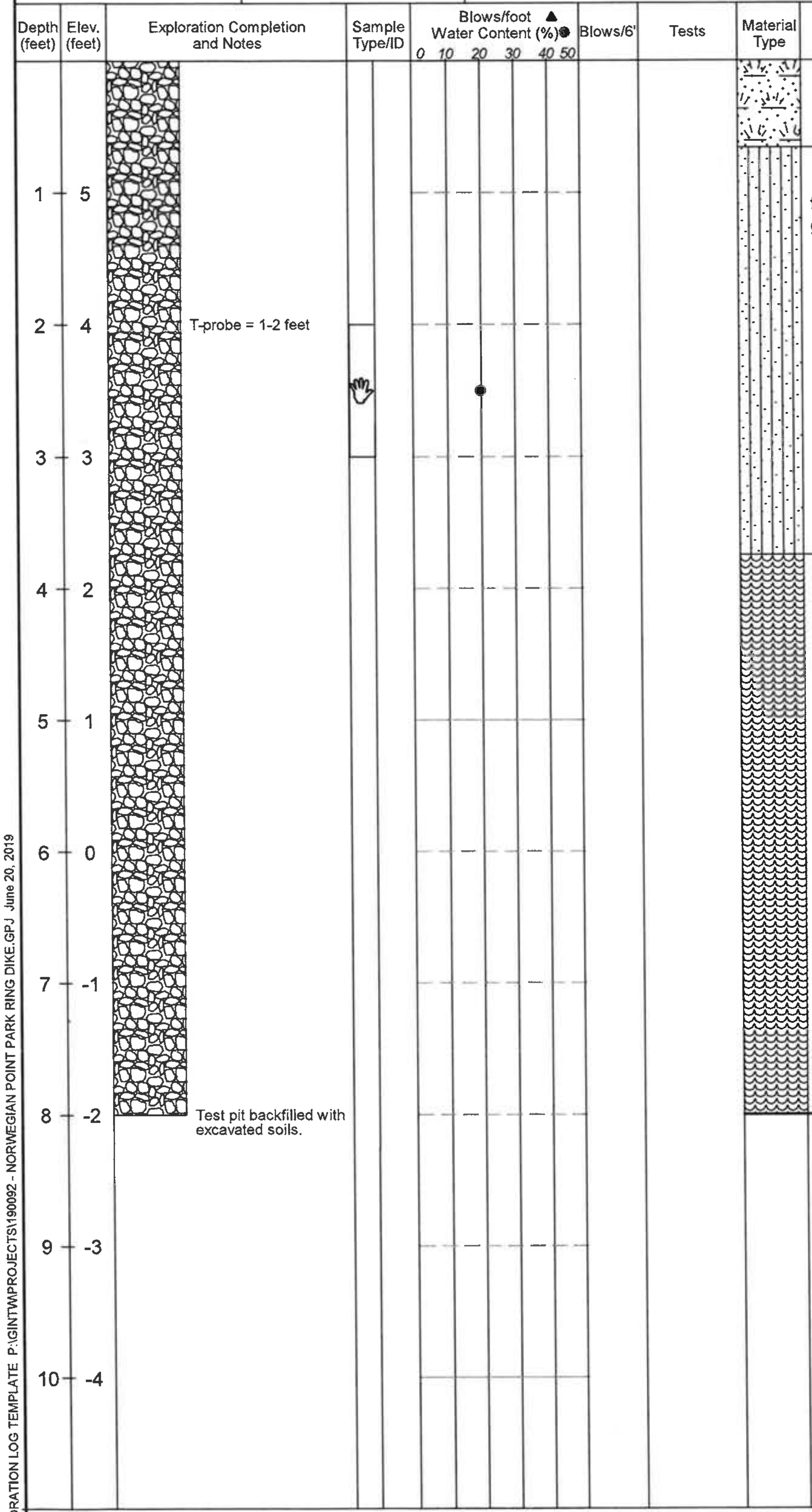
Logged by: ECS
Approved by: ECS

Exploration Log
TP-03
Sheet 1 of 1

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location			*Coordinates*	*Exploration Number*
Norwegian Point Park, Hansville, WA, See Figure 2			NA	**TP-04**
Contractor	*Equipment*	*Sampling Method*	*Ground Surface (GS) Elev. (NGVD29)*	
High Meadows Excavating	Mini Excavator	Grab	6'	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019	NA	No Water Encountered



Description	Depth (ft)
TOPSOIL; (8 inches thick)	
FILL SILTY SAND WITH GRAVEL (SM); loose, wet, gray; fine to coarse sand; fine to coarse, subrounded to rounded gravel.	1 2 3
WETLAND DEPOSITS PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics; strong organic odor.	4 5 6 7
Bottom of exploration at 8 ft. bgs.	8 9 10

Legend

Sample Type: 🖐 Grab sample

Plastic Limit ├──┤ Liquid Limit

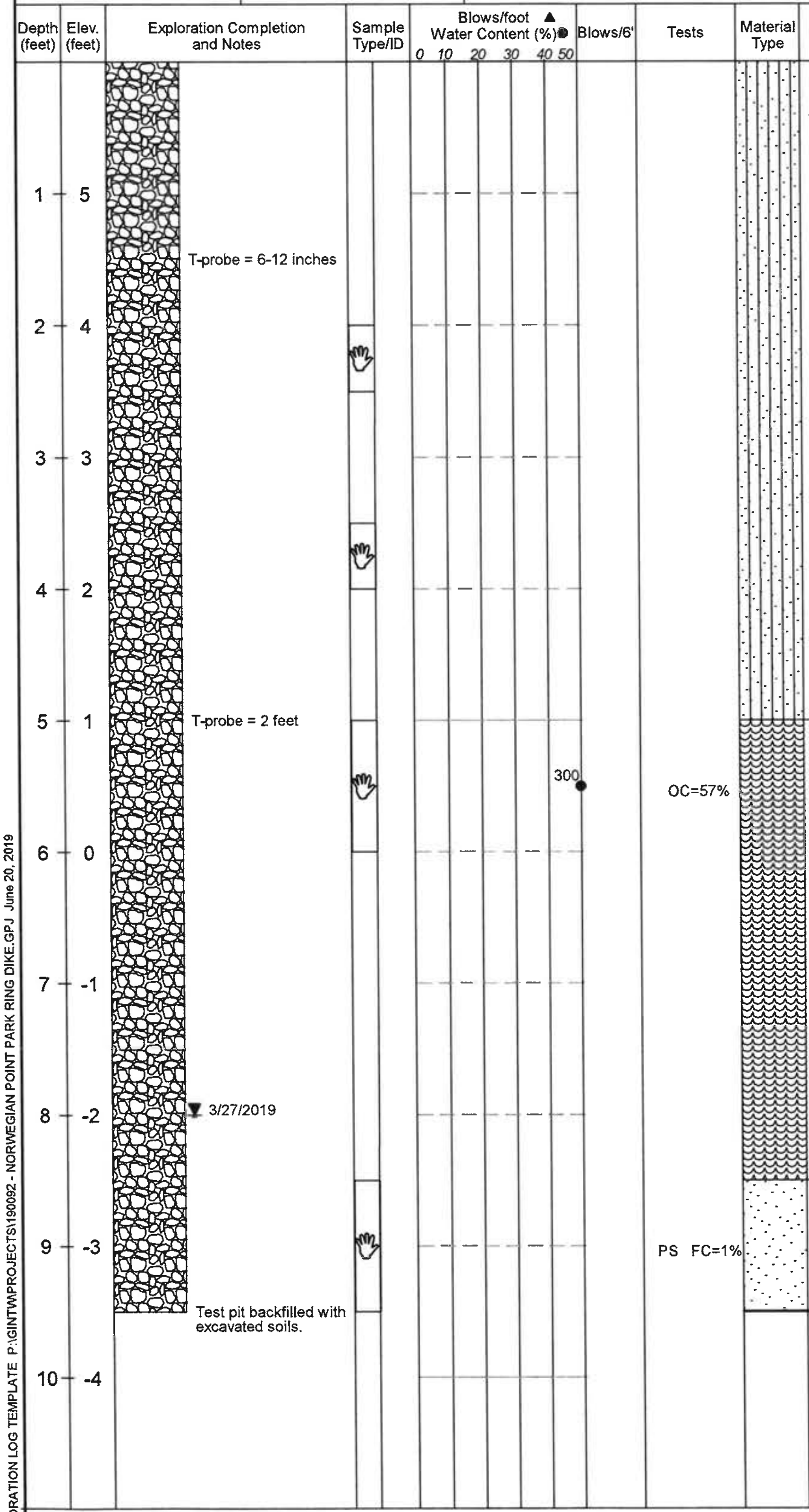
Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log
TP-04
Sheet 1 of 1

Aspect CONSULTING	Norwegian Point Park Ring Levee - 190092		Geotechnical Exploration Log	
	Project Address & Site Specific Location		*Coordinates*	*Exploration Number*
	Norwegian Point Park, Hansville, WA, See Figure 2		NA	**TP-05**
Contractor	*Equipment*	*Sampling Method*	*Ground Surface (GS) Elev. (NGVD29)*	
High Meadows Excavating	Mini Excavator	Grab	6'	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019	NA	8' (Static)



Description	Depth (ft)
FILL SILTY SAND WITH GRAVEL (SM); loose, moist, gray; fine to coarse sand; fine to coarse, rounded gravel.	
	1
	2
Becomes very moist	3
	4
WETLAND DEPOSITS PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics. Log encountered at 5.5 feet	5
	6
	7
	8
BEACH DEPOSITS SAND (SP); loose, wet, gray; mostly medium sand with some fine and coarse sand.	9
Bottom of exploration at 9.5 ft. bgs.	
	10

Plastic Limit ├──┤ Liquid Limit

Legend

Sample Type: ▨ Grab sample

Water Level: ▼ Static Water Level

See Exploration Log Key for explanation of symbols

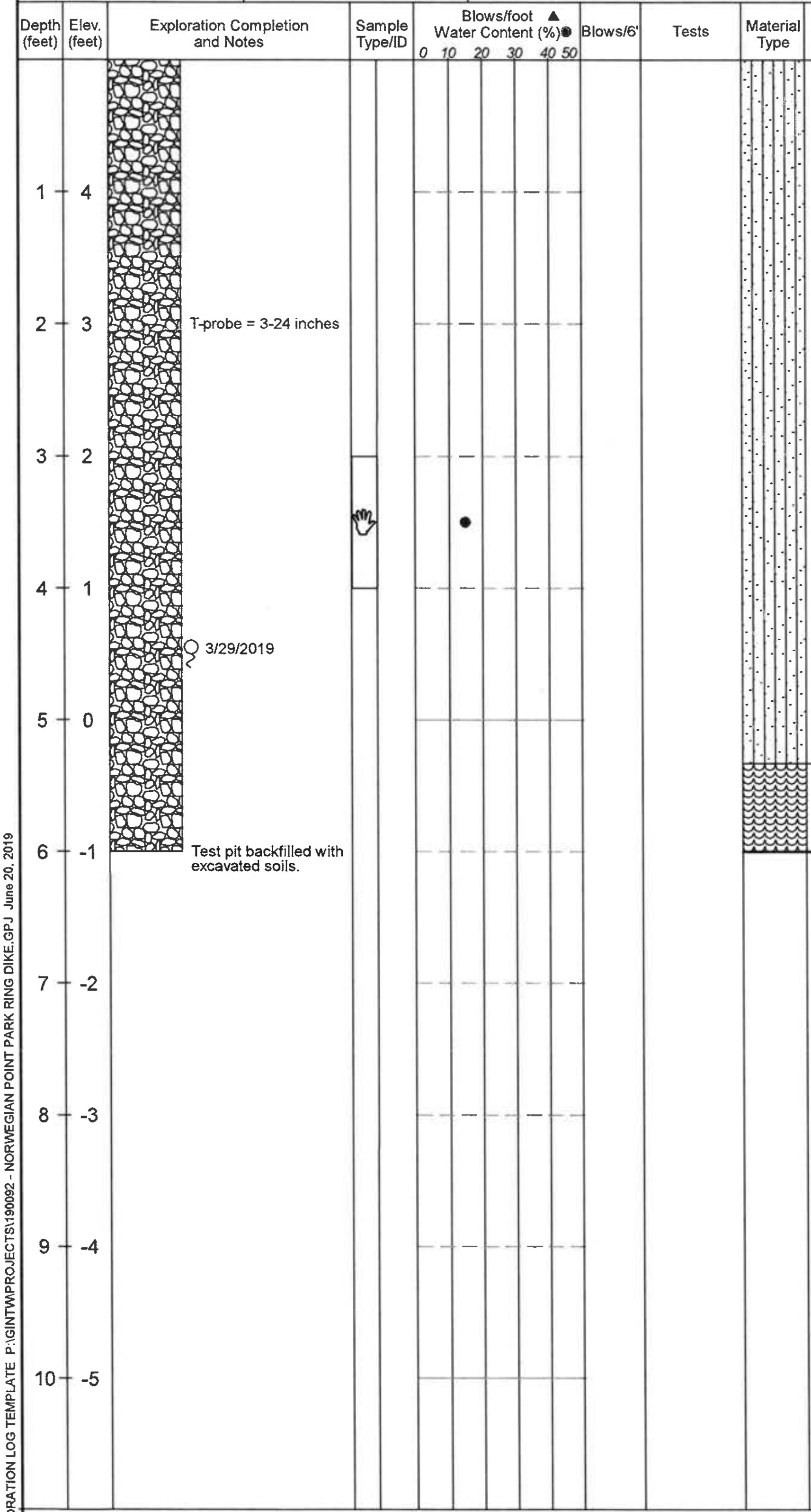
Logged by: ECS
Approved by: ECS

Exploration Log
TP-05
Sheet 1 of 1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\190092 - NORWEGIAN POINT PARK RING DIKE.GPJ June 20, 2019

Norwegian Point Park Ring Levee - 190092 | **Geotechnical Exploration Log**

Project Address & Site Specific Location			*Coordinates*	*Exploration Number*
Norwegian Point Park, Hansville, WA, See Figure 2			NA	**TP-06**
Contractor	*Equipment*	*Sampling Method*	*Ground Surface (GS) Elev. (NGVD29)*	
High Meadows Excavating	Mini Excavator	Grab	5'	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019	NA	



Depth (ft)	Description
0	**FILL** SILTY SAND WITH GRAVEL (SM); loose, moist, gray; fine to coarse sand; fine to coarse, subrounded to rounded gravel.
3.5	Becomes very moist
5.3	**WETLAND DEPOSITS** PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics.
6	Bottom of exploration at 6 ft. bgs.

Legend

Sample Type: 🖐 Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: ♀ Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log
TP-06
Sheet 1 of 1

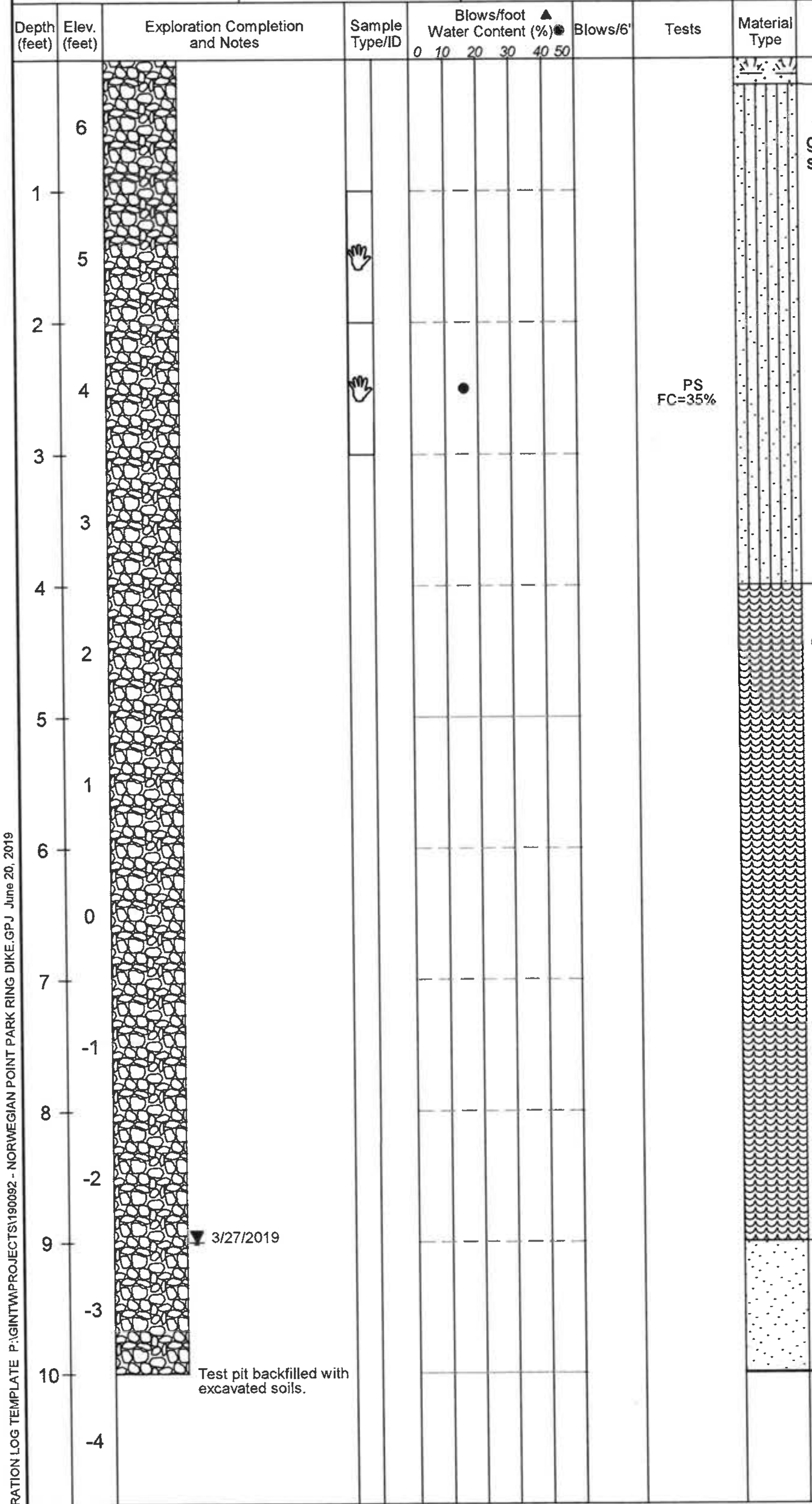
NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\190092 - NORWEGIAN POINT PARK RING DIKE.GPJ June 20, 2019

Aspect CONSULTING

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location			*Coordinates*	*Exploration Number*
Norwegian Point Park, Hansville, WA, See Figure 2			NA	**TP-07**
Contractor	*Equipment*	*Sampling Method*	*Ground Surface (GS) Elev. (NGVD29)*	
High Meadows Excavating	Mini Excavator	Grab	6.5'	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019	NA	9' (Static)



Description	Depth (ft)
TOPSOIL; (2 inches thick)	
FILL SILTY SAND WITH GRAVEL (SM); loose, moist, gray-brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel; occasional cobbles.	1
Becomes moist to very moist	2
	3
Becomes blue-gray	
WETLAND DEPOSITS PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics.	4
	5
	6
	7
	8
BEACH DEPOSITS SAND (SP); very loose, wet, gray; mostly medium sand with some fine and coarse sand.	9
Bottom of exploration at 10 ft. bgs.	10

Legend

Sample Type: ⊠ Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log TP-07

Sheet 1 of 1

Aspect CONSULTING	Norwegian Point Park Ring Levee - 190092		Geotechnical Exploration Log	
	Project Address & Site Specific Location Norwegian Point Park, Hansville, WA, See Figure 2		Coordinates NA	Exploration Number **TP-08**
Contractor High Meadows Excavating	Equipment Mini Excavator	Sampling Method Grab	Ground Surface (GS) Elev. (NGVD29) 7.5'	
Operator Andrew	Exploration Method(s) Test Pit	Work Start/Completion Dates 3/27/2019	Top of Casing Elev. (NGVD29) NA	Depth to Water (Below GS)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6'	Tests	Material Type	Description	Depth (ft)
								TOPSOIL; (4 inches thick)	
	7							**FILL** SILTY SAND WITH GRAVEL (SM); loose, moist, blue-gray; fine to coarse sand; fine to coarse, subrounded to rounded gravel, occasional cobbles.	
1									1
	6								
2		T-probe = 2 feet							2
	5		☒						
3								**WETLAND DEPOSITS** SILTY SAND (SM); very loose, moist, brown; fine to medium sand; abundant organics and wood debris.	3
	4		☒						
4									4
	3							Log encountered at 4.5 feet	
5									5
	2								
6		♀ 3/27/2019						**BEACH DEPOSITS** SAND (SP); very loose, wet, gray; mostly medium sand with some fine and coarse sand.	6
	1								
7								**WETLAND DEPOSITS** PEAT (PT); soft, very moist, brown; fibrous; contains decomposed sticks, logs and other organics.	7
	0		☒	175●		OC=28%			
8									8
	-1	♀ 3/27/2019						**BEACH DEPOSITS** SAND (SP); very loose, wet, gray; mostly medium sand with some fine and coarse sand.	
9									9
	-2								
10		Test pit backfilled with excavated soils.						Bottom of exploration at 10 ft. bgs.	10
	-3								

Legend

Sample Type
☒ Grab sample

Plastic Limit ├──┤ Liquid Limit

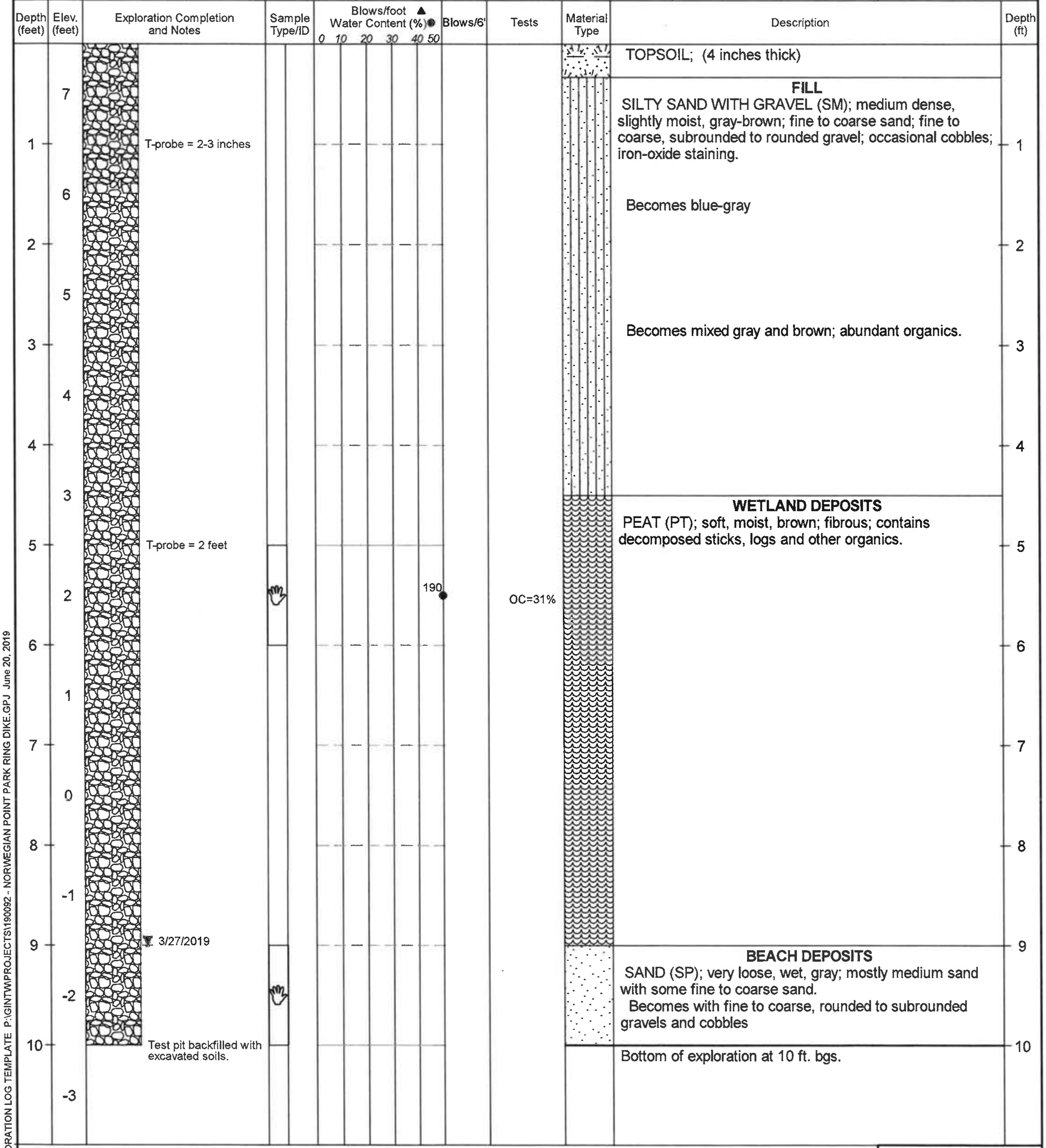
Water Level
♀ Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log
TP-08
Sheet 1 of 1

Aspect CONSULTING	Norwegian Point Park Ring Levee - 190092		Geotechnical Exploration Log	
	Project Address & Site Specific Location Norwegian Point Park, Hansville, WA, See Figure 2		*Coordinates* NA	*Exploration Number* **TP-09**
Contractor High Meadows Excavating	*Equipment* Mini Excavator	*Sampling Method* Grab	*Ground Surface (GS) Elev. (NGVD29)* 7.5'	
Operator Andrew	*Exploration Method(s)* Test Pit	*Work Start/Completion Dates* 3/27/2019	*Top of Casing Elev. (NGVD29)* NA	*Depth to Water (Below GS)* 9' (Static)



T-probe = 2-3 inches

T-probe = 2 feet

▼ 3/27/2019

Test pit backfilled with excavated soils.

TOPSOIL; (4 inches thick)

FILL

SILTY SAND WITH GRAVEL (SM); medium dense, slightly moist, gray-brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel; occasional cobbles; iron-oxide staining.

Becomes blue-gray

Becomes mixed gray and brown; abundant organics.

WETLAND DEPOSITS

PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics.

BEACH DEPOSITS

SAND (SP); very loose, wet, gray; mostly medium sand with some fine to coarse sand.

Becomes with fine to coarse, rounded to subrounded gravels and cobbles

Bottom of exploration at 10 ft. bgs.

Legend

Sample Type: 🖐 Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log
TP-09
Sheet 1 of 1

Aspect CONSULTING

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location	Coordinates	Exploration Number
Norwegian Point Park, Hansville, WA, See Figure 2	NA	TP-10

Contractor	Equipment	Sampling Method	Ground Surface (GS) Elev. (NGVD29)
High Meadows Excavating	Mini Excavator	Grab	6'

Operator	Exploration Method(s)	Work Start/Completion Dates	Top of Casing Elev. (NGVD29)	Depth to Water (Below GS)
Andrew	Test Pit	3/27/2019	NA	

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6'	Tests	Description	Depth (ft)
0	6						TOPSOIL; (4 inches thick)	
							FILL SILTY SAND WITH GRAVEL (SM); loose, moist, brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel	
1	5							1
2	4							2
			🖑					
3	3	♀ 3/27/2019						3
							OLDER TOPSOIL HORIZON SILTY SAND (SM); loose, moist, black; fine to medium sand; abundant organics.	
4	2		🖑					4
							WETLAND DEPOSITS PEAT (PT); soft, moist, brown; fibrous; contains decomposed sticks, logs and other organics.	
5	1							5
6	0							6
7	-1		🖑	409●		OC=56%		7
8	-2							8
9	-3	Test pit backfilled with excavated soils.					Bottom of exploration at 9 ft. bgs.	9
10	-4							10

Legend

Sample Type
- 🖑 Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level
- ♀ Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log
TP-10
Sheet 1 of 1

Aspect CONSULTING

Norwegian Point Park Ring Levee - 190092

Geotechnical Exploration Log

Project Address & Site Specific Location			*Coordinates*	*Exploration Number*
Norwegian Point Park, Hansville, WA, See Figure 2			NA	**TP-11**
Contractor	*Equipment*	*Sampling Method*	*Ground Surface (GS) Elev. (NGVD29)*	
High Meadows Excavating	Mini Excavator	Grab	6'	
Operator	*Exploration Method(s)*	*Work Start/Completion Dates*	*Top of Casing Elev. (NGVD29)*	*Depth to Water (Below GS)*
Andrew	Test Pit	3/27/2019	NA	6' (Static)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50	Blows/6"	Tests	Description	Depth (ft)
0	6						TOPSOIL; (4 inches thick)	
							FILL SILTY SAND WITH GRAVEL (SM); loose, moist, gray-brown; fine to coarse sand; fine to coarse, subrounded to rounded gravel.	
1	5							1
2	4							2
3	3							3
			🖐				**OLDER TOPSOIL HORIZON** SILTY SAND (SM); loose, moist, black; fine to medium sand; abundant organics.	
4	2						**BEACH DEPOSITS** SAND (SP); very moist, gray; mostly medium sand with some fine and coarse sand.	4
5	1		🖐	198●		OC=17%	**WETLAND DEPOSITS** PEAT (PT); soft, very moist, brown; fibrous; contains decomposed sticks, logs and other organics.	5
							BEACH DEPOSITS SAND (SP); very loose, wet, gray; mostly medium sand with some fine and coarse sand.	
6	0	▼ 3/27/2019						6
7	-1	Test pit backfilled with excavated soils.					Test pit terminated upon practical refusal on possible log Bottom of exploration at 7 ft. bgs.	7
8	-2							8
9	-3							9
10	-4							10

Legend

Sample Type: 🖐 Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: ECS
Approved by: ECS

Exploration Log
TP-11
Sheet 1 of 1

APPENDIX B

Laboratory Testing Results

B. Laboratory Test Methods

Laboratory tests were conducted on selected soil samples collected from the test pits to characterize certain physical and engineering properties of the soils. Laboratory tests included determination of moisture content, fines content, grain-size distribution, organic content, and compaction characteristics (proctor) testing. The laboratory tests were conducted in general accordance with appropriate ASTM test methods. The results of the laboratory tests are provided in the attached data sheets.

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Client: Aspect Consulting
Address: 401 2nd Ave S
Seattle, WA 98104
Attn: Eric Schellenger
Revised on:

Date: April 10, 2019
Project: Q.C. - NPP Ring Dike
Project #: 18B011-15
Sample #: B19-0190, 0191, 0193 & 0196
Date sampled: Not Reported

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
	Sieve Analysis			Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count				
X	Moisture Content	See Report			
	Specific Gravity, Coarse				
	Specific Gravity, Fine				
	Hydrometer Analysis				
	Atterberg Limits				

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Respectfully Submitted,
Meghan Blodgett-Carrillo
Laboratory Technician

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Project: Q.C. - NPP Ring Dike
Project #: 18B011-15
Date Received: April 5, 2019
Date Tested: April 8, 2019

Client: Aspect Consulting

Sampled by: Client
Tested by: A. Eifrig

Moisture Content - AASHTO T-265

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B19-0190	TP-3 @ 2-3'	378.2	1652.5	1495.5	157.0	1117.3	14.1%
B19-0191	TP-3 @ 4-5'	380.1	1647.8	1462.8	185.0	1082.7	17.1%
B19-0193	TP-4 @ 2-3'	413.8	1475.8	1298.5	177.3	884.7	20.0%
B19-0196	TP-6 @ 3-4'	379.8	1362.8	1235.7	127.1	855.9	14.8%

All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Reviewed by: Meghan Blodgett Carrillo

Meghan Blodgett-Carrillo

Corporate ~ 777 Chrysler Drive • Burlington, WA 98233 • Phone (360) 755-1990 • Fax (360) 755-1980

Regional Offices: Olympia ~ 360.534.9777 Bellingham ~ 360.647.6111 Silverdale ~ 360.698.6787 Tukwila ~ 206.241.1974

Visit our website: www.mtc-inc.net

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

MTC

Client: Aspect Consulting
Address: 401 2nd Ave S
Seattle, WA 98104
Attn: Eric Schellenger
Revised on:

Date: April 10, 2019
Project: Q.C. - NPP Ring Dike
Project #: 18B011-15
Sample #: B19-0192, 0194, 0199, 0200, 0201 & 0202
Date sampled: Not Reported

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
	Sieve Analysis			Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count				
	Moisture Content				
	Specific Gravity, Coarse				
	Specific Gravity, Fine				
	Hydrometer Analysis				
	Atterberg Limits				
X	Organic Content	See Report			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Meghan Blodgett Carrillo

Respectfully Submitted,
Meghan Blodgett-Carrillo
Laboratory Technician

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Project: Q.C. - NPP Ring Dike
Project #: 18B110-15
Date Received: April 5, 2019
Date Tested: April 9, 2019

Client: Aspect Consulting

Sampled by: Client
Tested by: A. Eifrig

Moisture Content - AASHTO T-265

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B19-0192	TP-3 @ 6-7'	707.9	1807.8	1001.4	806.4	293.5	274.8%
B19-0194	TP-5 @ 5-6'	731.1	1896.0	1022.0	874.0	290.9	300.4%
B19-0199	TP-8 @ 7-8'	759.4	1830.2	1145.3	684.9	385.9	177.5%
B19-0200	TP-9 @ 5-6'	724.1	1879.1	1175.6	703.5	451.5	155.8%
B19-0201	TP-10 @ 6-8'	645.4	1752.4	863.1	889.3	217.7	408.5%
B19-0202	TP-11 @ 5'	688.8	2026.9	1139.4	887.5	450.6	197.0%

Organic Content - AASHTO T-267

Sample #	Location	Tare	Soil + Tare, Pre-Ignition	Soil + Tare, Post Ignition	% Organics
B19-0192	TP-3 @ 6-7'	49.9	68.8	58.5	54.5%
B19-0194	TP-5 @ 5-6'	52.7	63.3	57.3	56.6%
B19-0199	TP-8 @ 7-8'	51.7	70.1	65.5	25.0%
B19-0200	TP-9 @ 5-6'	51.5	82.6	77.6	16.1%
B19-0201	TP-10 @ 6-8'	49.1	63.0	55.2	56.1%
B19-0202	TP-11 @ 5'	46.4	76.1	72.7	11.4%

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Client: Aspect Consulting
Address: 401 2nd Ave S
Seattle, WA 98104
Attn: Eric Schellenger
Revised on:

Date: April 16, 201
Project: Q.C. - NPP R
Project #: 18B011-15
Sample #: B19-0199, 02
Date sampled: Not Reported

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing w current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:
	Sieve Analysis			Sulfate Soundness
	Proctor			Bulk Density & Voids
	Sand Equivalent			WSDOT Degradation
	Fracture Count			
	Moisture Content			
	Specific Gravity, Coarse			
	Specific Gravity, Fine			
	Hydrometer Analysis			
	Atterberg Limits			
X	Organic Content	See Report		

If you have any questions concerning the test results, the procedures used, or if we can be of any further ass number below.

Respectfully Submitted,

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Project: Q.C. - NPP Ring Dike
Project #: 18B110-15
Date Received: April 5, 2019
Date Tested: April 15, 2019

Client: Aspect Consulting

Sampled by: Client
Tested by: A. Eifrig

Moisture Content - AASHTO T-265

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B19-0199 Re-test	TP-8 @ 7-8'	690.0	1250.5	893.7	356.8	203.7	175.2%
B19-0200 Re-test	TP-9 @ 5-6'	719.3	1621.9	1031.0	590.9	311.7	189.6%
B19-0202 Re-test	TP-11 @ 5'	686.9	1317.2	898.8	418.4	211.9	197.5%

Organic Content - AASHTO T-267

Sample #	Location	Tare	Soil + Tare, Pre-Ignition	Soil + Tare, Post Ignition	% Organics
B19-0199 Re-test	TP-8 @ 7-8'	68.5	106.2	95.9	27.3%
B19-0200 Re-test	TP-9 @ 5-6'	64.0	112.9	97.6	31.3%
B19-0202 Re-test	TP-11 @ 5'	68.1	122.0	112.9	16.9%

Reviewed by:

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Client: Aspect Consulting
Address: 401 2nd Ave S
Seattle, WA 98104
Attn: Eric Schellenger
Revised on:

Date: April 10, 2019
Project: Q.C. - NPP Ring Dike
Project #: 18B011-15
Sample #: B19-0189
Date sampled: Not Reported

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	See Report		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count				
	Moisture Content				
	Specific Gravity, Coarse				
	Specific Gravity, Fine				
	Hydrometer Analysis				
	Atterberg Limits				

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Respectfully Submitted,
Meghan Blodgett-Carrillo
Laboratory Technician

Sieve Report

Project: Q.C. - NPP Ring Dike
Project #: 18B011-15
Client: Aspect Consulting
Source: TP-1 @ 5-6'
Sample#: B19-0189

Date Received: 5-Apr-19
Sampled By: Client
Date Tested: 8-Apr-19
Tested By: A. Eifrig

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
Gray

AASHTO T-176, AASHTO T-255, AASTHO T-335, AASHTO T-89, AASHTO T-90

Specifications
No Specs
Sample Meets Specs ? N/A

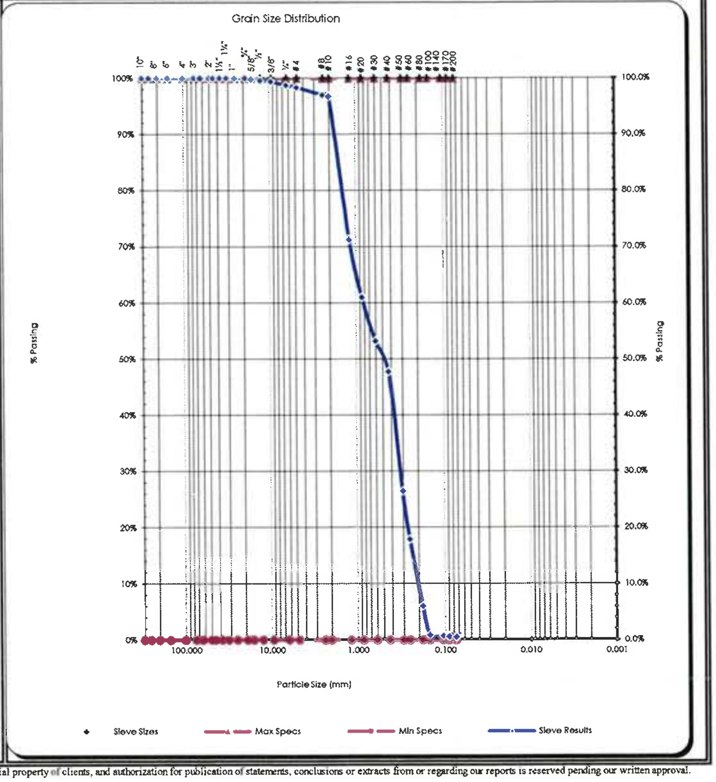
$D_{(5)}$ = 0.174 mm
$D_{(10)}$ = 0.203 mm
$D_{(15)}$ = 0.232 mm
$D_{(30)}$ = 0.320 mm
$D_{(50)}$ = 0.495 mm
$D_{(60)}$ = 0.817 mm
$D_{(90)}$ = 1.782 mm
Dust Ratio = 1/87

% Gravel = 1.6%
% Sand = 97.8%
% Silt & Clay = 0.6%
Liquid Limit = n/a
Plasticity Index = n/a
Sand Equivalent = n/a
Fracture %, 1 Face = n/a
Fracture %, 2+ Faces = n/a

Coeff. of Curvature, C_C = 0.62
Coeff. of Uniformity, C_U = 4.02
Fineness Modulus = 2.53
Plastic Limit = n/a
Moisture %, as sampled = n/a
Req'd Sand Equivalent =
Req'd Fracture %, 1 Face =
Req'd Fracture %, 2+ Faces =

ASTM C136 - AASHTO T11/T27

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	99%	99%	100.0%	0.0%
1/4"	6.30		99%	100.0%	0.0%
#4	4.75	98%	98%	100.0%	0.0%
#8	2.36		97%	100.0%	0.0%
#10	2.00	97%	97%	100.0%	0.0%
#16	1.18		71%	100.0%	0.0%
#20	0.850		61%	100.0%	0.0%
#30	0.600		53%	100.0%	0.0%
#40	0.425	48%	48%	100.0%	0.0%
#50	0.300		27%	100.0%	0.0%
#60	0.250		18%	100.0%	0.0%
#80	0.180		6%	100.0%	0.0%
#100	0.150	1%	1%	100.0%	0.0%
#140	0.106		1%	100.0%	0.0%
#170	0.090		1%	100.0%	0.0%
#200	0.075	0.6%	0.6%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Client: Aspect Consulting
Address: 401 2nd Ave S
Seattle, WA 98104
Attn: Eric Schellenger
Revised on:

Date: April 10, 2019
Project: Q.C. - NPP Ring Dike
Project #: 18B011-15
Sample #: B19-0195
Date sampled: Not Reported

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	See Report		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count				
	Moisture Content				
	Specific Gravity, Coarse				
	Specific Gravity, Fine				
	Hydrometer Analysis				
	Atterberg Limits				

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Respectfully Submitted,
Meghan Blodgett-Carrillo
Laboratory Technician

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Sieve Report

Project: Q.C. - NPP Ring Dike
Project #: 18B011-15
Client: Aspect Consulting
Source: TP-5 @ 8.5-9.5'
Sample#: B19-0195

Date Received: 5-Apr-19
Sampled By: Client
Date Tested: 8-Apr-19
Tested By: A. Eifrig

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
Gray

ACCREDITED

AASHTO T-176, AASHTO T-255, AASTHO T-335, AASHTO T-89, AASHTO T-90

Specifications
No Specs
Sample Meets Specs ? N/A

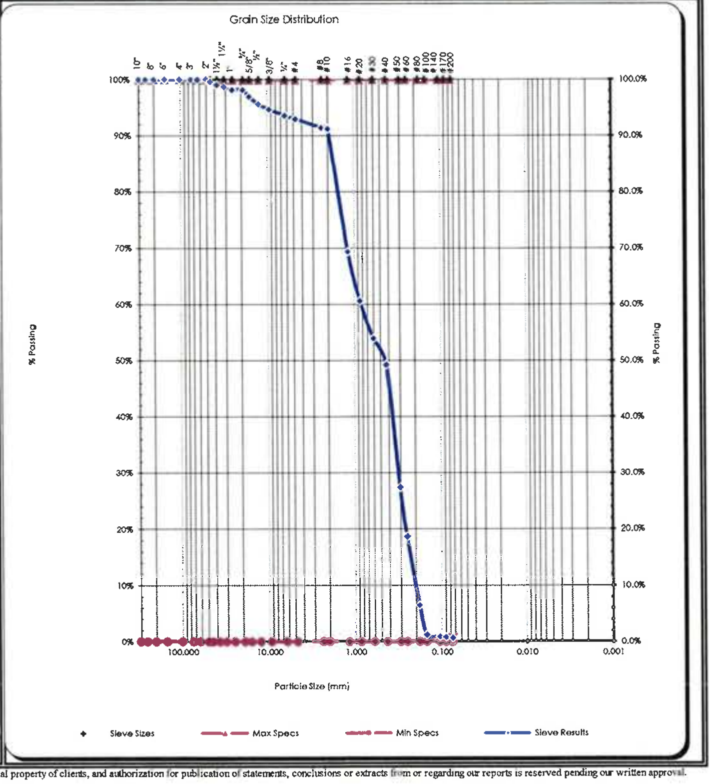
$D_{(5)}$ = 0.172 mm
$D_{(10)}$ = 0.200 mm
$D_{(15)}$ = 0.229 mm
$D_{(30)}$ = 0.315 mm
$D_{(50)}$ = 0.450 mm
$D_{(60)}$ = 0.826 mm
$D_{(90)}$ = 1.953 mm
Dust Ratio = 1/71

% Gravel = 7.0%
% Sand = 92.3%
% Silt & Clay = 0.7%
Liquid Limit = n/a
Plasticity Index = n/a
Sand Equivalent = n/a
Fracture %, 1 Face = n/a
Fracture %, 2+ Faces = n/a

Coeff. of Curvature, C_C = 0.60
Coeff. of Uniformity, C_U = 4.13
Fineness Modulus = 2.70
Plastic Limit = n/a
Moisture %, as sampled = n/a
Req'd Sand Equivalent =
Req'd Fracture %, 1 Face =
Req'd Fracture %, 2+ Faces =

ASTM C136 - AASHTO T11/T27

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		99%	100.0%	0.0%
1.25"	31.50		99%	100.0%	0.0%
1.00"	25.00	98%	98%	100.0%	0.0%
3/4"	19.00	98%	98%	100.0%	0.0%
5/8"	16.00		97%	100.0%	0.0%
1/2"	12.50	96%	96%	100.0%	0.0%
3/8"	9.50	95%	95%	100.0%	0.0%
1/4"	6.30		94%	100.0%	0.0%
#4	4.75	93%	93%	100.0%	0.0%
#8	2.36		91%	100.0%	0.0%
#10	2.00	91%	91%	100.0%	0.0%
#16	1.18		69%	100.0%	0.0%
#20	0.850		61%	100.0%	0.0%
#30	0.600		54%	100.0%	0.0%
#40	0.425	49%	49%	100.0%	0.0%
#50	0.300		27%	100.0%	0.0%
#60	0.250		19%	100.0%	0.0%
#80	0.180		6%	100.0%	0.0%
#100	0.150	1%	1%	100.0%	0.0%
#140	0.106		1%	100.0%	0.0%
#170	0.090		1%	100.0%	0.0%
#200	0.075	0.7%	0.7%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Client:	Aspect Consulting	**Date:**	April 9, 2019
Address:	401 2nd Ave S	**Project:**	Q.C. - NPP Ring Dike
	Seattle, WA 98104	**Project #:**	19B110
Attn:	Eric Schellenger	**Sample #:**	B19-0197
Revised on:		**Date sampled:**	Not Reported

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	See Report		Sulfate Soundness	
X	Proctor	133.8 pcf at 7.5%		Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count				
X	Moisture Content	15.5% moisture			
	Specific Gravity, Coarse				
	Specific Gravity, Fine				
	Hydrometer Analysis				
	Atterberg Limits				

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Respectfully Submitted,
Meghan Blodgett-Carrillo
Laboratory Technician

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Sieve Report

Project: Q.C. - NPP Ring Dike
Project #: 19B110
Client: Aspect Consulting
Source: TP-7 @ 2-3'
Sample#: B19-0197

Date Received: 5-Apr-19
Sampled By: Client
Date Tested: 8-Apr-19
Tested By: A. Eifrig

Unified Soil Classification System, ASTM-2487
SM, Silty Sand
Sample Color:
Brown

ACCREDITED

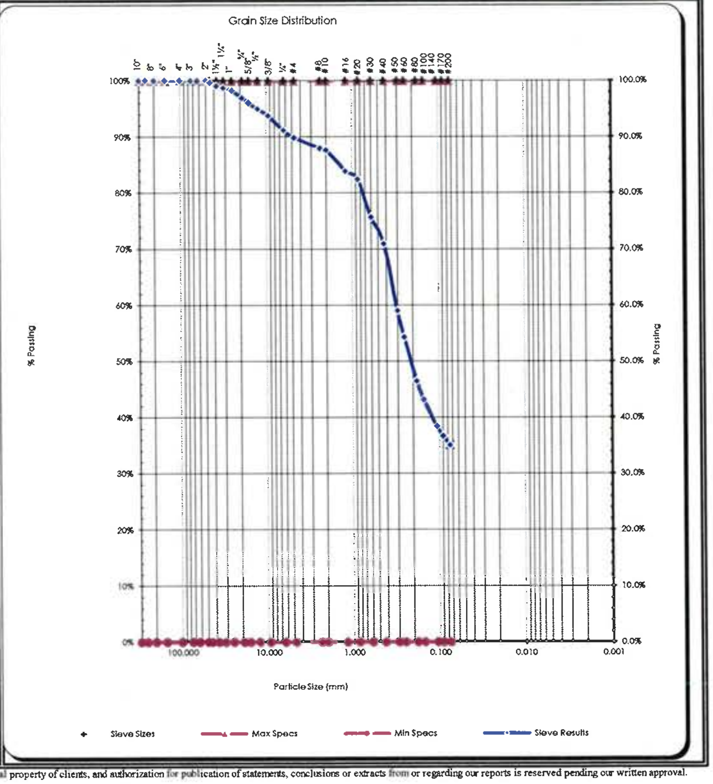
AASHTO T-176, AASHTO T-255, AASTHO T-335, AASHTO T-89, AASHTO T-90

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.011 mm	% Gravel = 10.1%	Coeff. of Curvature, C_C = 0.62
$D_{(10)}$ = 0.021 mm	% Sand = 54.8%	Coeff. of Uniformity, C_U = 14.49
$D_{(15)}$ = 0.032 mm	% Silt & Clay = 35.1%	Fineness Modulus = 1.69
$D_{(30)}$ = 0.064 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.211 mm	Plasticity Index = n/a	Moisture %, as sampled = 15.5%
$D_{(60)}$ = 0.309 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 4.887 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 45/91	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136 - AASHTO T11/T27

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		99%	100.0%	0.0%
1.25"	31.50		99%	100.0%	0.0%
1.00"	25.00	98%	98%	100.0%	0.0%
3/4"	19.00	97%	97%	100.0%	0.0%
5/8"	16.00		96%	100.0%	0.0%
1/2"	12.50	95%	95%	100.0%	0.0%
3/8"	9.50	94%	94%	100.0%	0.0%
1/4"	6.30		91%	100.0%	0.0%
#4	4.75	90%	90%	100.0%	0.0%
#8	2.36		88%	100.0%	0.0%
#10	2.00	88%	88%	100.0%	0.0%
#16	1.18		84%	100.0%	0.0%
#20	0.850	82%	82%	100.0%	0.0%
#30	0.600		76%	100.0%	0.0%
#40	0.425	71%	71%	100.0%	0.0%
#50	0.300		59%	100.0%	0.0%
#60	0.250	54%	54%	100.0%	0.0%
#80	0.180		47%	100.0%	0.0%
#100	0.150	43%	43%	100.0%	0.0%
#140	0.106		38%	100.0%	0.0%
#170	0.090		37%	100.0%	0.0%
#200	0.075	35.1%	35.1%	100.0%	0.0%



Comments: ____________________

Reviewed by: ____________________
Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Proctor Report

Project: Q.C. - NPP Ring Dike
Project #: 19B110
Client: Aspect Consulting
Source: TP-7 @ 2-3'
Sample#: B19-0197

Date Received: 5-Apr-19
Sampled By: Client
Date Tested: 8-Apr-19
Tested By: A. Eifrig

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color
Brown

Sample Prepared: Moist: X
Dry:
Manual:
Mechanical: X

Test Standard: ASTM D698:
ASTM D 1557: X
AASHTO T 99:
AASHTO T 180:
Method A

Assumed Sp. Gr.
2.70

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04

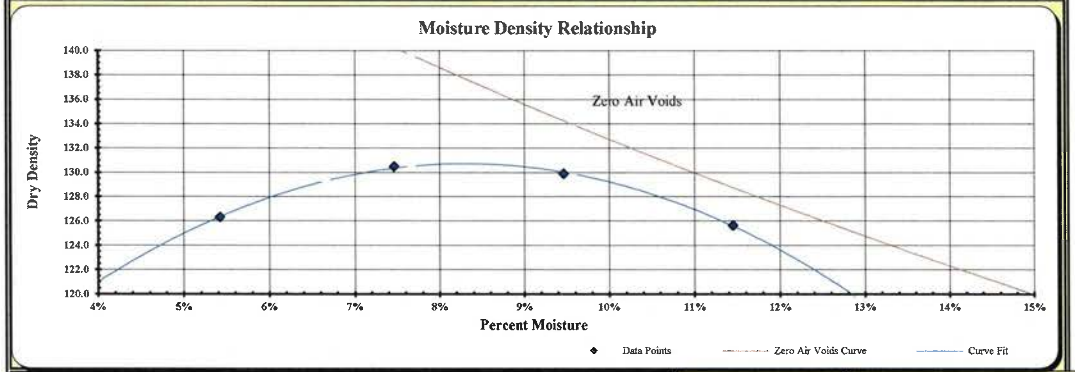
Point Number	Percent Moisture	Dry Density
1	5.4 %	126.3
2	7.5 %	130.5
3	9.5 %	129.9
4	11.4 %	125.6

Uncorrected Proctor Value

Max. Dry Density		Optimum Moist
130.7	lbs/ft³	8.3 %

Value w/ Oversize Correction Applied

Max. Dry Density		Optimum Moist
133.8	lbs/ft³	7.5%



AASHTO T11/T27

Sieve US	Size mm	Percent Passing	Specifications Max	Specifications Min
12.00"	300.00		100 %	0 %
10.00"	250.00		100 %	0 %
8.00"	200.00		100 %	0 %
6.00"	150.00		100 %	0 %
4.00"	100.00		100 %	0 %
3.00"	75.00		100 %	0 %
2.50"	63.00		100 %	0 %
2.00"	50.00	100 %	100 %	0 %
1.75"	45.00		100 %	0 %
1.50"	37.50		100 %	0 %
1.25"	31.50		100 %	0 %
1.00"	25.00	98 %	100 %	0 %
3/4"	19.00	97 %	100 %	0 %
5/8"	16.00		100 %	0 %
1/2"	12.50	95 %	100 %	0 %
3/8"	9.50	94 %	100 %	0 %
1/4"	6.30		100 %	0 %
#4	4.75	90 %	100 %	0 %
#8	2.36		100 %	0 %
#10	2.00	88 %	100 %	0 %
#16	1.18		100 %	0 %
#20	0.850	82 %	100 %	0 %
#30	0.600		100 %	0 %
#40	0.425	71 %	100 %	0 %
#50	0.300		100 %	0 %
#60	0.250	54 %	100 %	0 %
#80	0.180		100 %	0 %
#100	0.150	43 %	100 %	0 %
#140	0.106		100 %	0 %
#170	0.090		100 %	0 %
#200	0.075	35.1 %	100.0 %	0.0 %

Annex A1, Misc. Oversize Correction Values

% Oversize Mat'l: 10%

% Oversize Retained	Corrected Density	Optimum Moisture
5%	132.2	7.9%
10%	133.7	7.5%
15%	135.3	7.1%
20%	136.9	6.8%
25%	138.5	6.4%
30%	140.2	6.0%

Specs: No Specs
Meets Specs? N/A

% Gravel: 10.1%
% Sand: 54.8%
% Silt&Clay: 35.1%

C_C: 0.62
C_U: 14.49
FM: 1.69

$D_{(10)}$: 0.021
$D_{(30)}$: 0.064
$D_{(60)}$: 0.309

LL: n/a
PL: n/a
PI: n/a

Sand Equivalent: n/a
Req'd Sand Equivalent:

Fracture %, 1 Face: n/a
Fracture %, 2+ Faces: n/a
Req'd Fracture %, 1 Face:
Req'd Fracture %, 2+ Faces:

Comments:

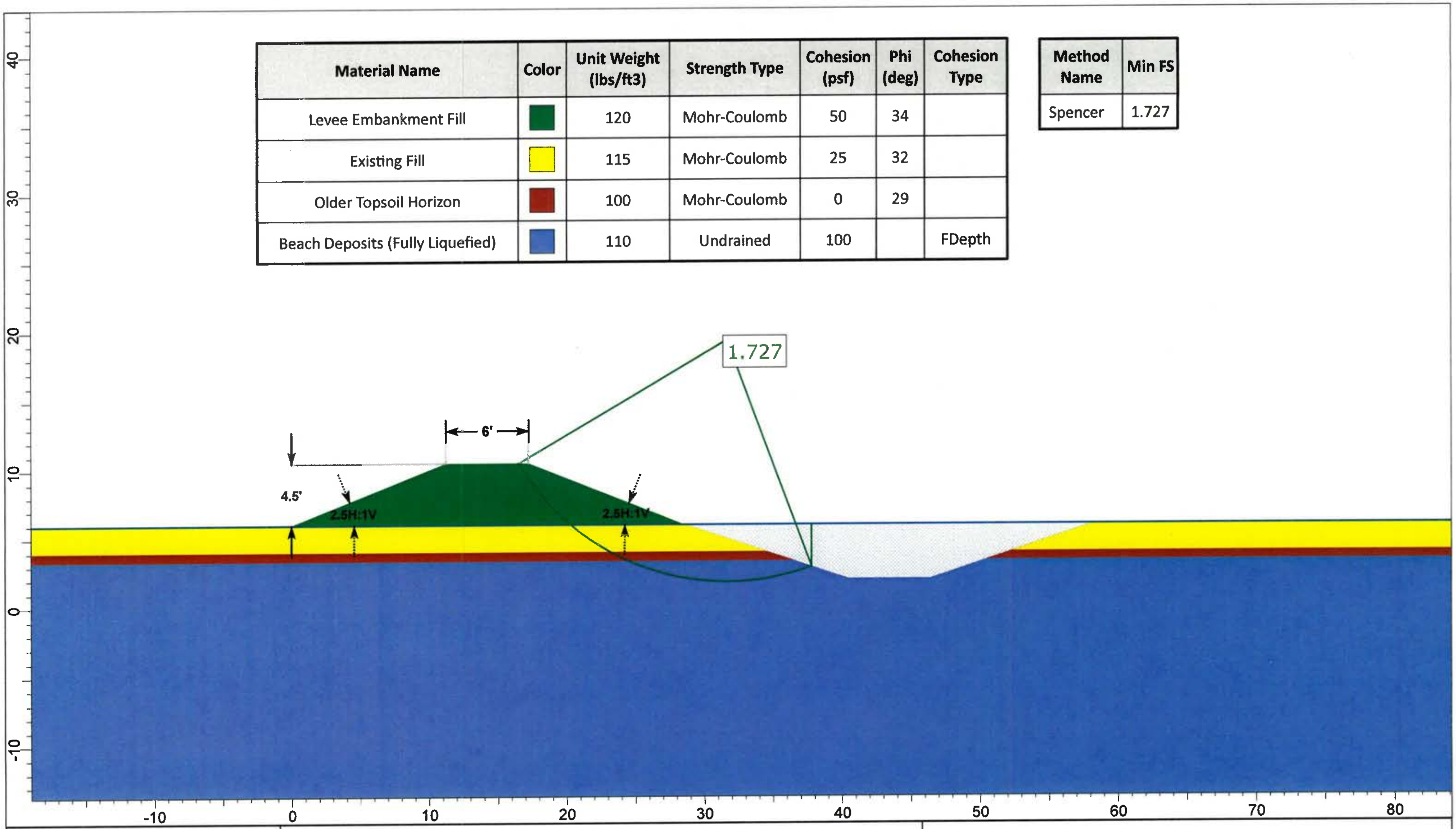
Reviewed by:
Meghan Blodgett-Carrillo

APPENDIX C

Levee Seepage and Slope Stability Analyses

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type
Levee Embankment Fill	🟩	120	Mohr-Coulomb	50	34	
Existing Fill	🟨	115	Mohr-Coulomb	25	32	
Older Topsoil Horizon	🟥	100	Mohr-Coulomb	0	29	
Beach Deposits (Fully Liquefied)	🟦	110	Undrained	100		FDepth

Method Name	Min FS
Spencer	1.727



Levee at TP-1 - Baseflow Conditions
Static Analysis

Slope Stability Analysis

Norwegian Point Park Ring Levee
Kitsap County, Washington

SCALE: 1":10'

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Aspect CONSULTING

6/20/2019

PROJECT NO. 190092

BY: ECS

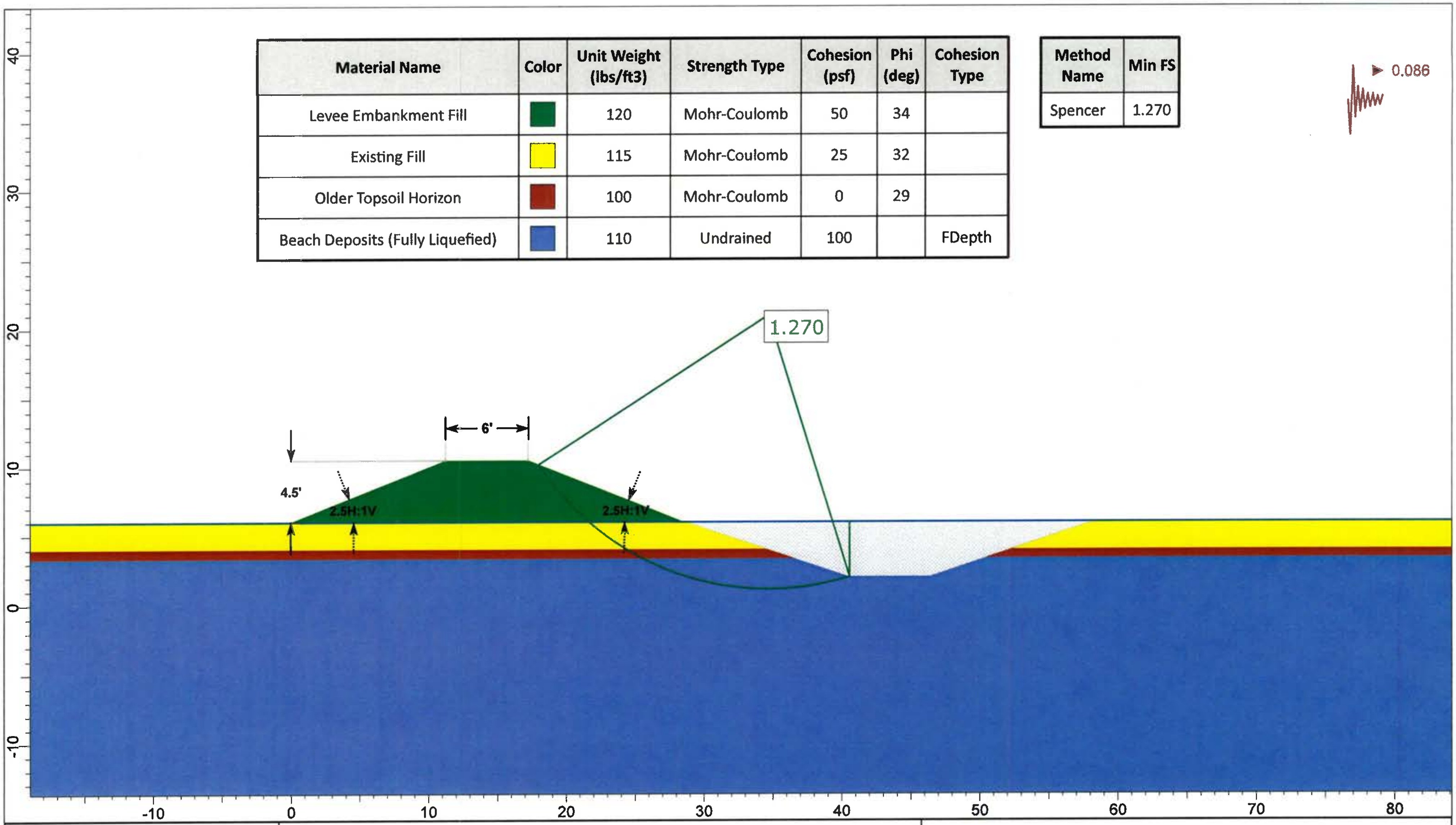
REVIEWED BY: AJH

APPENDIX: C-1

SLIDEINTERPRET 8.022

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type
Levee Embankment Fill	🟩	120	Mohr-Coulomb	50	34	
Existing Fill	🟨	115	Mohr-Coulomb	25	32	
Older Topsoil Horizon	🟥	100	Mohr-Coulomb	0	29	
Beach Deposits (Fully Liquefied)	🟦	110	Undrained	100		FDepth

Method Name	Min FS
Spencer	1.270



Levee at TP-1 - Baseflow Conditions Pseudostatic Analysis

Slope Stability Analysis

Norwegian Point Park Ring Levee
Kitsap County, Washington

SLIDEINTERPRET 8.022

SCALE: 1":10'
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Aspect CONSULTING

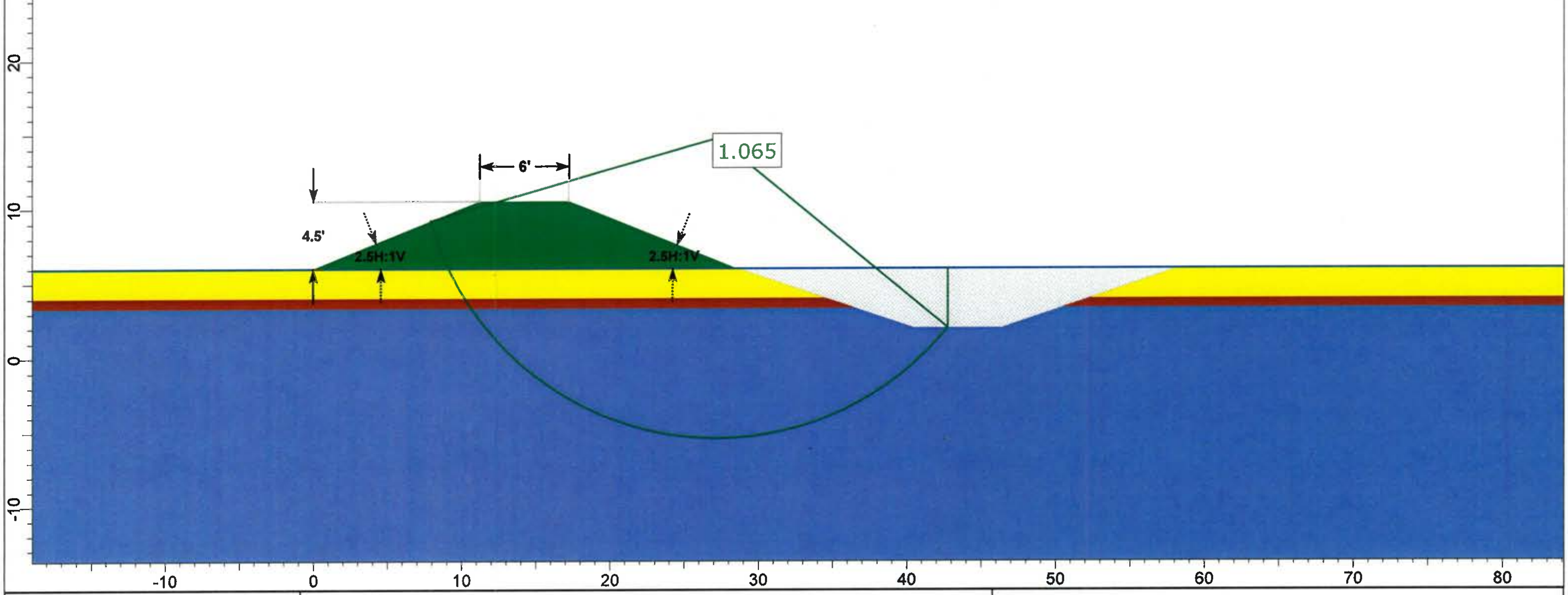
6/20/2019
PROJECT NO.
190092

BY:
ECS
REVIEWED BY:
AJH

APPENDIX:
C-2

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type
Levee Embankment Fill	🟩	120	Mohr-Coulomb	50	34	
Existing Fill	🟨	115	Mohr-Coulomb	25	32	
Older Topsoil Horizon	🟥	100	Mohr-Coulomb	0	29	
Beach Deposits (Fully Liquefied)	🟦	110	Undrained	100		FDepth

Method Name	Min FS
Spencer	1.065



Levee at TP-1 - Baseflow Conditions
Fully-Liquefied Analysis

Slope Stability Analysis

Norwegian Point Park Ring Levee
Kitsap County, Washington

SLIDEINTERPRET 8.022

SCALE: 1":10'

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Aspect CONSULTING

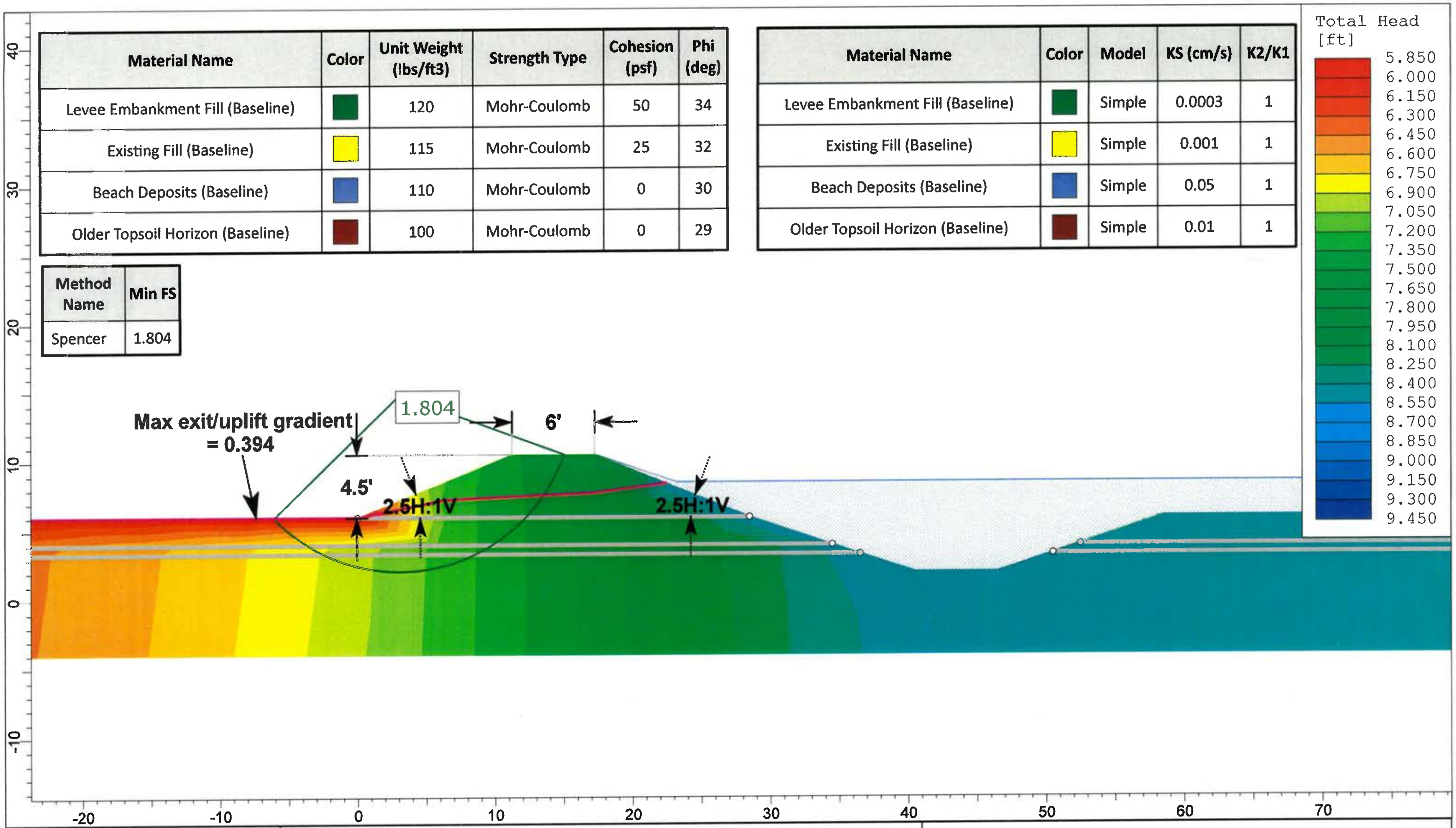
6/20/2019

PROJECT NO. 190092

BY: ECS

REVIEWED BY: AJH

APPENDIX: C-3



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Levee Embankment Fill (Baseline)	🟩	120	Mohr-Coulomb	50	34
Existing Fill (Baseline)	🟨	115	Mohr-Coulomb	25	32
Beach Deposits (Baseline)	🟦	110	Mohr-Coulomb	0	30
Older Topsoil Horizon (Baseline)	🟫	100	Mohr-Coulomb	0	29

Method Name	Min FS
Spencer	1.804

Material Name	Color	Model	KS (cm/s)	K2/K1
Levee Embankment Fill (Baseline)	🟩	Simple	0.0003	1
Existing Fill (Baseline)	🟨	Simple	0.001	1
Beach Deposits (Baseline)	🟦	Simple	0.05	1
Older Topsoil Horizon (Baseline)	🟫	Simple	0.01	1

Levee at TP-1 - Steady State Seepage Landside Stability

Seepage and Slope Stability Analysis

Norwegian Point Park Ring Levee
Kitsap County

SLIDEINTERPRET 8.022

SCALE: 1":10'
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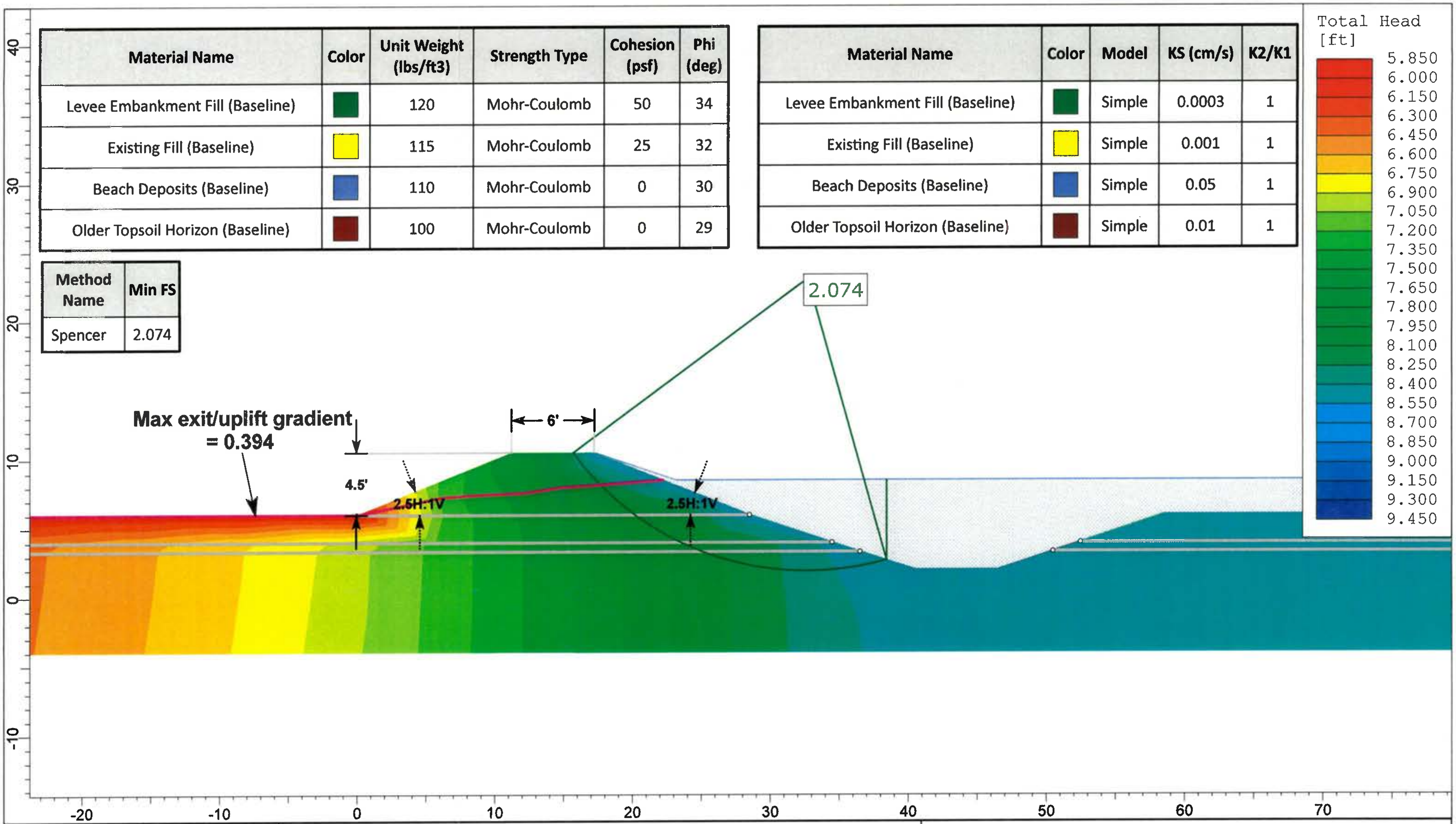
Aspect CONSULTING

6/20/2019
PROJECT NO. 190092

BY: ECS
REVIEWED BY: AJH

APPENDIX: C-4



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Levee Embankment Fill (Baseline)	🟩	120	Mohr-Coulomb	50	34
Existing Fill (Baseline)	🟨	115	Mohr-Coulomb	25	32
Beach Deposits (Baseline)	🟦	110	Mohr-Coulomb	0	30
Older Topsoil Horizon (Baseline)	🟥	100	Mohr-Coulomb	0	29

Material Name	Color	Model	KS (cm/s)	K2/K1
Levee Embankment Fill (Baseline)	🟩	Simple	0.0003	1
Existing Fill (Baseline)	🟨	Simple	0.001	1
Beach Deposits (Baseline)	🟦	Simple	0.05	1
Older Topsoil Horizon (Baseline)	🟥	Simple	0.01	1

Method Name	Min FS
Spencer	2.074

Max exit/uplift gradient = 0.394

Levee at TP-1 - Steady State Seepage Waterside Stability

Seepage and Slope Stability Analysis

Norwegian Point Park Ring Levee
Kitsap County

SLIDEINTERPRET 8.022

SCALE: 1":10'

O:\Portland_Projects\190000_Projects\190092_Norwegian Point Park Ring Dike\Data\Analyses\Seepage and SSA\Steady State Seepage - Waterside Slope

Aspect CONSULTING

6/20/2019

PROJECT NO.
190092

BY:
ECS

REVIEWED BY:
AJH

APPENDIX:
C-5

APPENDIX D

Report Limitations and Guidelines for Use

REPORT LIMITATIONS AND GUIDELINES FOR USE

Geoscience is Not Exact

The geoscience practices (geotechnical engineering, geology, and environmental science) are far less exact than other engineering and natural science disciplines. It is important to recognize this limitation in evaluating the content of the report. If you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or property, you should contact Aspect Consulting, LLC (Aspect).

This Report and Project-Specific Factors

Aspect's services are designed to meet the specific needs of our clients. Aspect has performed the services in general accordance with our agreement (the Agreement) with the Client (defined under the Limitations section of this project's work product). This report has been prepared for the exclusive use of the Client. This report should not be applied for any purpose or project except the purpose described in the Agreement.

Aspect considered many unique, project-specific factors when establishing the Scope of Work for this project and report. You should not rely on this report if it was:

- Not prepared for you;
- Not prepared for the specific purpose identified in the Agreement;
- Not prepared for the specific subject property assessed; or
- Completed before important changes occurred concerning the subject property, project, or governmental regulatory actions.

If changes are made to the project or subject property after the date of this report, Aspect should be retained to assess the impact of the changes with respect to the conclusions contained in the report.

Reliance Conditions for Third Parties

This report was prepared for the exclusive use of the Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against liability claims by third parties with whom there would otherwise be no contractual limitations. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with our Agreement with the Client and recognized geoscience practices in the same locality and involving similar conditions at the time this report was prepared

Property Conditions Change Over Time

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by events such as a change in property use or occupancy, or by natural events, such as floods, earthquakes, slope instability, or groundwater fluctuations. If any of the described events may have occurred following the issuance of the report, you should contact Aspect so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Geotechnical, Geologic, and Environmental Reports Are Not Interchangeable

The equipment, techniques, and personnel used to perform a geotechnical or geologic study differ significantly from those used to perform an environmental study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually address any environmental findings, conclusions, or recommendations (e.g., about the likelihood of encountering underground storage tanks or regulated contaminants). Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding the subject property.

We appreciate the opportunity to perform these services. If you have any questions please contact the Aspect Project Manager for this project.

APPENDIX

8.4 PROJECT DRAWINGS

SECTION 16, TOWNSHIP 28 NORTH, RANGE 02 EAST, WILLAMETTE MERIDIAN, CITY OF HANSVILLE, KITSAP COUNTY, WASHINGTON

FINN CREEK RESTORATION

SITE IMPROVEMENTS PLAN

39118 HANSVILLE RD NE, HANSVILLE, WA 98340

LEGEND

EXISTING SYMBOL LEGEND

◎	FND IP
◕	FND MON (DESCRIBE IN NOTES)
○	FND REBAR
◉	SET IRON PIPE
⊟	CATCH BASIN
Ⓓ	STORM DRAIN CLEAN OUT
☁	BUSH
⬡	LARGE ROCK
✳	CONFIR TREE
Ⓑ	BOLLARD
∘	GATE POST
⚑	FLAG POLE
MB	MAIL BOX
▲	MONITORING WELL/PIEZOMETER/BORING
⊤	ROAD SIGN
♿	HANDICAP SYMBOL
Ⓒ	COMMUNICATIONS MANHOLE
dp ○	U/G UTILITY DROP FROM POLE
E	ELEC. BOX ON CONC./SHOTS ON PED ON PAD COR.
⊘	ELECTRICAL METER
→	GUY ANCHOR
GP	GUY POLE
T	PHONE PEDASTAL
-○-	UTILITY POLE
☼	YARD LIGHT
⫯	H2O BLOWOFF VALVE
♉	FIRE HYDRANT
hb	HOSE BIB (FAUCET)
Ⓡ	IRRIGATION BOX
W	WATER METER
	WATER VALVE

EXISTING LINE LEGEND

——200——	MAJOR CONTOUR LINE
————	MINOR CONTOUR LINE
—···—···—	EDGE OF WATER
—·· >> ··—	CENTER LINE DITCH
— — — —	CULVERT
- - - - - - -	EAVE OVERHANG
——X——	FENCE
—— □ ——	GUARD RAIL
━━ ━━	SINGLE YELLOW DASH STRIPE
═══	DOUBLE YELLOW STRIPE
═━ ━═	SINGLE YELLOW STRIPE W/DASH STRIPE
━━━	WHITE STRIPE/FOG LINE
———	EDGE OF CONCRETE
—— —— ——	EDGE OF GRAVEL
———	UNDERGROUND WATER LINE
———	UNDERGROUND CABLE LINE
———	UNDERGROUND POWER LINE
———	UNDERGROUND FIBER OPTIC LINE
———	OVERHEAD POWER, TELEPHONE & CABLE LINE
——OCM——	OVERHEAD COMMUNICATION LINE
———	OVERHEAD ELECTRIC LINE

PROPOSED SYMBOL LEGEND

—●—	PROPOSED STREET SIGN
■	PROPOSED STORM DRAIN CATCH BASIN
◙	PROPOSED STORM DRAIN MANHOLE
⬡	PROPOSED CAVFS

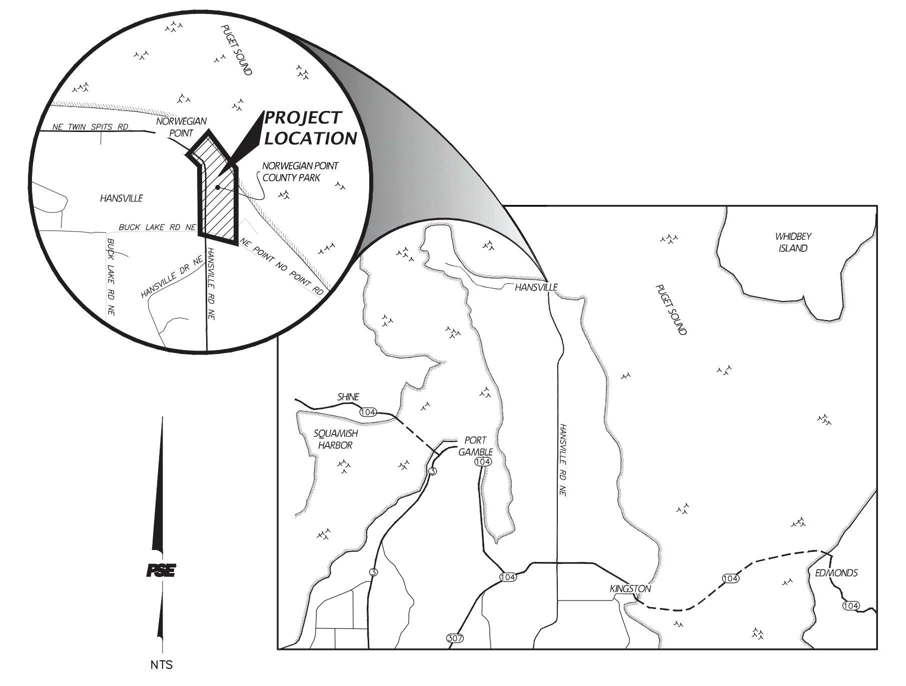
PROPOSED LINE LEGEND

———	= PROPOSED EDGE OF ASPHALT
—— — — ——	= PROPOSED EDGE OF CONCRETE
———	= PROPOSED SIDEWALK
———	= PROPOSED STRIPE
━ ━ ━ ━	= PROPOSED SAWCUT LIMITS
━━SD━━	= PROPOSED STORM DRAIN LINE
—▼ TOP ▼—	= PROPOSED TOP OF SLOPE LINE
▼	= PROPOSED SLOPE DIRECTION ARROW
— TOE —	= PROPOSED TOE OF SLOPE LINE
——(125)——	= PROPOSED FINISHED GRADE INDEX CONTOUR
——(124)——	= PROPOSED FINISHED GRADE INTERVAL CONTOUR

SHEET INDEX

SHEET NUMBER	SHEET TITLE
SW-1	COVER
SW-2	OVERALL
SW-3	EXISTING CONDITIONS SW
SW-4	EXISTING CONDITIONS NW
SW-5	EXISTING CONDITIONS SE
SW-6	EXISTING CONDITIONS NE
SW-7	HANSVILLE SITE PLAN SW
SW-8	HANSVILLE SITE PLAN NW
SW-9	DRIVEWAY SITE PLAN SE
SW-10	DRIVEWAY SITE PLAN NE
SW-11	TEMPORARY EROSION & SEDIMENT CONTROL PLAN
SW-12	ROAD & ACCESS DETAILS

VICINITY MAP



SURVEY NOTES

BASE MAP PREPARED BY KITSAP COUNTY PUBLIC WORKS SURVEY DEPARTMENT (AUGUST, 2023), FROM FIELD SURVEY DATA COLLECTED JULY 2023. KITSAP COUNTY DID NOT VERIFY NOR EDIT ANY OF THE MAPPING DATA FROM AES CONSULTANTS, INC. BASE MAP SUPPLIED TO THE ENGINEERING DESIGN TEAM.

HORIZONTAL DATUM: NAD83(1991), WASHINGTON PLANE COORDINATE SYSTEM (NORTH ZONE), AS ESTABLISHED BY AES CONSULTANTS, INC. FOR KITSAP COUNTY PARKS DEPARTMENT.

VERTICAL DATUM: NGVD 1929 AS ESTABLISHED BY AES CONSULTANTS, INC. FOR KITSAP COUNTY PARKS DEPARTMENT.

CONTOUR INTERVAL IS ONE–FOOT AND ARE COMPUTER GENERATED FROM GROUND FIELD TOPOGRAPHY GATHERED FOR THIS SURVEY UTILIZING ELECTRONIC DATA COLLECTION. KITSAP COUNTY GENERATED SURFACE MODEL FROM OUR OWN DATA. KITSAP COUNTY MERGED COUNTY AND AES SURFACE MODELS FOR THE ENGINEERING DESIGN TEAM.

SUBSURFACE UTILITY LINES WERE MARKED AS PART OF "MT. VIEW LOCATING SERVICES LLC" LOCATE REQUEST. UTILITY SURFACE LINES AND FEATURES WERE LOCATED AND SHOWN ON THE BASE MAP AS ACCURATELY AS POSSIBLE FROM FIELD MARKINGS. PORTIONS OF THE WATERLINE IS SHOWN ON THE BASE MAP WHERE IT WAS TRACEABLE. ENGINEERING DESIGN WILL BE REQUIRED TO CONTACT WATER PROVIDER TO CONFIRM UNKNOWN LOCATIONS.

NO ADDITIONAL WETLAND FLAGS WERE LOCATED AS PART OF THE KITSAP COUNTY MAPPING. THERE MAY BE ADDITIONAL WETLANDS BEYOND THE MAPPING LIMITS OF THE AES CONSULTANTS, INC. BASE MAP.

ABBREVIATIONS

ACP	ASPHALT CONCRETE PAVING
ADA	AMERICAN DISABILITIES ACT
A.F.#	AUDITOR'S FILE NUMBER
APWA	AMERICAN PUBLIC WORKS ASSOCIATION
APPROX.	APPROXIMATE
A.D.	ALGEBRAIC DIFFERENCE
B/C	BACK OF CURB
BW	BOTTOM OF WALL
BMP	BEST MANAGEMENT PRACTICE
CB	CATCH BASIN
BVCS	BEGINNING VERTICAL CURVE STATION
BVCE	BEGINNING VERTICAL CURVE ELEVATION
C&G	CURB AND GUTTER
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CONC.	CONCRETE
DIA.	DIAMETER
CPP	CORRUGATED POLYETHYLENE PIPE
EG	EXISTING GRADE
EL.	ELEVATION
EOP	EDGE OF PAVEMENT
EVCS	ENDING VERTICAL CURVE STATION
EX.	EXISTING
EVCE	ENDING VERTICAL CURVE ELEVATION
F&G	FRAME AND GRATE
F.HYD.	FIRE HYDRANT
F/C	FACE OF CURB
FF	FINISH FLOOR
FG	FINISH GRADE
FL	FLOWLINE
FS	FINISH SURFACE
GA.	GAUGE
GALV.	GALVANIZED
H.C.	HANDICAP
I.E.	INVERT ELEVATION
INV.	INVERT
K	RATE OF VERTICAL CURVATURE
LT	LEFT
LF	LINEAL FEET
MAX.	MAXIMUM
MIN.	MINIMUM
N.I.C.	NOT IN CONTRACT
NVPA	NATIVE VEGETATION PROTECTION AREA
OHWM	ORDINARY HIGH WATER MARK
PROP.	PROPOSED
PERF.	PERFORATED
PVC	POLYVINYL CHLORIDE
PVI	POINT OF VERTICAL INFLECTION
PC	POINT OF CURVATURE
PT	POINT OF TANGENCY
R=	CURVE RADIUS
RT	RIGHT
R/W	RIGHT OF WAY
SD	STORM DRAIN
SDCB	STORM DRAIN CATCH BASIN
SDR	STANDARD DIAMETER RATIO
SDMH	STORM DRAIN MANHOLE
SVC	SERVICE
SPEC.	SPECIFICATION
SSCO	SANITARY SEWER CLEAN–OUT
SSMH	SANITARY SEWER MANHOLE
STD	STANDARD
STA	STATION
S/W	SIDEWALK
SF	SQUARE FOOT
T/W	TOP OF WALL
TBOC	TOP BACK OF CURB
TC	TOP OF CURB
TF	TOP OF FOOTING
TP	TOP OF PIPE
TYP.	TYPICAL
VC	VERTICAL CURVE LENGTH
WM	WATER METER
WSDOE	WASHINGTON STATE DEPT. OF ECOLOGY
WSDOT	WASHINGTON STATE DEPT. OF TRANSPORTATION

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			1	01/29/2024	30% DESIGN

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(360)319-8069

FINN CREEK RESTORATION
HANSVILLE, WA
SITE IMPROVEMENTS

COVER

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WWW.PSESURVEY.COM | INFO@PSESURVEY.COM

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DESIGN	XXX	XXX	STAKING:	XXX
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HORIZ. SCALE:	XXX		HORIZ.:	XXX
VERT. SCALE:	XXX		VERT.:	XXX

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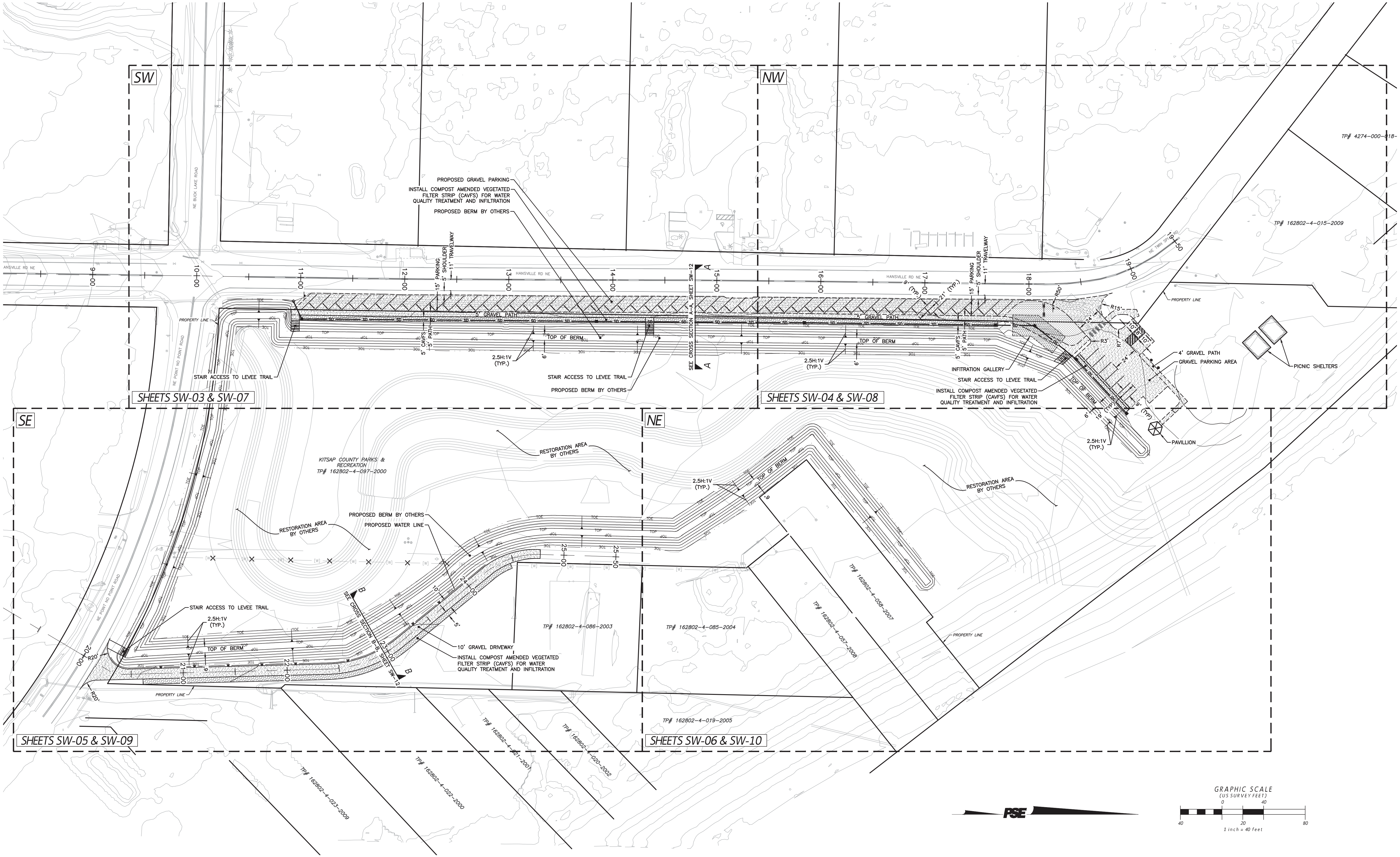
SHEET SW-1 OF SW-12

DAVID P. GALBRAITH Jr.
44679
01-29-2024



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VERT. SCALE:	XXX		VERT.:	XXX

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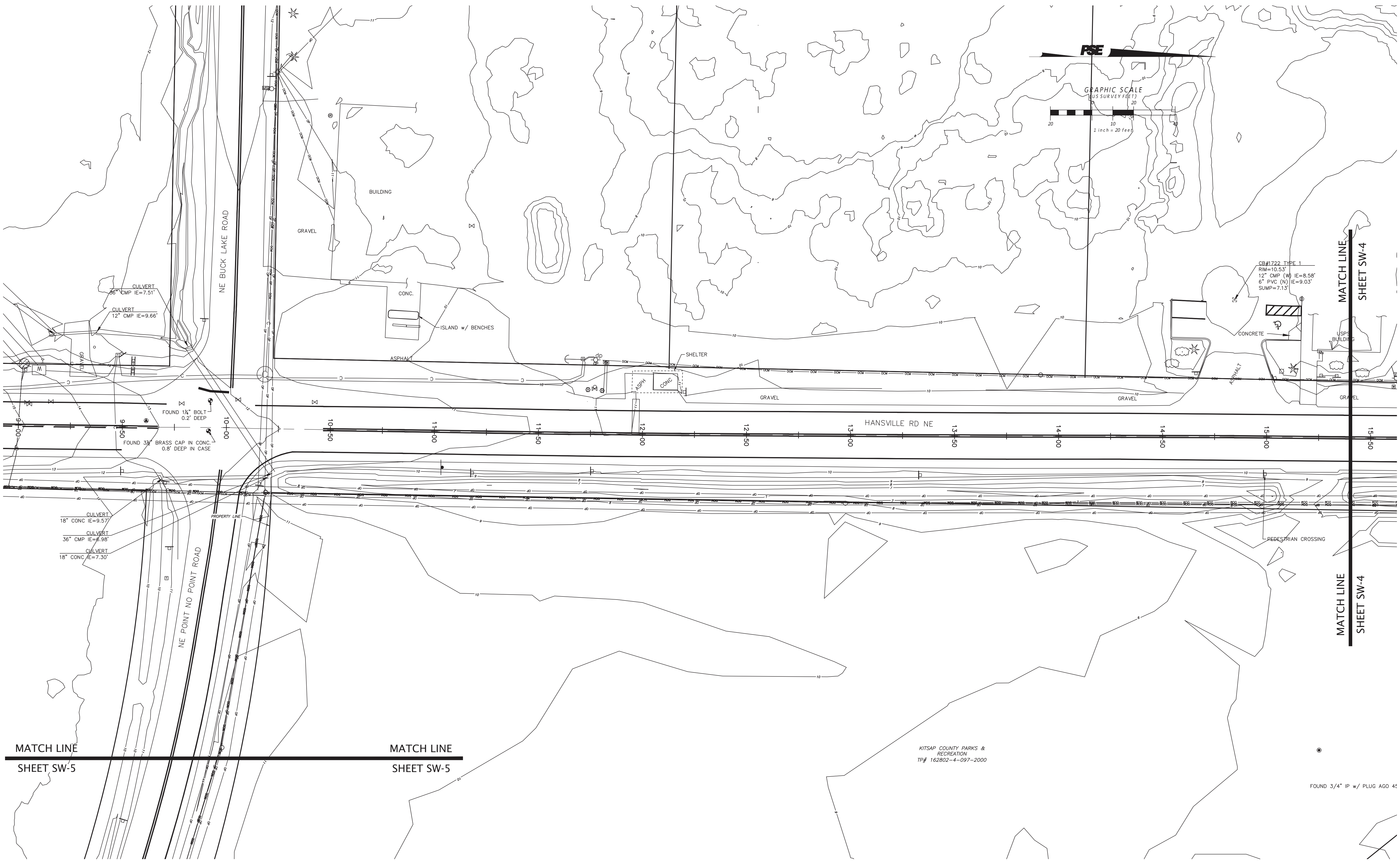
SHEET SW-2 OF SW-12

DAVID P. GALBRAITH JR.
44679
01-29-2024



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HANSVILLE, WA
SITE IMPROVEMENTS

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VERT. SCALE:	XXX		VERT.:	XXX

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SHEET SW-3 OF SW-12

DAVID P. GALBRAITH JR.
44679
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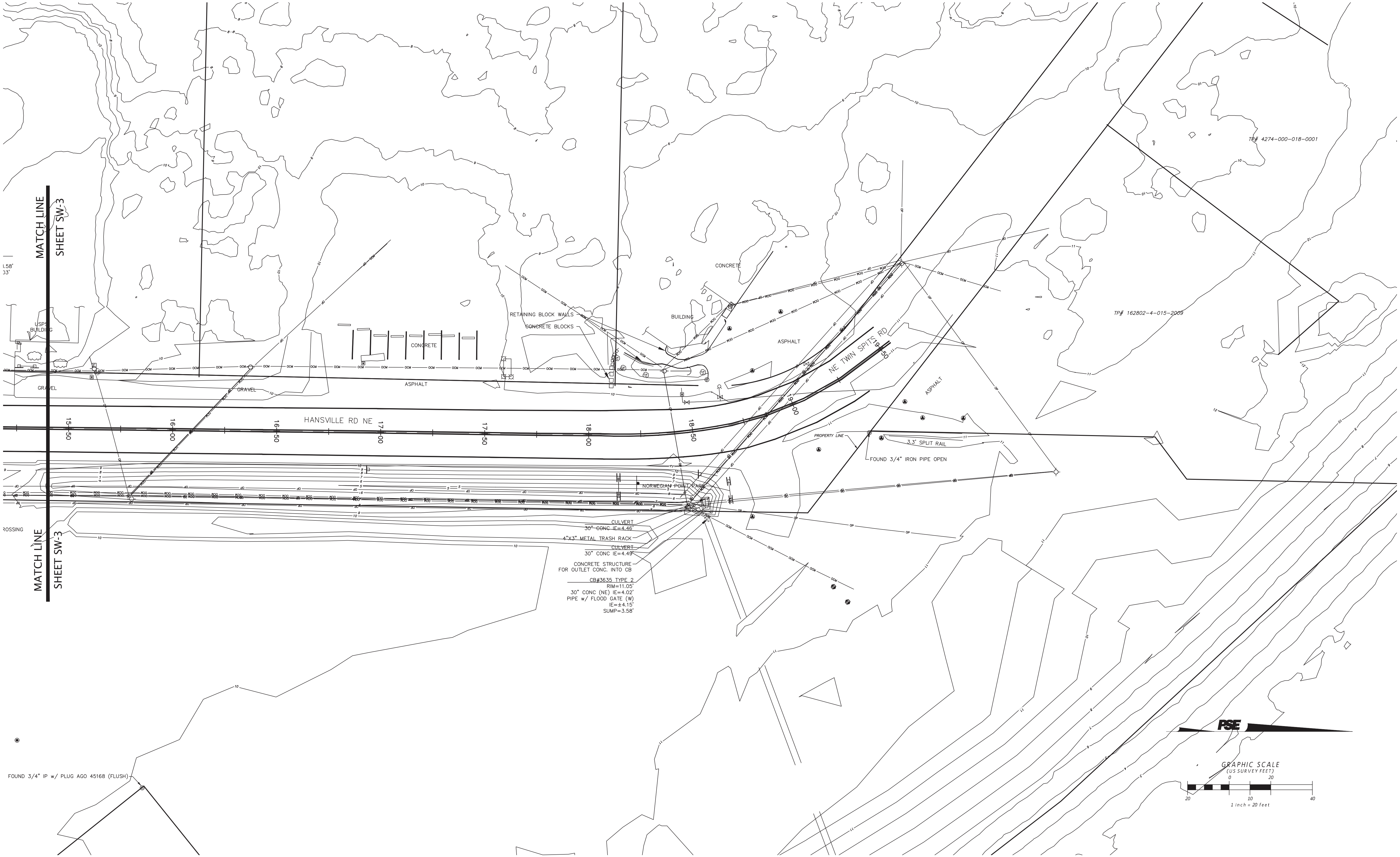

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SHEET SW-4 OF SW-12

DAVID P. GALBRAITH JR.
44679
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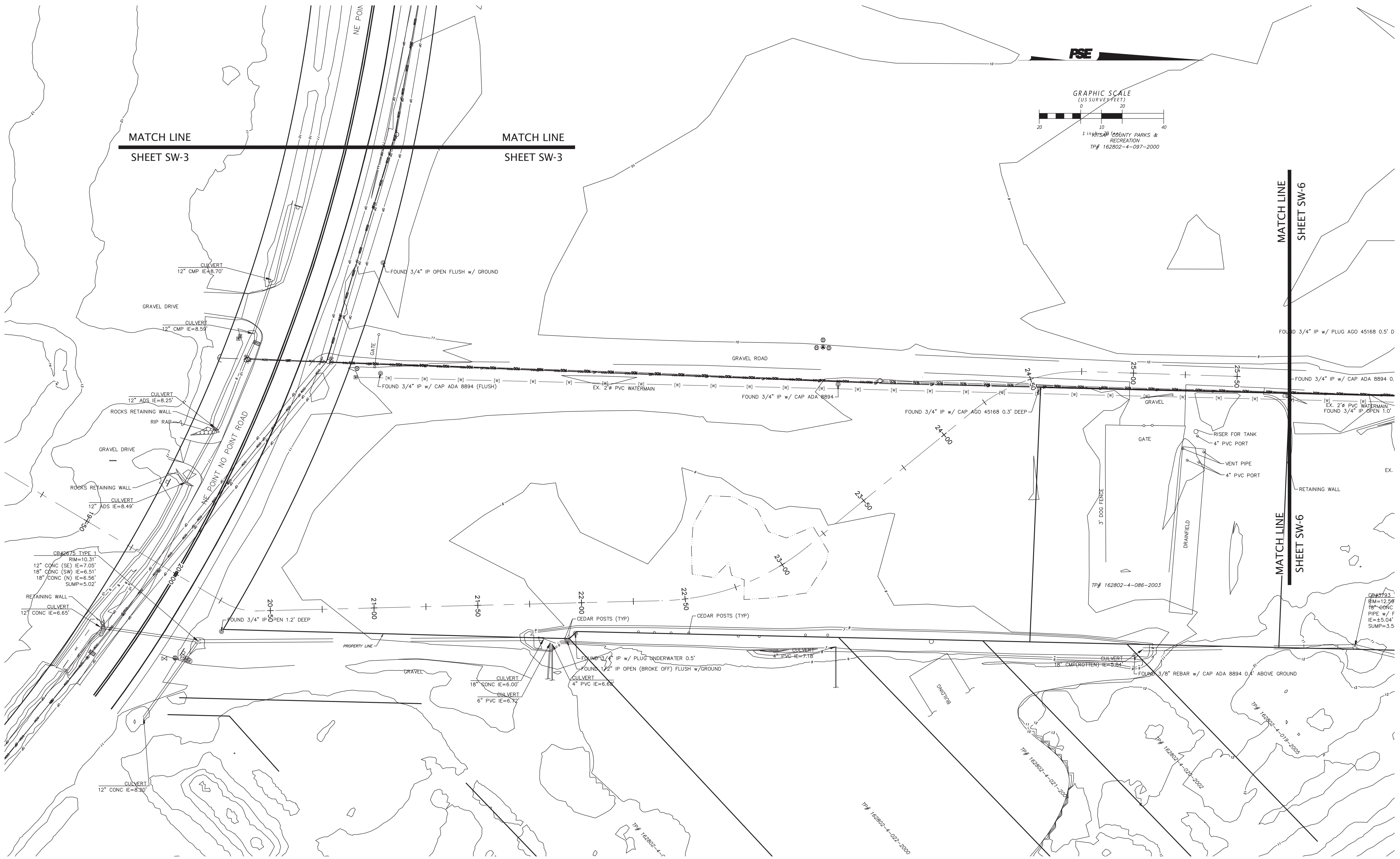

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SHEET SW-5 OF SW-12

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SHEET SW-6 OF SW-12

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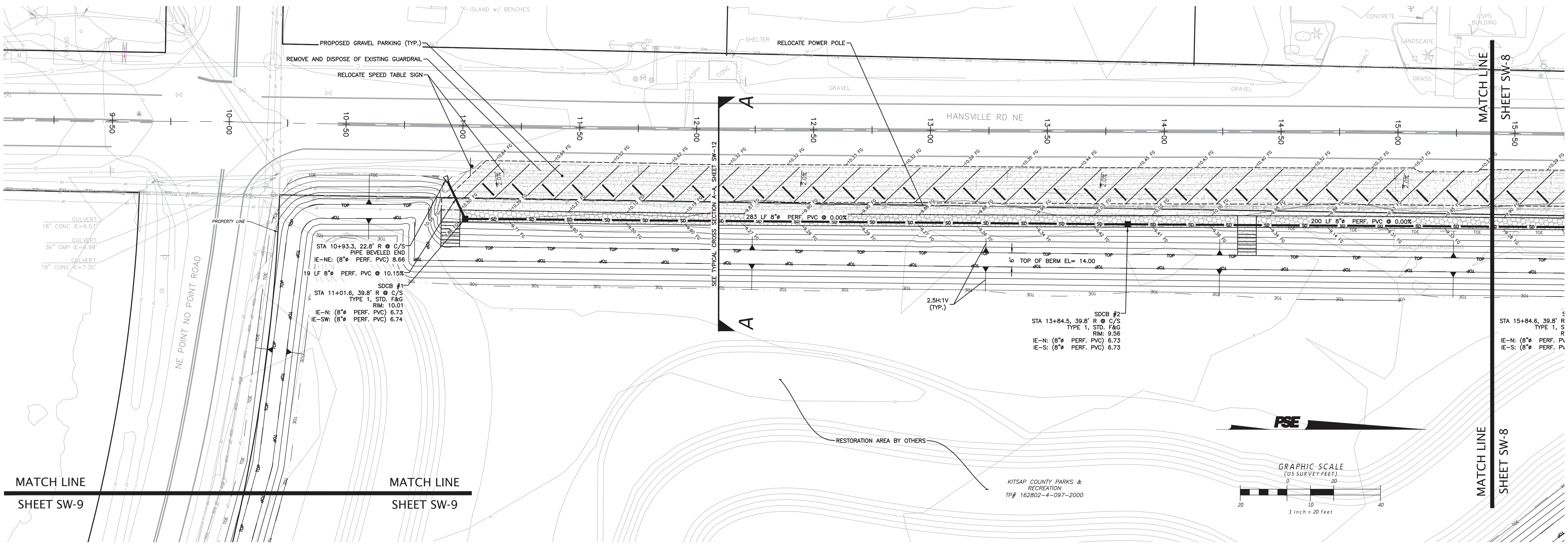

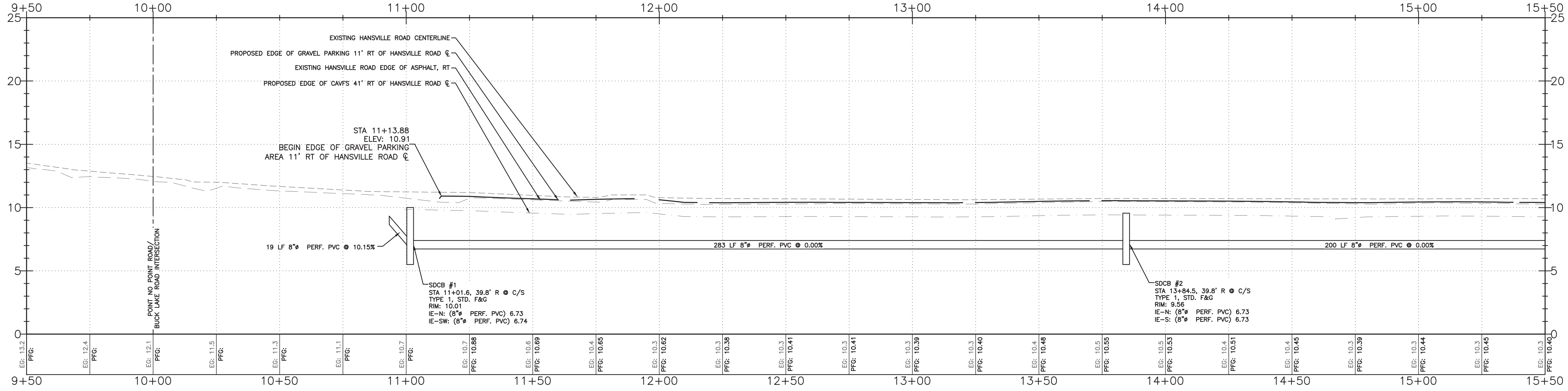

HANSVILLE ROAD PROFILE

H. SCALE: 1"=20' V. SCALE: 1"=4'

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FINN CREEK RESTORATION
HANSVILLE, WA
SITE IMPROVEMENTS

HANSVILLE SITE PLAN SW

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VERT. SCALE:	XXX		VERT.:	XXX

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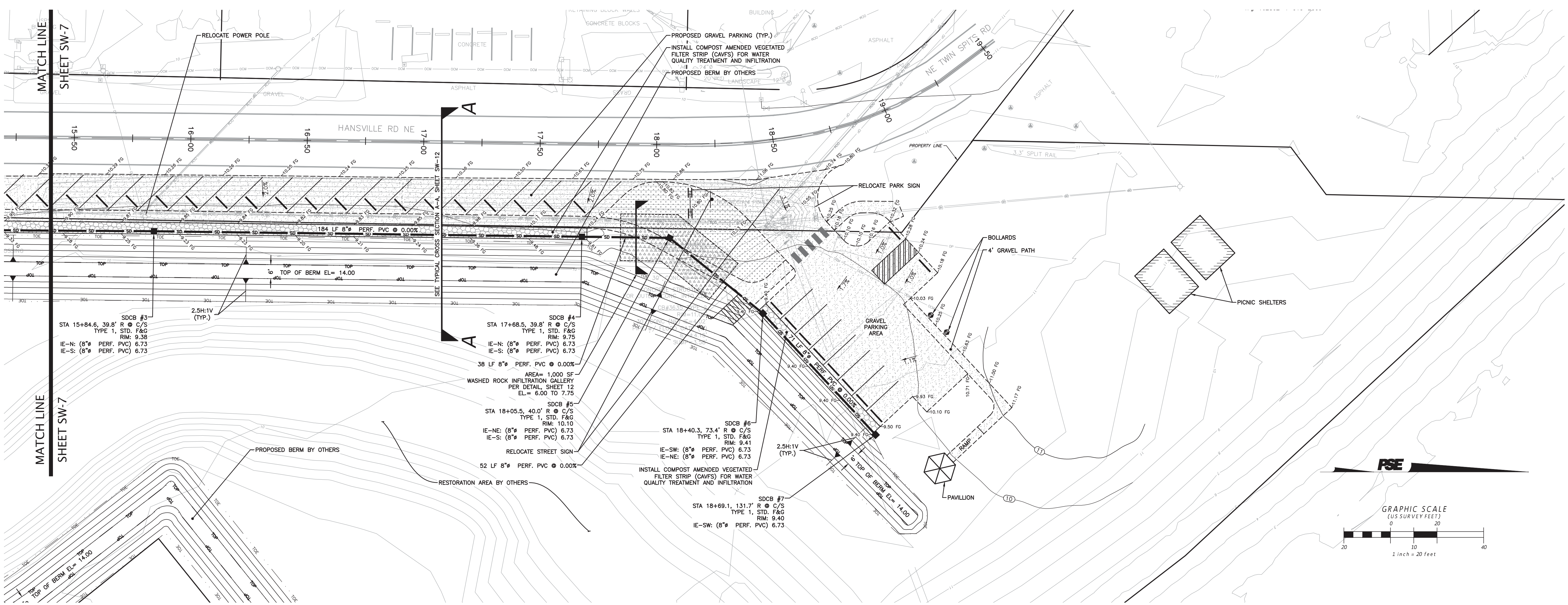
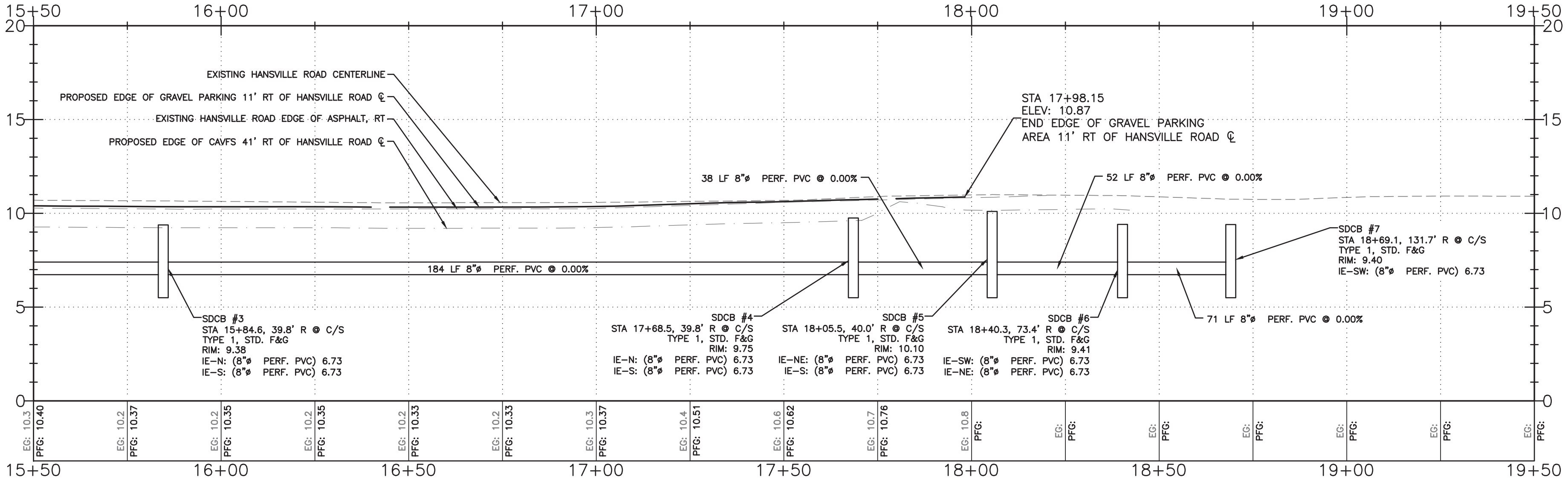
SHEET SW-7 OF SW-12

DAVID P. GALBRAITH, JR.
44679
01-29-2024





HANSVILLE ROAD PROFILE

H. SCALE: 1"=20' V. SCALE: 1"=4'

CALL BEFORE YOU DIG 1-800-424-5555

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FINN CREEK RESTORATION
HANSVILLE, WA
SITE IMPROVEMENTS

HANSVILLE SITE PLAN NW

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VERT. SCALE:	XXX		VERT.:	XXX

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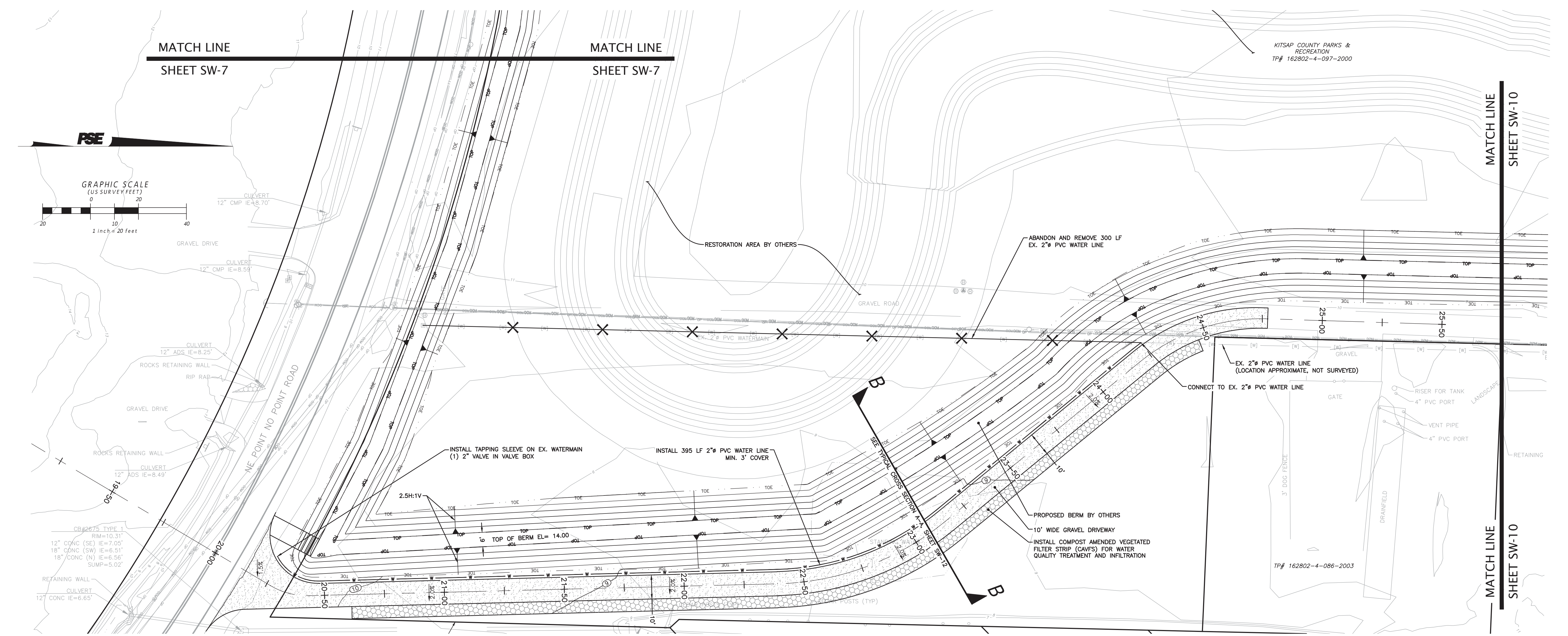
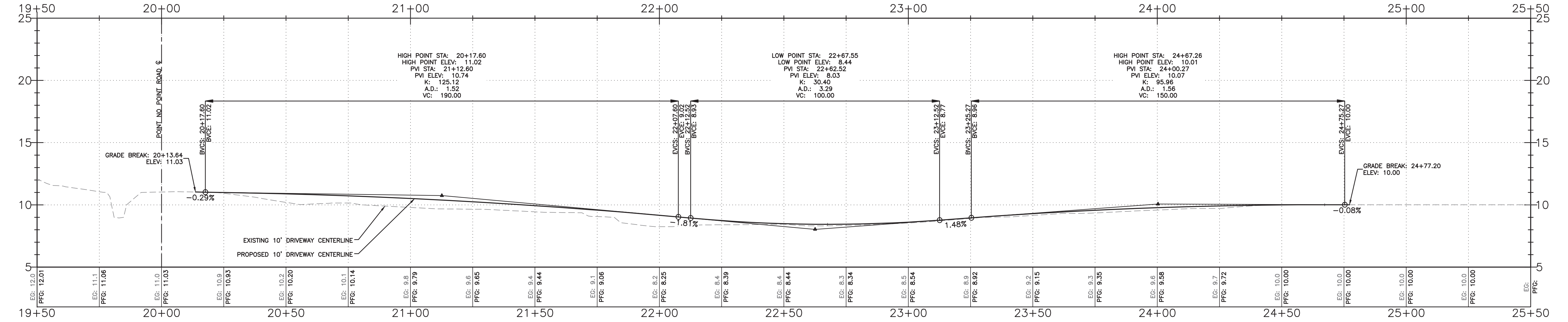
SHEET SW-8 OF SW-12

DAVID P. GALBRAITH Jr.
44679
01-29-2024





PROPOSED DRIVEWAY PROFILE

H. SCALE: 1"=20' V. SCALE: 1"=4'

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FINN CREEK RESTORATION
HANSVILLE, WA
SITE IMPROVEMENTS

DRIVEWAY SITE PLAN SE

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VERT. SCALE:	XXX		VERT.:	XXX

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SHEET SW-9 OF SW-12

DAVID P. GALBRAITH JR.
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01-29-2024

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(360)319-8069

FINN CREEK RESTORATION

HANSVILLE, WA
SITE IMPROVEMENTS

DRIVEWAY SITE PLAN NE

PACIFIC SURVEYING
& ENGINEERING, INC.
909 Squalicum Way, Suite 111 | BELLINGHAM, WA 98225
T: 360.671.7387 | F: 360.671.4685
WWW.PSESURVEY.COM | INFO@PSESURVEY.COM

DATA	DRAWN BY	CHECKED BY	FIELD BOOKS	
BASE	XXX	XXX	DESIGN:	XXX
DESIGN	XXX	XXX	STAKING:	XXX
XREF:	XXX		ASBUILT:	XXX
JOB#:	XXX		DATUM	
HORIZ. SCALE:	XXX		HORIZ.:	XXX
VERT. SCALE:	XXX		VERT.:	XXX

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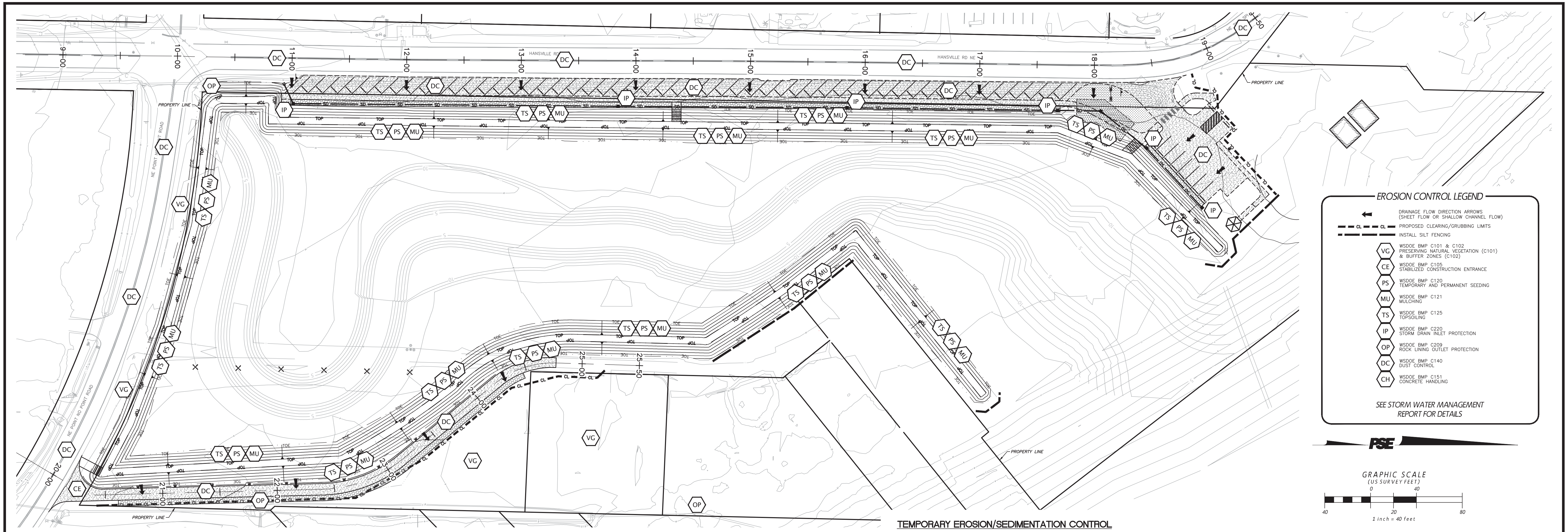
SHEET SW-10 OF SW-12

DAVID P. GALBRAITH Jr.
44679
01-29-2024



EROSION CONTROL LEGEND

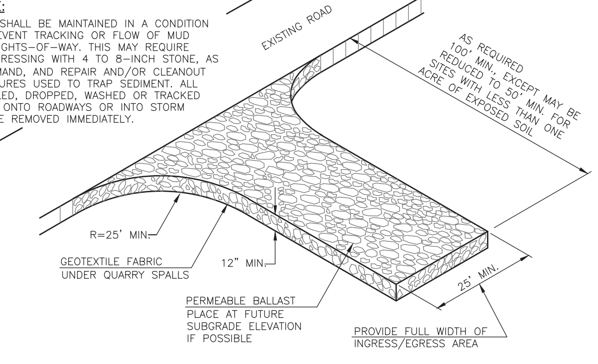
←	DRAINAGE FLOW DIRECTION ARROWS (SHEET FLOW OR SHALLOW CHANNEL FLOW)
— CL — CL —	PROPOSED CLEARING/GRUBBING LIMITS
— — —	INSTALL SILT FENCING
VG	WSDOE BMP C101 & C102 PRESERVING NATURAL VEGETATION (C101) & BUFFER ZONES (C102)
CE	WSDOE BMP C105 STABILIZED CONSTRUCTION ENTRANCE
PS	WSDOE BMP C120 TEMPORARY AND PERMANENT SEEDING
MU	WSDOE BMP C121 MULCHING
TS	WSDOE BMP C125 TOPSOILING
IP	WSDOE BMP C220 STORM DRAIN INLET PROTECTION
OP	WSDOE BMP C209 ROCK LINING OUTLET PROTECTION
DC	WSDOE BMP C140 DUST CONTROL
CH	WSDOE BMP C151 CONCRETE HANDLING

SEE STORM WATER MANAGEMENT REPORT FOR DETAILS

GRAPHIC SCALE
(US SURVEY FEET)
1 inch = 40 feet

MAINTENANCE:

THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOW OF MUD ONTO PUBLIC RIGHTS-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH 4 TO 8-INCH STONE, AS CONDITIONS DEMAND, AND REPAIR AND/OR CLEANOUT OF ANY STRUCTURES USED TO TRAP SEDIMENT. ALL MATERIALS SPILLED, DROPPED, WASHED OR TRACKED FROM VEHICLES ONTO ROADWAYS OR INTO STORM DRAINS MUST BE REMOVED IMMEDIATELY.

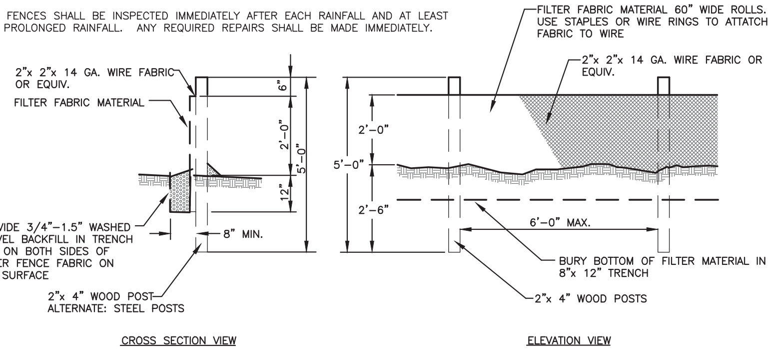


ROCK STABILIZATION CONSTRUCTION ROAD ENTRANCE

NOT TO SCALE

FILTER FENCE NOTES

1. THE FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID USE OF JOINTS. WHEN JOINTS ARE NECESSARY, FILTER CLOTH SHALL BE SPLICED TOGETHER ONLY AT A SUPPORT POST WITH A MINIMUM 6-INCH OVERLAP AND BOTH ENDS SECURELY FASTENED TO THE POST.
2. THE FILTER FABRIC FENCE SHALL BE INSTALLED TO FOLLOW THE CONTOURS (WHERE FEASIBLE). THE FENCE POSTS SHALL BE SPACED AT A MAXIMUM OF 6 FEET APART AND DRIVEN SECURELY INTO THE GROUND (MINIMUM OF 30 INCHES).
3. A TRENCH SHALL BE EXCAVATED, ROUGHLY 8 INCHES WIDE AND 12 INCHES DEEP, UPSLOPE AND ADJACENT TO THE WOOD POST TO ALLOW THE FILTER FABRIC TO BE BURIED.
4. WHEN STANDARD STRENGTH FILTER FABRIC IS USED, A WIRE MESH SUPPORT FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY-DUTY WIRE STAPLES AT LEAST 1 INCH LONG, TIE WIRES OR HOG RINGS. THE WIRE SHALL EXTEND INTO THE TRENCH A MINIMUM OF 4 INCHES AND SHALL NOT EXTEND MORE THAN 36 INCHES ABOVE THE ORIGINAL GROUND SURFACE.
5. THE STANDARD STRENGTH FILTER FABRIC SHALL BE STAPLED OR WIRED TO THE FENCE AND 20 INCHES OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. THE FABRIC SHALL NOT EXTEND MORE THAN 36 INCHES ABOVE THE ORIGINAL GROUND SURFACE. FILTER FABRIC SHALL NOT BE STAPLED TO EXISTING TREES.
6. WHEN EXTRA STRENGTH FILTER FABRIC AND CLOSER POST SPACING ARE USED, THE WIRE MESH SUPPORT FENCE MAY BE ELIMINATED. IN SUCH A CASE, THE FILTER FABRIC IS STAPLED OR WIRED DIRECTLY TO THE POSTS WITH ALL OTHER PROVISIONS OF STANDARD NOTE 5 APPLYING.
7. THE TRENCH SHALL BE BACKFILLED WITH 3/4-INCH MINIMUM DIAMETER WASHED GRAVEL.
8. FILTER FABRIC FENCES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFUL PURPOSE BUT NOT BEFORE THE UPSLOPE AREA HAS BEEN PERMANENTLY STABILIZED.
9. FILTER FABRIC FENCES SHALL BE INSPECTED IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST DAILY DURING PROLONGED RAINFALL. ANY REQUIRED REPAIRS SHALL BE MADE IMMEDIATELY.



SILT FENCE DETAILS

NOT TO SCALE

TEMPORARY EROSION/SEDIMENTATION CONTROL

1. A COPY OF THESE APPROVED PLANS MUST BE ON THE JOB SITE WHENEVER CONSTRUCTION IS IN PROGRESS.
2. APPROVAL OF THESE TEMPORARY EROSION/SEDIMENTATION CONTROL (TESC) PLANS DOES NOT CONSTITUTE AN APPROVAL OF PERMANENT ROAD OR DRAINAGE DESIGN (E.G., SIZE AND LOCATION OF ROADS, PIPES, RESTRICTORS, CHANNELS, RETENTION FACILITIES, UTILITIES, ETC.).
3. THE IMPLEMENTATION OF THESE TESC PLANS AND THE CONSTRUCTION, MAINTENANCE, REPLACEMENT AND UPGRADING OF THESE TESC FACILITIES IS THE RESPONSIBILITY OF THE CONTRACTOR UNTIL ALL CONSTRUCTION IS APPROVED.
4. THE BOUNDARIES OF THE CLEARING LIMITS SHOWN ON THIS PLAN SHALL BE CLEARLY FLAGGED IN THE FIELD PRIOR TO CONSTRUCTION. DURING THE CONSTRUCTION PERIOD, NO DISTURBANCE BEYOND THE FLAGGED CLEARING LIMITS SHALL BE PERMITTED. THE FLAGGING SHALL BE MAINTAINED BY THE CONTRACTOR FOR THE DURATION OF CONSTRUCTION.
5. THE TESC FACILITIES SHOWN ON THE PLANS MUST BE CONSTRUCTED PRIOR TO ALL, AS FEASIBLE, CLEARING AND GRADING ACTIVITIES, AND IN SUCH A MANNER AS TO INSURE THAT SEDIMENT LADEN WATER DOES NOT ENTER THE DRAINAGE SYSTEM OR VIOLATE APPLICABLE WATER STANDARDS.
6. THE TESC FACILITIES SHOWN ON THE PLANS ARE THE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE CONDITIONS. DURING THE CONSTRUCTION PERIOD, THESE TESC FACILITIES SHALL BE UPGRADED (E.G., ADDITIONAL SUMPS, RELOCATION OF DITCHES AND SILT FENCES, ETC.) AS NEEDED FOR UNEXPECTED STORM EVENTS.
7. THE TESC FACILITIES SHALL BE INSPECTED DAILY BY THE CONTRACTOR AND MAINTAINED AS NECESSARY TO ENSURE THEIR CONTINUED FUNCTIONING. A RECORD OF EACH INSPECTION AND ANY CORRECTIVE ACTION TAKEN MUST BE RETAINED WITH THE SWPPP.
8. ANY AREA STRIPPED OF VEGETATION, INCLUDING ROADWAY EMBANKMENTS, WHERE NO FURTHER WORK IS ANTICIPATED FOR A PERIOD OF 7 DAYS, SHALL BE IMMEDIATELY STABILIZED WITH THE APPROVED TESC METHODS (E.G., SEEDING, MULCHING, NETTING, EROSION BLANKETS, ETC.).
9. ANY AREA NEEDING TESC MEASURES, NOT REQUIRING IMMEDIATE ATTENTION, SHALL BE ADDRESSED WITHIN FIFTEEN (15) DAYS.
10. THE TESC FACILITIES ON INACTIVE SITES SHALL BE INSPECTED AND MAINTAINED A MINIMUM OF ONCE A MONTH OR WITHIN THE 24 HOURS FOLLOWING A STORM EVENT WITH THE APPROVAL OF ENGINEER.
11. AT NO TIME SHALL MORE THAN ONE FOOT OF SEDIMENT BE ALLOWED TO ACCUMULATE WITHIN A CATCH BASIN. ALL CATCH BASINS AND CONVEYANCE LINES SHALL BE CLEANED PRIOR TO PAVING. THE CLEANING OPERATION SHALL NOT FLUSH SEDIMENT LADEN WATER INTO THE DOWNSTREAM SYSTEM.
12. STABILIZED CONSTRUCTION ENTRANCES AND WASH PADS SHALL BE INSTALLED AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES MAY BE REQUIRED TO INSURE THAT ALL PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.
13. DURING THE TIME PERIOD OF OCTOBER 1 THROUGH APRIL 30, ALL PROJECT DISTURBED AREAS GREATER THAN 5,000 SQUARE FEET, THAT ARE TO BE LEFT UNWORKED FOR MORE THAN 12 HOURS, SHALL BE COVERED BY ONE OF THE FOLLOWING COVER MEASURES: MULCH, SODDING, OR PLASTIC COVERING.
14. ANY PERMANENT RETENTION/DETENTION FACILITY USED AS A TEMPORARY SETTLING BASIN SHALL BE MODIFIED WITH THE NECESSARY EROSION CONTROL MEASURES AND SHALL PROVIDE ADEQUATE STORAGE CAPACITY. IF THE PERMANENT FACILITY IS TO FUNCTION ULTIMATELY AS AN INFILTRATION OR DISPERSION SYSTEM, THE FACILITY SHALL NOT BE USED AS A TEMPORARY SETTLING BASIN. NO UNDERGROUND DETENTION TANK, DETENTION VAULT, OR SYSTEM WHICH BACKS UNDER OR INTO A POND SHALL BE USED AS A TEMPORARY SETTLING BASIN.
15. WHERE SEEDING FOR TEMPORARY EROSION CONTROL IS REQUIRED, FAST GERMINATING GRASSES SHALL BE APPLIED AT AN APPROPRIATE RATE (E.G. ANNUAL OR PERENNIAL RYE APPLIED AT APPROXIMATELY 120 POUNDS PER ACRE).
16. WHERE STRAW MULCH FOR TEMPORARY EROSION CONTROL IS REQUIRED, IT SHALL BE APPLIED AT A MINIMUM THICKNESS OF TWO INCHES.
17. ALL EROSION/SEDIMENTATION CONTROL PONDS WITH A DEAD STORAGE DEPTH EXCEEDING 6 INCHES MUST HAVE SLOPES NOT STEEPER THAN 3H:1V.
18. ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH WASHINGTON STATE DEPARTMENT OF TRANSPORTATION STANDARDS AND SPECIFICATIONS.
19. EROSION/SEDIMENTATION CONTROL FACILITIES SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE DETAILS IN THESE PLANS LOCATIONS MAY BE MOVED TO SUIT FIELD CONDITIONS, SUBJECT TO APPROVAL BY THE ENGINEER AND LOCAL JURISDICTIONAL AUTHORITY.

NPDES NOTES

1. THE CONTRACTOR SHALL KEEP A RECORD OF THE DATES WHEN MAJOR GRADING ACTIVITIES OCCUR, WHEN CONSTRUCTION ACTIVITIES TEMPORARILY OR PERMANENTLY CEASE ON A PORTION OF THE SITE, AND WHEN STABILIZATION MEASURES ARE IMPLEMENTED.
2. ALL EROSION CONTROL FACILITIES SHALL BE INSPECTED, MAINTAINED AND REPAIRED BY THE CONTRACTOR AS NEEDED TO ASSURE CONTINUED PERFORMANCE OF THEIR INTENDED FUNCTION. ALL ON SITE EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE INSPECTED AT LEAST ONCE EVERY SEVEN DAYS AND WITHIN 24 HOURS AFTER ANY STORM EVENT OF GREATER THAN 0.5 INCHES PER 24 HOUR PERIOD. AN INSPECTION REPORT FILE SHALL BE MAINTAINED BY THE CONTRACTOR FOR EACH INSPECTION.
3. THIS PROJECT REQUIRES A NPDES PERMIT AND ON-SITE CESCL FOR THE PROJECT DURATION. THE CONTRACTOR SHALL NAME THE CESCL PRIOR TO BEGINNING WORK.

SEEDING NOTES

1. SEEDBED PREPARATION MAY INCLUDE THE FOLLOWING:
   - A. IF INFERTILE OR COURSE TEXTURED SUBSOIL WILL BE EXPOSED DURING GRADING, STOCKPILE TOPSOIL AND RE-SPREAD IT OVER THE FINISHED SLOPE AND ROLL IT TO PROVIDE A FIRM BASE.
   - B. IF CONSTRUCTION FILLS HAVE LEFT SOIL EXPOSED WITH A LOOSE, ROUGH OR IRREGULAR SURFACE, TRACK WALK UP SLOPE.
   - C. IF CUTS OR CONSTRUCTION EQUIPMENT HAVE LEFT A TIGHTLY COMPACTED SURFACE, BREAK WITH CHISEL PLOW OR OTHER SUITABLE EQUIPMENT.
   - D. PERFORM ALL CULTURAL OPERATIONS ACROSS OR AT RIGHT ANGLES TO THE SLOPES (CONTOURED). THE SEEDBED SHOULD BE FIRM WITH A FAIRLY FINE SURFACE AFTER ROUGHENING.
2. FERTILIZATION – AS PER SUPPLIER'S RECOMMENDATIONS. DEVELOPMENTS ADJACENT TO WATER BODIES MUST USE NON-PHOSPHOROUS FERTILIZER.
3. HYDROSEEDING APPLICATIONS WITH APPROVED SEED-MULCH-FERTILIZER MIXTURES MAY ALSO BE USED.
4. SEEDING – APPLY APPROPRIATE MIXTURE TO THE PREPARED SEEDBED AT A RATE OF 120 LBS/ACRE. COVER THE SEED WITH TOPSOIL OR MULCH NO DEEPER THAN ONE-HALF INCH.

SEED MIX	VEGETATION TYPE (COMMON NAME)	PROPORTIONS BY WEIGHT	PERCENT PURITY	PERCENT GERMINATION
TEMPORARY EROSION CONTROL*	CHEWINGS OR RED FESCUE	40%	98	90
	PERENNIAL RYE	50%	98	90
	REDTOP OR COLONIAL BENTGRASS	5%	92	85
	WHITE DUTCH CLOVER	5%	98	90
LOW GROW*	DWARF TALL FESCUE VAR.	45%	98	90
	DWARF PERENNIAL RYE (BARCLAY)	30%	98	90
	RED FESCUE	20%	98	90
	COLONIAL BENTGRASS	5%	98	90

*(ADOPTED FROM WSDOE 2005 STORMWATER MANAGEMENT MANUAL WESTERN WASHINGTON, VOLUME. II, BMP C120)

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REVISION	DATE	DESCRIPTION	ISSUE	DATE	DESCRIPTION
			1	01/29/2024	30% DESIGN

BLUE COAST ENGINEERING
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BELLINGHAM, WA 98225
(360)319-8069

FINN CREEK RESTORATION

HANSVILLE, WA
SITE IMPROVEMENTS

TEMPORARY EROSION & SEDIMENT CONTROL PLAN

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SHEET SW-11 OF SW-12

DAVID P. GALBRAITH Jr.
44679
01-29-2024

GENERAL NOTES

1. ALL WORKMANSHIP AND MATERIALS SHALL CONFORM TO THE MOST CURRENT STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION PREPARED BY WSDOT AND APWA AS ADOPTED BY THE KCPW.
2. ANY REVISIONS TO THE ACCEPTED CONSTRUCTION PLANS SHALL BE REVIEWED AND APPROVED BY KITSAP COUNTY PRIOR TO IMPLEMENTATION IN THE FIELD.
3. THE CONTRACTOR SHALL MAINTAIN A SET OF THE ACCEPTED CONSTRUCTION DRAWINGS ONSITE AT ALL TIMES WHILE CONSTRUCTION IS IN PROGRESS.
4. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO OBTAIN ALL NECESSARY PERMITS FROM THE KCPW PRIOR TO COMMENCING ANY WORK WITHIN COUNTY RIGHT OF WAY.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING ADEQUATE TRAFFIC CONTROL AT ALL TIMES DURING CONSTRUCTION ALONGSIDE OR WITHIN ALL PUBLIC ROADWAYS. TRAFFIC FLOW ON EXISTING PUBLIC ROADWAYS SHALL BE MAINTAINED AT ALL TIMES, UNLESS PERMISSION IS OBTAINED FROM THE KCPW FOR ROAD CLOSURE AND/OR DETOURS.
6. THE LOCATION OF EXISTING UTILITIES ON THIS PLAN IS APPROXIMATE ONLY. THE CONTRACTOR SHALL CONTACT THE "UNDERGROUND LOCATE" CENTER AT 811, AND NON_SUBSCRIBING INDIVIDUAL UTILITY COMPANIES 48 HOURS IN ADVANCE OF THE COMMENCEMENT OF ANY CONSTRUCTION ACTIVITY. THE CONTRACTOR SHALL PROVIDE FOR PROTECTION OF EXISTING UTILITIES FROM DAMAGE CAUSED BY THE CONTRACTOR'S OPERATIONS.
7. ROCKERIES OR OTHER RETAINING FACILITIES THAT SUSTAIN A SURCHARGE OR EXCEED 4 FEET IN HEIGHT AS MEASURED FROM THE FOUNDATION REQUIRE A SEPARATE PERMIT PRIOR TO CONSTRUCTION.
8. A TIMBER HARVEST PERMIT MAY BE REQUIRED PRIOR TO CLEARING OF THE SITE.

CONSTRUCTION SEQUENCE

1. APPLY FOR AND PICK UP ANY RIGHT OF WAY PERMITS FROM KITSAP COUNTY DEPARTMENT OF PUBLIC WORKS (KCPW).
2. CONSTRUCT STABILIZED CONSTRUCTION ENTRANCE(S).
3. CONSTRUCT SILT FENCE BARRIERS.
4. CONSTRUCT SEDIMENTATION BASINS.
5. CONSTRUCT RUNOFF INTERCEPTION AND DIVERSION DITCHES.
6. CLEAR AND GRADE THE MINIMUM SITE AREA REQUIRED FOR CONSTRUCTION OF THE VARIOUS PHASES OF WORK.
7. PROVIDE TEMPORARY HYDROSEEDING OR OTHER SOURCE CONTROL STABILIZATION MEASURES ON ALL DISTURBED SOILS.
8. MAINTAIN ALL EROSION AND SEDIMENTATION CONTROL BEST MANAGEMENT PRACTICES (BMPS) TO PROVIDE THE REQUIRED PROTECTION OF DOWNSTREAM WATER QUALITY.
9. ALL CATCH BASINS AND CONVEYANCE LINES SHALL BE CLEANED PRIOR TO PAVING. THE CLEANING OPERATION SHALL NOT FLUSH SEDIMENT LADEN WATER INTO THE DOWNSTREAM SYSTEM.
10. PROVIDE PERMANENT SITE STABILIZATION.
11. EROSION AND SEDIMENTATION CONTROL BMPS SHALL NOT BE REMOVED UNTIL CONSTRUCTION IS COMPLETE AND ACCEPTED BY KITSAP COUNTY.

DRAINAGE NOTES

1. THE CONTRACTOR SHALL ENSURE THAT THE DRAINAGE IS INSTALLED AND OPERATIONAL PRIOR TO COMMENCEMENT OF PAVING WORK.
2. ALL STEEL PIPE AND PARTS SHALL BE GALVANIZED. ALL SUBMERGED STEEL PIPES AND PARTS SHALL BE GALVANIZED AND HAVE ASPHALT TREATMENT #1 OR BETTER.
3. DRAINAGE STUB-OUTS ON INDIVIDUAL LOTS SHALL BE LOCATED WITH A 5_FOOT_HIGH 2" X 4" STAKE MARKED "STORM." THE STUB OUT SHALL EXTEND ABOVE SURFACE LEVEL AND BE SECURED TO THE STAKE.
4. VIDEO DOCUMENTATION OF PIPE INTERIOR FOR ALIGNMENT AND JOINT CONNECTION ADEQUACY SHALL BE PROVIDED IF NOT INSPECTED PRIOR TO COVER.

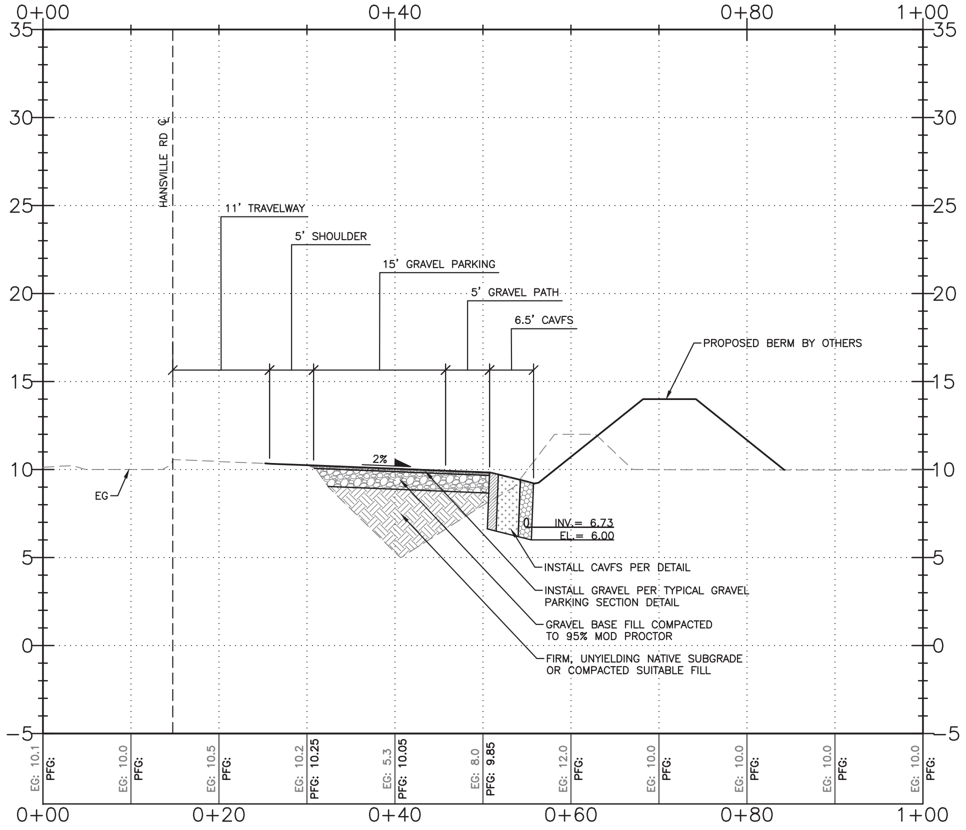
GRADING NOTES

THE CONTRACTOR SHALL NOTIFY THE ENGINEER IN THE EVENT OR DISCOVERY OF POOR SOILS, GROUNDWATER OR DISCREPANCIES IN THE EXISTING CONDITIONS AS NOTED ON THE PLANS.

1. MAXIMUM SLOPE STEEPNESS SHALL BE 2:1 (HORIZONTAL TO VERTICAL) FOR CUT AND FILL SLOPES.
2. UNLESS OTHERWISE SPECIFIED, ALL EMBANKMENTS IN THE PLAN SET SHALL BE CONSTRUCTED IN ACCORDANCE WITH SECTION 2_03.3(14)B OF THE WSDOT STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION (WSDOT 2020). EMBANKMENT COMPACTIONS SHALL CONFORM TO SECTION 2_03.3(14)C, METHOD B OF SAID STANDARD SPECIFICATIONS.
3. EMBANKMENTS DESIGNED TO IMPOUND WATER SHALL BE COMPACTED TO 95 PERCENT MAXIMUM DENSITY PER SECTION 2_03.3(14)C, METHOD C OF WSDOT STANDARD SPECIFICATIONS.
4. ALL AREAS RECEIVING FILL MATERIAL SHALL BE PREPARED BY REMOVING VEGETATION, NON_COMPLYING FILL, TOPSOIL AND OTHER UNSUITABLE MATERIAL, BY SCARIFYING THE SURFACE TO PROVIDE A BOND WITH THE NEW FILL, AND WHERE SLOPES ARE STEEPER THAN 3 HORIZONTAL TO 1 VERTICAL AND THE HEIGHT IS GREATER THAN 5 FEET., BY BENCHING INTO SOUND COMPETENT MATERIAL AS DETERMINED BY A GEOTECHNICAL ENGINEER.

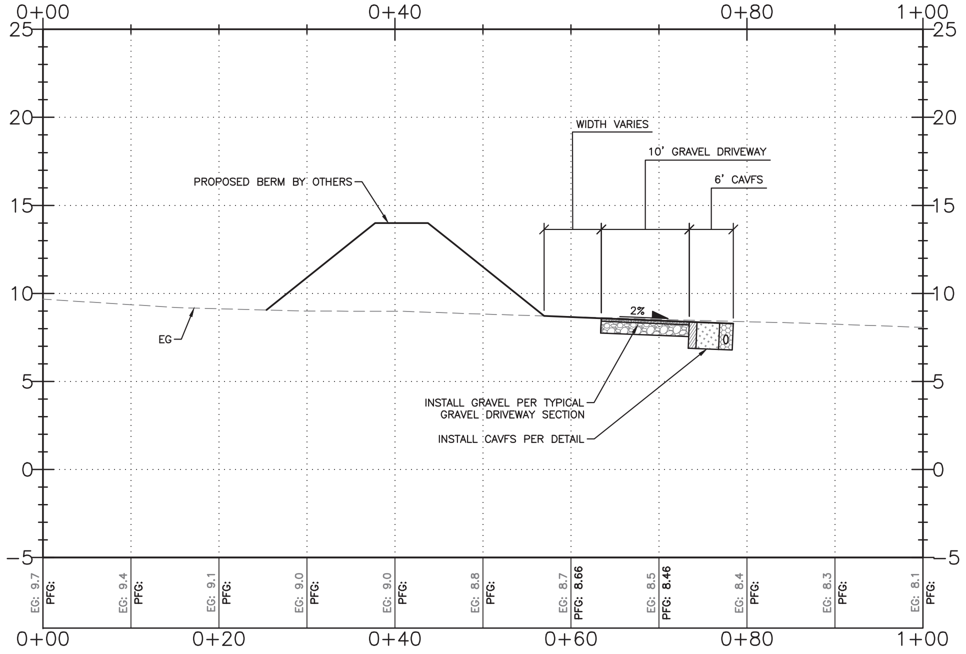
INSPECTION SCHEDULE

1. THE CONTRACTOR SHALL NOTIFY THE DEPARTMENT OF COMMUNITY DEVELOPMENT TO ARRANGE FOR INSPECTION OF THE VARIOUS WORK ACTIVITIES LISTED BELOW. ALL INSPECTIONS SHALL BE COMPLETED PRIOR TO PROCEEDING WITH THE NEXT PHASE OF WORK.
   a. ESTABLISHMENT OF CLEARING LIMITS.
   b. IMPLEMENTATION OF THE VARIOUS PHASES OF THE EROSION AND SEDIMENTATION CONTROL PLAN.
   c. INSTALLATION OF CONVEYANCE, ON-SITE STORMWATER MANAGEMENT BMPS, FLOW CONTROL BMPS, AND WATER QUALITY BMPS, PRIOR TO BACKFILL.
   d. PROTECTION OF ON-SITE STORMWATER MANAGEMENT BMPS.
   e. PRIOR TO PLACEMENT OF THE OUTLET CONTROL STRUCTURES (ORIFICE SIZE VERIFIED PRIOR TO INSTALLATION).
   f. FOR PUBLIC ROAD PROJECTS:
   i. INSPECTION OF PREPARED SUB-GRADE.
   ii. INSPECTION OF GRAVEL BASE PLACEMENT.
   iii. INSPECTION OF FINE GRADING PRIOR TO PAVING.
   iv. INSPECTION OF PAVING OPERATIONS.
   v. FINAL INSPECTION.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL WORK PERFORMED AND SHALL ENSURE THAT CONSTRUCTION IS ACCEPTABLE TO KITSAP COUNTY.
3. IF INSPECTION IS NOT CALLED FOR PRIOR TO COMPLETION OF ANY ITEM OF WORK SO DESIGNATED, SPECIAL DESTRUCTIVE AND/OR NON-DESTRUCTIVE TESTING PROCEDURES MAY BE REQUIRED TO ENSURE THE ACCEPTABILITY OF THE WORK. IF SUCH PROCEDURES ARE REQUIRED, THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL COSTS ASSOCIATED WITH THE TESTING AND/OR RESTORATION OF THE WORK.



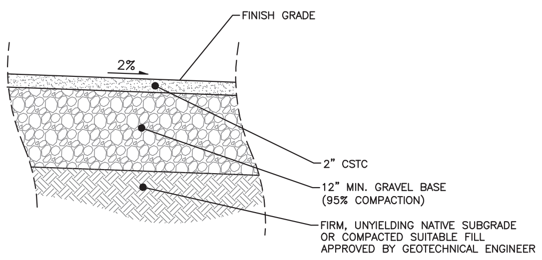
TYPICAL CROSS SECTION A-A

H. SCALE: 1"=10' V. SCALE: 1"=5'



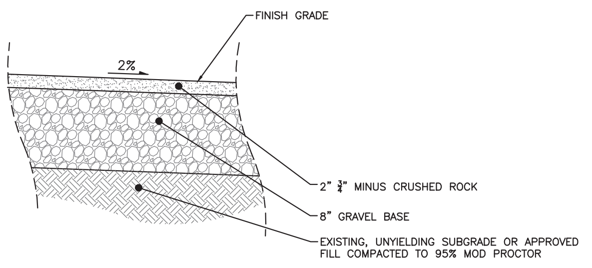
TYPICAL CROSS SECTION B-B

H. SCALE: 1"=10' V. SCALE: 1"=5'



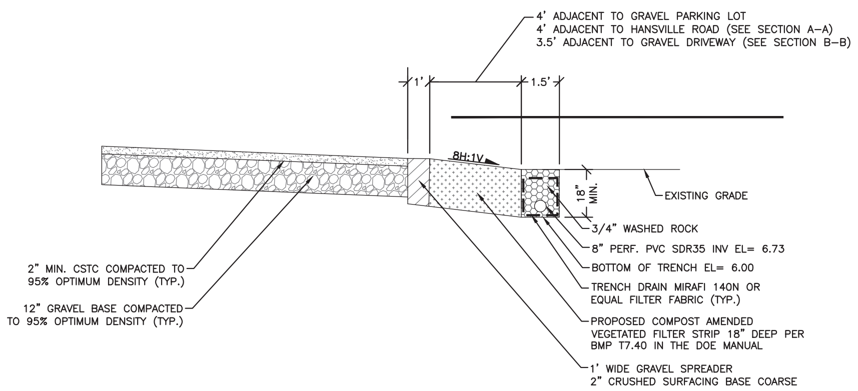
TYPICAL GRAVEL PARKING SECTION

NTS



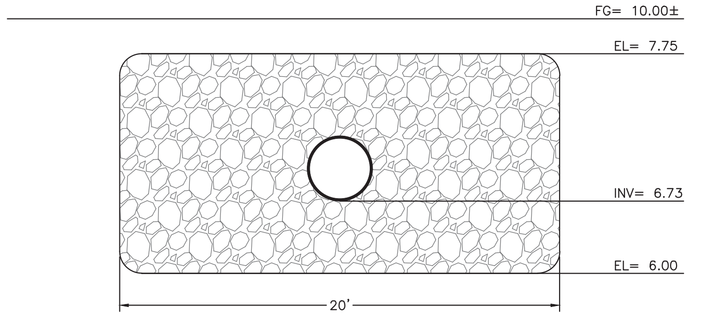
TYPICAL GRAVEL DRIVEWAY SECTION

NTS



TYPICAL CAVFS DETAIL

NTS



INFILTRATION GALLERY CROSS SECTION

NTS

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SHEET SW-12 OF SW-12

DAVID P. GALBRAITH Jr.
44679
01-29-2024

APPENDIX

8.5 WWHM MODELING

WWHM2012
PROJECT REPORT

Project Name: GRAVEL PARKING AREA
Site Name: GRAVEL PARKING AREA
Site Address:
City :
Report Date: 1/29/2024
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2021/08/18
Version : 4.2.18

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Flat	.24
Pervious Total	0.24

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.24

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
A B, Pasture, Flat	**.042**
Pervious Total	**0.042**

Impervious Land Use	**acre**
ROADS FLAT	**0.198**
Impervious Total	**0.198**
Basin Total	**0.24**

Element Flows To:

Surface	**Interflow**	**Groundwater**
CAVFS 1 Surface 1	CAVFS 1 Surface 1	

Name : CAVFS 1
CAVFS Length: 72.00 ft.
CAVFS Width: 4.00 ft.
Gravel thickness: 1
Material thickness of CAVFS layer: 1.5
Slope of CAVFS layer: 0.125
Infiltration On
Infiltration rate: 1.42
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 21.949
Total Volume Through Riser (ac-ft.): 0.195
Total Volume Through Facility (ac-ft.): 23.544
Percent Infiltrated: 93.23
Total Precip Applied to Facility: 0.336
Total Evap From Facility: 0.311
Outlet Control
Overflow Height: 0.5 ft.
Overflow width: 36 in.

Element Flows To:

Outlet 1	**Outlet 2**
Gravel Trench Bed 1	

CAVFS 1 Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0025	0.0000	0.0000	0.0000
0.0615	0.0025	0.0001	0.0000	0.0000
0.1231	0.0025	0.0001	0.0000	0.0000
0.1846	0.0025	0.0002	0.0000	0.0000
0.2462	0.0025	0.0003	0.0000	0.0000
0.3077	0.0025	0.0003	0.0000	0.0000
0.3692	0.0025	0.0004	0.0000	0.0000
0.4308	0.0025	0.0004	0.0000	0.0000

0.4923	0.0025	0.0005	0.0000	0.0000
0.5538	0.0025	0.0006	0.0000	0.0000
0.6154	0.0025	0.0006	0.0000	0.0000
0.6769	0.0025	0.0007	0.0000	0.0000
0.7385	0.0025	0.0008	0.0000	0.0000
0.8000	0.0025	0.0008	0.0000	0.0000
0.8615	0.0025	0.0009	0.0000	0.0000
0.9231	0.0025	0.0009	0.0000	0.0000
0.9846	0.0025	0.0010	0.0001	0.0118
1.0462	0.0025	0.0011	0.0001	0.0118
1.1077	0.0025	0.0011	0.0001	0.0118
1.1692	0.0025	0.0012	0.0002	0.0118
1.2308	0.0025	0.0013	0.0002	0.0118
1.2923	0.0025	0.0013	0.0002	0.0118
1.3538	0.0025	0.0014	0.0003	0.0118
1.4154	0.0025	0.0014	0.0003	0.0118
1.4769	0.0025	0.0015	0.0004	0.0118
1.5385	0.0025	0.0016	0.0004	0.0118
1.6000	0.0025	0.0016	0.0005	0.0118
1.6615	0.0025	0.0017	0.0006	0.0118
1.7231	0.0025	0.0017	0.0006	0.0118
1.7846	0.0025	0.0018	0.0007	0.0118
1.8462	0.0025	0.0019	0.0008	0.0118
1.9077	0.0025	0.0019	0.0009	0.0118
1.9692	0.0025	0.0020	0.0010	0.0118
2.0308	0.0025	0.0021	0.0011	0.0118
2.0923	0.0025	0.0021	0.0012	0.0118
2.1538	0.0025	0.0022	0.0013	0.0118
2.2154	0.0025	0.0022	0.0014	0.0118
2.2769	0.0025	0.0023	0.0016	0.0118
2.3385	0.0025	0.0024	0.0017	0.0118
2.4000	0.0025	0.0024	0.0018	0.0118
2.4615	0.0025	0.0025	0.0020	0.0118
2.5231	0.0025	0.0025	0.0021	0.0118
2.5846	0.0025	0.0026	0.0023	0.0118
2.6462	0.0025	0.0027	0.0024	0.0118
2.7077	0.0025	0.0027	0.0026	0.0118
2.7692	0.0025	0.0028	0.0028	0.0118
2.8308	0.0025	0.0029	0.0030	0.0118
2.8923	0.0025	0.0029	0.0032	0.0118
2.9538	0.0025	0.0030	0.0034	0.0118
3.0154	0.0025	0.0030	0.0036	0.0118
3.0769	0.0025	0.0031	0.0038	0.0118
3.1385	0.0025	0.0032	0.0040	0.0118
3.2000	0.0025	0.0032	0.0043	0.0118
3.2615	0.0025	0.0033	0.0045	0.0118
3.3231	0.0025	0.0033	0.0047	0.0118
3.3846	0.0025	0.0034	0.0050	0.0118
3.4462	0.0025	0.0035	0.0053	0.0118
3.5077	0.0025	0.0035	0.0055	0.0118
3.5692	0.0025	0.0036	0.0058	0.0118
3.6308	0.0025	0.0036	0.0061	0.0118
3.6923	0.0025	0.0037	0.0064	0.0118
3.7538	0.0025	0.0038	0.0067	0.0118
3.8154	0.0025	0.0038	0.0070	0.0118
3.8769	0.0025	0.0039	0.0073	0.0118
3.9385	0.0025	0.0040	0.0077	0.0118

4.0000	0.0025	0.0040	0.0080	0.0118
4.0615	0.0025	0.0041	0.0084	0.0118
4.1231	0.0025	0.0041	0.0087	0.0118
4.1846	0.0025	0.0042	0.0091	0.0118
4.2462	0.0025	0.0043	0.0095	0.0118
4.3077	0.0025	0.0043	0.0100	0.0118
4.3692	0.0025	0.0044	0.0231	0.0118
4.4308	0.0025	0.0044	0.0231	0.0118
4.4923	0.0025	0.0045	0.0231	0.0118
4.5538	0.0025	0.0046	0.0231	0.0118
4.6154	0.0025	0.0046	0.0231	0.0118
4.6769	0.0025	0.0047	0.0231	0.0118
4.7385	0.0025	0.0047	0.0231	0.0118
4.8000	0.0025	0.0048	0.0231	0.0118
4.8615	0.0025	0.0049	0.0231	0.0118
4.9231	0.0025	0.0049	0.0231	0.0118
4.9846	0.0025	0.0050	0.0231	0.0118
5.0000	0.0025	0.0050	0.0231	0.0118

CAVFS 1 Surface 1 Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Wetted Surface
5.0000	0.0025	0.0050	0.0000	0.0350	0.0000
5.0615	0.0025	0.0052	0.0000	0.0350	0.0000
5.1231	0.0025	0.0053	0.0000	0.0350	0.0000
5.1846	0.0025	0.0055	0.0000	0.0350	0.0000
5.2462	0.0025	0.0056	0.0000	0.0350	0.0000
5.3077	0.0025	0.0058	0.0000	0.0350	0.0000
5.3692	0.0025	0.0059	0.0000	0.0350	0.0000
5.4308	0.0025	0.0061	0.0000	0.0350	0.0000
5.4923	0.0025	0.0062	0.0000	0.0350	0.0000
5.5538	0.0025	0.0064	0.0000	0.0350	0.0000
5.6000	0.0025	0.0065	0.0000	0.0350	0.0000

Name : CAVFS 1 Surface 1

Element Flows To:

Outlet 1	Outlet 2
Gravel Trench Bed 1	CAVFS 1

Name : Gravel Trench Bed 1
Bottom Length: 155.00 ft.
Bottom Width: 7.00 ft.
Trench bottom slope 1: 0 To 1
Trench Left side slope 0: 0 To 1
Trench right side slope 2: 0 To 1
Material thickness of first layer: 2.5
Pour Space of material for first layer: 0.33
Material thickness of second layer: 0
Pour Space of material for second layer: 0
Material thickness of third layer: 0
Pour Space of material for third layer: 0
Infiltration On
Infiltration rate: 1.42
Infiltration safety factor: 1

Total Volume Infiltrated (ac-ft.): 1.544
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 1.544
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 1.5 ft.
Riser Diameter: 8 in.

Element Flows To:
Outlet 1 Outlet 2

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.024	0.000	0.000	0.000
0.0278	0.024	0.000	0.000	0.035
0.0556	0.024	0.000	0.000	0.035
0.0833	0.024	0.000	0.000	0.035
0.1111	0.024	0.000	0.000	0.035
0.1389	0.024	0.001	0.000	0.035
0.1667	0.024	0.001	0.000	0.035
0.1944	0.024	0.001	0.000	0.035
0.2222	0.024	0.001	0.000	0.035
0.2500	0.024	0.002	0.000	0.035
0.2778	0.024	0.002	0.000	0.035
0.3056	0.024	0.002	0.000	0.035
0.3333	0.024	0.002	0.000	0.035
0.3611	0.024	0.003	0.000	0.035
0.3889	0.024	0.003	0.000	0.035
0.4167	0.024	0.003	0.000	0.035
0.4444	0.024	0.003	0.000	0.035
0.4722	0.024	0.003	0.000	0.035
0.5000	0.024	0.004	0.000	0.035
0.5278	0.024	0.004	0.000	0.035
0.5556	0.024	0.004	0.000	0.035
0.5833	0.024	0.004	0.000	0.035
0.6111	0.024	0.005	0.000	0.035
0.6389	0.024	0.005	0.000	0.035
0.6667	0.024	0.005	0.000	0.035
0.6944	0.024	0.005	0.000	0.035
0.7222	0.024	0.005	0.000	0.035
0.7500	0.024	0.006	0.000	0.035
0.7778	0.024	0.006	0.000	0.035
0.8056	0.024	0.006	0.000	0.035
0.8333	0.024	0.006	0.000	0.035
0.8611	0.024	0.007	0.000	0.035
0.8889	0.024	0.007	0.000	0.035
0.9167	0.024	0.007	0.000	0.035
0.9444	0.024	0.007	0.000	0.035
0.9722	0.024	0.008	0.000	0.035
1.0000	0.024	0.008	0.000	0.035
1.0278	0.024	0.008	0.000	0.035

1.0556	0.024	0.008	0.000	0.035
1.0833	0.024	0.008	0.000	0.035
1.1111	0.024	0.009	0.000	0.035
1.1389	0.024	0.009	0.000	0.035
1.1667	0.024	0.009	0.000	0.035
1.1944	0.024	0.009	0.000	0.035
1.2222	0.024	0.010	0.000	0.035
1.2500	0.024	0.010	0.000	0.035
1.2778	0.024	0.010	0.000	0.035
1.3056	0.024	0.010	0.000	0.035
1.3333	0.024	0.011	0.000	0.035
1.3611	0.024	0.011	0.000	0.035
1.3889	0.024	0.011	0.000	0.035
1.4167	0.024	0.011	0.000	0.035
1.4444	0.024	0.011	0.000	0.035
1.4722	0.024	0.012	0.000	0.035
1.5000	0.024	0.012	0.000	0.035
1.5278	0.024	0.012	0.032	0.035
1.5556	0.024	0.012	0.092	0.035
1.5833	0.024	0.013	0.168	0.035
1.6111	0.024	0.013	0.255	0.035
1.6389	0.024	0.013	0.348	0.035
1.6667	0.024	0.013	0.441	0.035
1.6944	0.024	0.013	0.531	0.035
1.7222	0.024	0.014	0.610	0.035
1.7500	0.024	0.014	0.678	0.035
1.7778	0.024	0.014	0.730	0.035
1.8056	0.024	0.014	0.769	0.035
1.8333	0.024	0.015	0.799	0.035
1.8611	0.024	0.015	0.841	0.035
1.8889	0.024	0.015	0.873	0.035
1.9167	0.024	0.015	0.903	0.035
1.9444	0.024	0.016	0.933	0.035
1.9722	0.024	0.016	0.961	0.035
2.0000	0.024	0.016	0.989	0.035
2.0278	0.024	0.016	1.017	0.035
2.0556	0.024	0.016	1.043	0.035
2.0833	0.024	0.017	1.069	0.035
2.1111	0.024	0.017	1.094	0.035
2.1389	0.024	0.017	1.118	0.035
2.1667	0.024	0.017	1.143	0.035
2.1944	0.024	0.018	1.166	0.035
2.2222	0.024	0.018	1.189	0.035
2.2500	0.024	0.018	1.212	0.035
2.2778	0.024	0.018	1.234	0.035
2.3056	0.024	0.019	1.256	0.035
2.3333	0.024	0.019	1.277	0.035
2.3611	0.024	0.019	1.299	0.035
2.3889	0.024	0.019	1.319	0.035
2.4167	0.024	0.019	1.340	0.035
2.4444	0.024	0.020	1.360	0.035
2.4722	0.024	0.020	1.380	0.035
2.5000	0.024	0.020	1.399	0.035

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.24
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.042
Total Impervious Area:0.198

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.000174
5 year	0.000199
10 year	0.00021
25 year	0.00022
50 year	0.000226
100 year	0.00023

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.000	0.000
1950	0.000	0.000
1951	0.000	0.000
1952	0.000	0.000
1953	0.000	0.000
1954	0.000	0.000
1955	0.000	0.000
1956	0.000	0.000
1957	0.000	0.000
1958	0.000	0.000
1959	0.000	0.000
1960	0.000	0.000
1961	0.000	0.000
1962	0.000	0.000
1963	0.000	0.000
1964	0.000	0.000
1965	0.000	0.000
1966	0.000	0.000
1967	0.000	0.000

1968	0.000	0.000
1969	0.000	0.000
1970	0.000	0.000
1971	0.000	0.000
1972	0.000	0.000
1973	0.000	0.000
1974	0.000	0.000
1975	0.000	0.000
1976	0.000	0.000
1977	0.000	0.000
1978	0.000	0.000
1979	0.000	0.000
1980	0.000	0.000
1981	0.000	0.000
1982	0.000	0.000
1983	0.000	0.000
1984	0.000	0.000
1985	0.000	0.000
1986	0.000	0.000
1987	0.000	0.000
1988	0.000	0.000
1989	0.000	0.000
1990	0.000	0.000
1991	0.000	0.000
1992	0.000	0.000
1993	0.000	0.000
1994	0.000	0.000
1995	0.000	0.000
1996	0.000	0.000
1997	0.000	0.000
1998	0.000	0.000
1999	0.000	0.000
2000	0.000	0.000
2001	0.000	0.000
2002	0.000	0.000
2003	0.000	0.000
2004	0.000	0.000
2005	0.000	0.000
2006	0.000	0.000
2007	0.000	0.000
2008	0.000	0.000
2009	0.000	0.000

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	0.0002	0.0000
2	0.0002	0.0000
3	0.0002	0.0000
4	0.0002	0.0000
5	0.0002	0.0000
6	0.0002	0.0000
7	0.0002	0.0000
8	0.0002	0.0000
9	0.0002	0.0000
10	0.0002	0.0000

11	0.0002	0.0000
12	0.0002	0.0000
13	0.0002	0.0000
14	0.0002	0.0000
15	0.0002	0.0000
16	0.0002	0.0000
17	0.0002	0.0000
18	0.0002	0.0000
19	0.0002	0.0000
20	0.0002	0.0000
21	0.0002	0.0000
22	0.0002	0.0000
23	0.0002	0.0000
24	0.0002	0.0000
25	0.0002	0.0000
26	0.0002	0.0000
27	0.0002	0.0000
28	0.0002	0.0000
29	0.0002	0.0000
30	0.0002	0.0000
31	0.0002	0.0000
32	0.0002	0.0000
33	0.0002	0.0000
34	0.0002	0.0000
35	0.0002	0.0000
36	0.0002	0.0000
37	0.0002	0.0000
38	0.0002	0.0000
39	0.0002	0.0000
40	0.0002	0.0000
41	0.0002	0.0000
42	0.0002	0.0000
43	0.0002	0.0000
44	0.0002	0.0000
45	0.0002	0.0000
46	0.0002	0.0000
47	0.0002	0.0000
48	0.0002	0.0000
49	0.0002	0.0000
50	0.0002	0.0000
51	0.0002	0.0000
52	0.0002	0.0000
53	0.0001	0.0000
54	0.0001	0.0000
55	0.0001	0.0000
56	0.0001	0.0000
57	0.0001	0.0000
58	0.0001	0.0000
59	0.0001	0.0000
60	0.0001	0.0000
61	0.0001	0.0000

Stream Protection Duration
POC #1
The Facility PASSED

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The Facility PASSED.

Flow(cfs) Predev  Mit Percentage Pass/Fail
0.0001    1141     0          0       Pass
0.0001    1119     0          0       Pass
0.0001    1097     0          0       Pass
0.0001    1055     0          0       Pass
0.0001    1021     0          0       Pass
0.0001    965      0          0       Pass
0.0001    949      0          0       Pass
0.0001    929      0          0       Pass
0.0001    891      0          0       Pass
0.0001    870      0          0       Pass
0.0001    833      0          0       Pass
0.0001    810      0          0       Pass
0.0001    792      0          0       Pass
0.0001    752      0          0       Pass
0.0001    736      0          0       Pass
0.0001    693      0          0       Pass
0.0001    678      0          0       Pass
0.0001    663      0          0       Pass
0.0001    647      0          0       Pass
0.0001    634      0          0       Pass
0.0001    606      0          0       Pass
0.0001    601      0          0       Pass
0.0001    593      0          0       Pass
0.0001    561      0          0       Pass
0.0001    543      0          0       Pass
0.0001    518      0          0       Pass
0.0001    505      0          0       Pass
0.0001    486      0          0       Pass
0.0001    471      0          0       Pass
0.0001    461      0          0       Pass
0.0001    431      0          0       Pass
0.0001    421      0          0       Pass
0.0001    418      0          0       Pass
0.0001    406      0          0       Pass
0.0001    398      0          0       Pass
0.0001    382      0          0       Pass
0.0001    373      0          0       Pass
0.0001    367      0          0       Pass
0.0001    347      0          0       Pass
0.0001    338      0          0       Pass
0.0001    325      0          0       Pass
0.0001    309      0          0       Pass
0.0001    289      0          0       Pass
0.0001    266      0          0       Pass
0.0001    260      0          0       Pass
0.0002    242      0          0       Pass
0.0002    235      0          0       Pass
0.0002    230      0          0       Pass
0.0002    216      0          0       Pass
0.0002    206      0          0       Pass
0.0002    195      0          0       Pass
0.0002    191      0          0       Pass
0.0002    177      0          0       Pass
0.0002    170      0          0       Pass
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0.0002	166	0	0	Pass
0.0002	152	0	0	Pass
0.0002	147	0	0	Pass
0.0002	133	0	0	Pass
0.0002	127	0	0	Pass
0.0002	122	0	0	Pass
0.0002	116	0	0	Pass
0.0002	110	0	0	Pass
0.0002	100	0	0	Pass
0.0002	92	0	0	Pass
0.0002	85	0	0	Pass
0.0002	73	0	0	Pass
0.0002	65	0	0	Pass
0.0002	60	0	0	Pass
0.0002	55	0	0	Pass
0.0002	51	0	0	Pass
0.0002	37	0	0	Pass
0.0002	35	0	0	Pass
0.0002	25	0	0	Pass
0.0002	23	0	0	Pass
0.0002	18	0	0	Pass
0.0002	7	0	0	Pass
0.0002	4	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

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LID Technique                 Used for    Total Volume   Volume    Infiltration  Cumulative
Percent     Water Quality  Percent       Comment
                              Treatment?  Needs          Through   Volume        Volume
Volume                     Water Quality
                                          Treatment      Facility  (ac-ft.)       Infiltration
Infiltrated                Treated
                                          (ac-ft)        (ac-ft)                 Credit
___________________________________________________________________________________________________
Gravel Trench Bed 1 POC            N      1.40                                         N
100.00
CAVFS  1 1                         N      21.43                                        N
93.23
Total Volume Infiltrated                  22.83          0.00      0.00
93.64       0.00           0%            No Treat. Credit
Compliance with LID Standard 8
Duration Analysis Result = Passed
```

Perlnd and Implnd Changes

No changes have been made.

WWHM2012
PROJECT REPORT

Project Name: HANSVILLE ROAD PARKING
Site Name: HANSVILLE ROAD PARKING
Site Address:
City :
Report Date: 2/14/2024
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2021/08/18
Version : 4.2.18

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
A B, Forest, Flat	**.63**
Pervious Total	**0.63**

Impervious Land Use	**acre**
Impervious Total	**0**
Basin Total	**0.63**

Element Flows To:

Surface	**Interflow**	**Groundwater**

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
A B, Pasture, Flat	.028
Pervious Total	0.028

Impervious Land Use	**acre**
ROADS FLAT	0.604
Impervious Total	0.604

Basin Total	0.632

Element Flows To:

Surface	**Interflow**	**Groundwater**
CAVFS 1 Surface 1	CAVFS 1 Surface 1	

Name : CAVFS 1
CAVFS Length: 670.00 ft.
CAVFS Width: 4.00 ft.
Gravel thickness: 1
Material thickness of CAVFS layer: 1.5
Slope of CAVFS layer: 0.125
Infiltration On
Infiltration rate: 1.42
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 71.976
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 72.568
Percent Infiltrated: 99.18
Total Precip Applied to Facility: 3.112
Total Evap From Facility: 2.761
Outlet Control
Overflow Height: 0.5 ft.
Overflow width: 335 in.

Element Flows To:

Outlet 1	**Outlet 2**
Gravel Trench Bed 1	

CAVFS 1 Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0231	0.0000	0.0000	0.0000
0.0615	0.0231	0.0006	0.0000	0.0000
0.1231	0.0231	0.0012	0.0000	0.0000
0.1846	0.0231	0.0018	0.0000	0.0000
0.2462	0.0231	0.0024	0.0000	0.0000
0.3077	0.0231	0.0029	0.0000	0.0000
0.3692	0.0231	0.0035	0.0000	0.0000
0.4308	0.0231	0.0041	0.0000	0.0000

0.4923	0.0231	0.0047	0.0000	0.0000
0.5538	0.0231	0.0053	0.0000	0.0000
0.6154	0.0231	0.0059	0.0000	0.0000
0.6769	0.0231	0.0065	0.0000	0.0000
0.7385	0.0231	0.0071	0.0000	0.0000
0.8000	0.0231	0.0077	0.0000	0.0000
0.8615	0.0231	0.0082	0.0000	0.0000
0.9231	0.0231	0.0088	0.0000	0.0000
0.9846	0.0231	0.0094	0.0007	0.1101
1.0462	0.0231	0.0100	0.0009	0.1101
1.1077	0.0231	0.0106	0.0012	0.1101
1.1692	0.0231	0.0111	0.0015	0.1101
1.2308	0.0231	0.0117	0.0018	0.1101
1.2923	0.0231	0.0123	0.0022	0.1101
1.3538	0.0231	0.0128	0.0026	0.1101
1.4154	0.0231	0.0134	0.0030	0.1101
1.4769	0.0231	0.0140	0.0035	0.1101
1.5385	0.0231	0.0146	0.0041	0.1101
1.6000	0.0231	0.0151	0.0047	0.1101
1.6615	0.0231	0.0157	0.0053	0.1101
1.7231	0.0231	0.0163	0.0060	0.1101
1.7846	0.0231	0.0168	0.0067	0.1101
1.8462	0.0231	0.0174	0.0075	0.1101
1.9077	0.0231	0.0180	0.0083	0.1101
1.9692	0.0231	0.0185	0.0092	0.1101
2.0308	0.0231	0.0191	0.0102	0.1101
2.0923	0.0231	0.0197	0.0111	0.1101
2.1538	0.0231	0.0203	0.0122	0.1101
2.2154	0.0231	0.0208	0.0133	0.1101
2.2769	0.0231	0.0214	0.0145	0.1101
2.3385	0.0231	0.0220	0.0157	0.1101
2.4000	0.0231	0.0225	0.0170	0.1101
2.4615	0.0231	0.0231	0.0183	0.1101
2.5231	0.0231	0.0237	0.0198	0.1101
2.5846	0.0231	0.0242	0.0212	0.1101
2.6462	0.0231	0.0248	0.0228	0.1101
2.7077	0.0231	0.0254	0.0244	0.1101
2.7692	0.0231	0.0260	0.0260	0.1101
2.8308	0.0231	0.0265	0.0278	0.1101
2.8923	0.0231	0.0271	0.0296	0.1101
2.9538	0.0231	0.0277	0.0314	0.1101
3.0154	0.0231	0.0282	0.0334	0.1101
3.0769	0.0231	0.0288	0.0354	0.1101
3.1385	0.0231	0.0294	0.0375	0.1101
3.2000	0.0231	0.0299	0.0396	0.1101
3.2615	0.0231	0.0305	0.0418	0.1101
3.3231	0.0231	0.0311	0.0441	0.1101
3.3846	0.0231	0.0317	0.0465	0.1101
3.4462	0.0231	0.0322	0.0490	0.1101
3.5077	0.0231	0.0328	0.0515	0.1101
3.5692	0.0231	0.0334	0.0541	0.1101
3.6308	0.0231	0.0339	0.0568	0.1101
3.6923	0.0231	0.0345	0.0595	0.1101
3.7538	0.0231	0.0351	0.0624	0.1101
3.8154	0.0231	0.0356	0.0653	0.1101
3.8769	0.0231	0.0362	0.0683	0.1101
3.9385	0.0231	0.0368	0.0714	0.1101

4.0000	0.0231	0.0374	0.0746	0.1101
4.0615	0.0231	0.0379	0.0779	0.1101
4.1231	0.0231	0.0385	0.0813	0.1101
4.1846	0.0231	0.0391	0.0849	0.1101
4.2462	0.0231	0.0396	0.0885	0.1101
4.3077	0.0231	0.0402	0.0931	0.1101
4.3692	0.0231	0.0408	0.2152	0.1101
4.4308	0.0231	0.0414	0.2152	0.1101
4.4923	0.0231	0.0419	0.2152	0.1101
4.5538	0.0231	0.0425	0.2152	0.1101
4.6154	0.0231	0.0431	0.2152	0.1101
4.6769	0.0231	0.0436	0.2152	0.1101
4.7385	0.0231	0.0442	0.2152	0.1101
4.8000	0.0231	0.0448	0.2152	0.1101
4.8615	0.0231	0.0453	0.2152	0.1101
4.9231	0.0231	0.0459	0.2152	0.1101
4.9846	0.0231	0.0465	0.2152	0.1101
5.0000	0.0231	0.0466	0.2152	0.1101

CAVFS 1 Surface 1 Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Wetted Surface
5.0000	0.0231	0.0466	0.0000	0.3253	0.0000
5.0615	0.0231	0.0480	0.0000	0.3253	0.0000
5.1231	0.0231	0.0495	0.0000	0.3253	0.0000
5.1846	0.0231	0.0509	0.0000	0.3253	0.0000
5.2462	0.0231	0.0523	0.0000	0.3253	0.0000
5.3077	0.0231	0.0537	0.0000	0.3253	0.0000
5.3692	0.0231	0.0551	0.0000	0.3253	0.0000
5.4308	0.0231	0.0566	0.0000	0.3253	0.0000
5.4923	0.0231	0.0580	0.0000	0.3253	0.0000
5.5538	0.0231	0.0594	0.0000	0.3253	0.0000
5.6000	0.0231	0.0605	0.0000	0.3253	0.0000

Name : CAVFS 1 Surface 1

Element Flows To:

Outlet 1	**Outlet 2**
Gravel Trench Bed 1	CAVFS 1

Name : Gravel Trench Bed 1
Bottom Length: 680.00 ft.
Bottom Width: 1.50 ft.
Trench bottom slope 1: 0 To 1
Trench Left side slope 0: 0 To 1
Trench right side slope 2: 0 To 1
Material thickness of first layer: 2.5
Pour Space of material for first layer: 0.33
Material thickness of second layer: 0
Pour Space of material for second layer: 0
Material thickness of third layer: 0
Pour Space of material for third layer: 0
Infiltration On
Infiltration rate: 1.42
Infiltration safety factor: 1

Total Volume Infiltrated (ac-ft.): 0.539
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 0.539
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 1.5 ft.
Riser Diameter: 8 in.

Element Flows To:
Outlet 1 **Outlet 2**

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.023	0.000	0.000	0.000
0.0278	0.023	0.000	0.000	0.033
0.0556	0.023	0.000	0.000	0.033
0.0833	0.023	0.000	0.000	0.033
0.1111	0.023	0.000	0.000	0.033
0.1389	0.023	0.001	0.000	0.033
0.1667	0.023	0.001	0.000	0.033
0.1944	0.023	0.001	0.000	0.033
0.2222	0.023	0.001	0.000	0.033
0.2500	0.023	0.001	0.000	0.033
0.2778	0.023	0.002	0.000	0.033
0.3056	0.023	0.002	0.000	0.033
0.3333	0.023	0.002	0.000	0.033
0.3611	0.023	0.002	0.000	0.033
0.3889	0.023	0.003	0.000	0.033
0.4167	0.023	0.003	0.000	0.033
0.4444	0.023	0.003	0.000	0.033
0.4722	0.023	0.003	0.000	0.033
0.5000	0.023	0.003	0.000	0.033
0.5278	0.023	0.004	0.000	0.033
0.5556	0.023	0.004	0.000	0.033
0.5833	0.023	0.004	0.000	0.033
0.6111	0.023	0.004	0.000	0.033
0.6389	0.023	0.004	0.000	0.033
0.6667	0.023	0.005	0.000	0.033
0.6944	0.023	0.005	0.000	0.033
0.7222	0.023	0.005	0.000	0.033
0.7500	0.023	0.005	0.000	0.033
0.7778	0.023	0.006	0.000	0.033
0.8056	0.023	0.006	0.000	0.033
0.8333	0.023	0.006	0.000	0.033
0.8611	0.023	0.006	0.000	0.033
0.8889	0.023	0.006	0.000	0.033
0.9167	0.023	0.007	0.000	0.033
0.9444	0.023	0.007	0.000	0.033
0.9722	0.023	0.007	0.000	0.033
1.0000	0.023	0.007	0.000	0.033
1.0278	0.023	0.007	0.000	0.033

1.0556	0.023	0.008	0.000	0.033
1.0833	0.023	0.008	0.000	0.033
1.1111	0.023	0.008	0.000	0.033
1.1389	0.023	0.008	0.000	0.033
1.1667	0.023	0.009	0.000	0.033
1.1944	0.023	0.009	0.000	0.033
1.2222	0.023	0.009	0.000	0.033
1.2500	0.023	0.009	0.000	0.033
1.2778	0.023	0.009	0.000	0.033
1.3056	0.023	0.010	0.000	0.033
1.3333	0.023	0.010	0.000	0.033
1.3611	0.023	0.010	0.000	0.033
1.3889	0.023	0.010	0.000	0.033
1.4167	0.023	0.010	0.000	0.033
1.4444	0.023	0.011	0.000	0.033
1.4722	0.023	0.011	0.000	0.033
1.5000	0.023	0.011	0.000	0.033
1.5278	0.023	0.011	0.032	0.033
1.5556	0.023	0.012	0.092	0.033
1.5833	0.023	0.012	0.168	0.033
1.6111	0.023	0.012	0.255	0.033
1.6389	0.023	0.012	0.348	0.033
1.6667	0.023	0.012	0.441	0.033
1.6944	0.023	0.013	0.531	0.033
1.7222	0.023	0.013	0.610	0.033
1.7500	0.023	0.013	0.678	0.033
1.7778	0.023	0.013	0.730	0.033
1.8056	0.023	0.014	0.769	0.033
1.8333	0.023	0.014	0.799	0.033
1.8611	0.023	0.014	0.841	0.033
1.8889	0.023	0.014	0.873	0.033
1.9167	0.023	0.014	0.903	0.033
1.9444	0.023	0.015	0.933	0.033
1.9722	0.023	0.015	0.961	0.033
2.0000	0.023	0.015	0.989	0.033
2.0278	0.023	0.015	1.017	0.033
2.0556	0.023	0.015	1.043	0.033
2.0833	0.023	0.016	1.069	0.033
2.1111	0.023	0.016	1.094	0.033
2.1389	0.023	0.016	1.118	0.033
2.1667	0.023	0.016	1.143	0.033
2.1944	0.023	0.017	1.166	0.033
2.2222	0.023	0.017	1.189	0.033
2.2500	0.023	0.017	1.212	0.033
2.2778	0.023	0.017	1.234	0.033
2.3056	0.023	0.017	1.256	0.033
2.3333	0.023	0.018	1.277	0.033
2.3611	0.023	0.018	1.299	0.033
2.3889	0.023	0.018	1.319	0.033
2.4167	0.023	0.018	1.340	0.033
2.4444	0.023	0.018	1.360	0.033
2.4722	0.023	0.019	1.380	0.033
2.5000	0.023	0.019	1.399	0.033

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.63
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.028
Total Impervious Area:0.604

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.000456
5 year	0.000522
10 year	0.000552
25 year	0.000578
50 year	0.000593
100 year	0.000605

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.000	0.000
1950	0.000	0.000
1951	0.001	0.000
1952	0.000	0.000
1953	0.000	0.000
1954	0.000	0.000
1955	0.000	0.000
1956	0.000	0.000
1957	0.000	0.000
1958	0.000	0.000
1959	0.000	0.000
1960	0.000	0.000
1961	0.001	0.000
1962	0.000	0.000
1963	0.001	0.000
1964	0.000	0.000
1965	0.000	0.000
1966	0.000	0.000
1967	0.000	0.000

1968	0.000	0.000
1969	0.000	0.000
1970	0.001	0.000
1971	0.000	0.000
1972	0.000	0.000
1973	0.000	0.000
1974	0.000	0.000
1975	0.000	0.000
1976	0.000	0.000
1977	0.000	0.000
1978	0.001	0.000
1979	0.000	0.000
1980	0.000	0.000
1981	0.000	0.000
1982	0.000	0.000
1983	0.000	0.000
1984	0.001	0.000
1985	0.000	0.000
1986	0.000	0.000
1987	0.000	0.000
1988	0.000	0.000
1989	0.000	0.000
1990	0.000	0.000
1991	0.001	0.000
1992	0.000	0.000
1993	0.000	0.000
1994	0.000	0.000
1995	0.000	0.000
1996	0.001	0.000
1997	0.000	0.000
1998	0.000	0.000
1999	0.001	0.000
2000	0.001	0.000
2001	0.000	0.000
2002	0.000	0.000
2003	0.000	0.000
2004	0.000	0.000
2005	0.000	0.000
2006	0.001	0.000
2007	0.001	0.000
2008	0.000	0.000
2009	0.000	0.000

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	0.0005	0.0000
2	0.0005	0.0000
3	0.0005	0.0000
4	0.0005	0.0000
5	0.0005	0.0000
6	0.0005	0.0000
7	0.0005	0.0000
8	0.0005	0.0000
9	0.0005	0.0000
10	0.0005	0.0000

11	0.0005	0.0000
12	0.0005	0.0000
13	0.0005	0.0000
14	0.0005	0.0000
15	0.0005	0.0000
16	0.0005	0.0000
17	0.0005	0.0000
18	0.0005	0.0000
19	0.0005	0.0000
20	0.0005	0.0000
21	0.0005	0.0000
22	0.0005	0.0000
23	0.0005	0.0000
24	0.0005	0.0000
25	0.0005	0.0000
26	0.0005	0.0000
27	0.0005	0.0000
28	0.0005	0.0000
29	0.0005	0.0000
30	0.0005	0.0000
31	0.0005	0.0000
32	0.0005	0.0000
33	0.0005	0.0000
34	0.0005	0.0000
35	0.0005	0.0000
36	0.0005	0.0000
37	0.0005	0.0000
38	0.0005	0.0000
39	0.0005	0.0000
40	0.0004	0.0000
41	0.0004	0.0000
42	0.0004	0.0000
43	0.0004	0.0000
44	0.0004	0.0000
45	0.0004	0.0000
46	0.0004	0.0000
47	0.0004	0.0000
48	0.0004	0.0000
49	0.0004	0.0000
50	0.0004	0.0000
51	0.0004	0.0000
52	0.0004	0.0000
53	0.0004	0.0000
54	0.0004	0.0000
55	0.0004	0.0000
56	0.0003	0.0000
57	0.0003	0.0000
58	0.0003	0.0000
59	0.0003	0.0000
60	0.0003	0.0000
61	0.0001	0.0000

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0002	1144	0	0	Pass
0.0002	1119	0	0	Pass
0.0002	1086	0	0	Pass
0.0002	1054	0	0	Pass
0.0002	1012	0	0	Pass
0.0002	972	0	0	Pass
0.0003	945	0	0	Pass
0.0003	922	0	0	Pass
0.0003	891	0	0	Pass
0.0003	857	0	0	Pass
0.0003	835	0	0	Pass
0.0003	806	0	0	Pass
0.0003	778	0	0	Pass
0.0003	757	0	0	Pass
0.0003	725	0	0	Pass
0.0003	695	0	0	Pass
0.0003	678	0	0	Pass
0.0003	662	0	0	Pass
0.0003	647	0	0	Pass
0.0003	625	0	0	Pass
0.0003	612	0	0	Pass
0.0003	599	0	0	Pass
0.0003	579	0	0	Pass
0.0003	562	0	0	Pass
0.0003	536	0	0	Pass
0.0003	520	0	0	Pass
0.0003	503	0	0	Pass
0.0003	482	0	0	Pass
0.0003	471	0	0	Pass
0.0003	459	0	0	Pass
0.0003	436	0	0	Pass
0.0003	421	0	0	Pass
0.0003	414	0	0	Pass
0.0003	407	0	0	Pass
0.0004	396	0	0	Pass
0.0004	382	0	0	Pass
0.0004	372	0	0	Pass
0.0004	360	0	0	Pass
0.0004	346	0	0	Pass
0.0004	336	0	0	Pass
0.0004	326	0	0	Pass
0.0004	303	0	0	Pass
0.0004	283	0	0	Pass
0.0004	265	0	0	Pass
0.0004	256	0	0	Pass
0.0004	244	0	0	Pass
0.0004	235	0	0	Pass
0.0004	223	0	0	Pass
0.0004	216	0	0	Pass
0.0004	205	0	0	Pass
0.0004	195	0	0	Pass
0.0004	189	0	0	Pass
0.0004	179	0	0	Pass
0.0004	170	0	0	Pass

0.0004	161	0	0	Pass
0.0004	154	0	0	Pass
0.0004	146	0	0	Pass
0.0004	135	0	0	Pass
0.0004	127	0	0	Pass
0.0004	121	0	0	Pass
0.0004	116	0	0	Pass
0.0005	107	0	0	Pass
0.0005	102	0	0	Pass
0.0005	90	0	0	Pass
0.0005	83	0	0	Pass
0.0005	75	0	0	Pass
0.0005	65	0	0	Pass
0.0005	60	0	0	Pass
0.0005	55	0	0	Pass
0.0005	46	0	0	Pass
0.0005	37	0	0	Pass
0.0005	34	0	0	Pass
0.0005	26	0	0	Pass
0.0005	21	0	0	Pass
0.0005	16	0	0	Pass
0.0005	7	0	0	Pass
0.0005	1	0	0	Pass
0.0005	0	0	0	Pass
0.0005	0	0	0	Pass
0.0005	0	0	0	Pass
0.0005	0	0	0	Pass
0.0005	0	0	0	Pass
0.0005	0	0	0	Pass
0.0005	0	0	0	Pass
0.0005	0	0	0	Pass
0.0005	0	0	0	Pass
0.0005	0	0	0	Pass
0.0005	0	0	0	Pass
0.0006	0	0	0	Pass
0.0006	0	0	0	Pass
0.0006	0	0	0	Pass
0.0006	0	0	0	Pass
0.0006	0	0	0	Pass
0.0006	0	0	0	Pass
0.0006	0	0	0	Pass
0.0006	0	0	0	Pass
0.0006	0	0	0	Pass
0.0006	0	0	0	Pass
0.0006	0	0	0	Pass
0.0006	0	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

```
LID Technique                     Used for    Total Volume   Volume    Infiltration  Cumulative
Percent     Water Quality  Percent      Comment
                              Treatment?  Needs          Through   Volume        Volume
Volume                     Water Quality
                                          Treatment      Facility  (ac-ft.)       Infiltration
Infiltrated                Treated
                                          (ac-ft)        (ac-ft)                 Credit
_____________________________________________________________________________________________________
Gravel Trench Bed 1 POC            N      0.49                                         N
100.00
CAVFS  1 1                         N      66.04                                        N
99.18
Total Volume Infiltrated                  66.53          0.00      0.00
99.19       0.00          0%             No Treat. Credit
Compliance with LID Standard 8
Duration Analysis Result = Passed
```

Perlnd and Implnd Changes

No changes have been made.

WWHM2012
PROJECT REPORT

Project Name: GRAVEL DRIVEWAY
Site Name: GRAVEL DRIVEWAY
Site Address:
City :
Report Date: 1/29/2024
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2021/08/18
Version : 4.2.18

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Flat	.27
Pervious Total	**0.27**

Impervious Land Use	acre
Impervious Total	**0**
Basin Total	**0.27**

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
A B, Pasture, Flat	**.147**
Pervious Total	**0.147**

Impervious Land Use	**acre**
ROADS FLAT	**0.117**
Impervious Total	**0.117**

Basin Total	**0.264**

Element Flows To:

Surface	**Interflow**	**Groundwater**
CAVFS 1 Surface 1	CAVFS 1 Surface 1	

Name : CAVFS 1
CAVFS Length: 385.00 ft.
CAVFS Width: 3.50 ft.
Gravel thickness: 1
Material thickness of CAVFS layer: 1.5
Slope of CAVFS layer: 0.142857142857143
Infiltration On
Infiltration rate: 1.42
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 14.06
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 14.188
Percent Infiltrated: 99.1
Total Precip Applied to Facility: 1.782
Total Evap From Facility: 1.448
Outlet Control
Overflow Height: 0.5 ft.
Overflow width: 192.5 in.

Element Flows To:

Outlet 1	**Outlet 2**
Gravel Trench Bed 1	

CAVFS 1 Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0133	0.0000	0.0000	0.0000
0.0560	0.0133	0.0003	0.0000	0.0000
0.1121	0.0133	0.0006	0.0000	0.0000
0.1681	0.0133	0.0009	0.0000	0.0000
0.2242	0.0133	0.0012	0.0000	0.0000
0.2802	0.0133	0.0015	0.0000	0.0000
0.3363	0.0133	0.0019	0.0000	0.0000
0.3923	0.0133	0.0022	0.0000	0.0000

0.4484	0.0133	0.0025	0.0000	0.0000
0.5044	0.0133	0.0028	0.0000	0.0000
0.5604	0.0133	0.0031	0.0000	0.0000
0.6165	0.0133	0.0034	0.0000	0.0000
0.6725	0.0133	0.0037	0.0000	0.0000
0.7286	0.0133	0.0040	0.0000	0.0000
0.7846	0.0133	0.0043	0.0000	0.0000
0.8407	0.0133	0.0046	0.0000	0.0000
0.8967	0.0133	0.0049	0.0005	0.0569
0.9527	0.0133	0.0052	0.0007	0.0569
1.0088	0.0133	0.0055	0.0008	0.0569
1.0648	0.0133	0.0058	0.0010	0.0569
1.1209	0.0133	0.0061	0.0013	0.0569
1.1769	0.0133	0.0064	0.0015	0.0569
1.2330	0.0133	0.0067	0.0018	0.0569
1.2890	0.0133	0.0070	0.0021	0.0569
1.3451	0.0133	0.0073	0.0025	0.0569
1.4011	0.0133	0.0076	0.0028	0.0569
1.4571	0.0133	0.0079	0.0032	0.0569
1.5132	0.0133	0.0082	0.0037	0.0569
1.5692	0.0133	0.0085	0.0041	0.0569
1.6253	0.0133	0.0088	0.0046	0.0569
1.6813	0.0133	0.0091	0.0052	0.0569
1.7374	0.0133	0.0094	0.0057	0.0569
1.7934	0.0133	0.0097	0.0064	0.0569
1.8495	0.0133	0.0100	0.0070	0.0569
1.9055	0.0133	0.0103	0.0077	0.0569
1.9615	0.0133	0.0106	0.0084	0.0569
2.0176	0.0133	0.0109	0.0092	0.0569
2.0736	0.0133	0.0112	0.0100	0.0569
2.1297	0.0133	0.0115	0.0108	0.0569
2.1857	0.0133	0.0118	0.0117	0.0569
2.2418	0.0133	0.0121	0.0126	0.0569
2.2978	0.0133	0.0124	0.0136	0.0569
2.3538	0.0133	0.0127	0.0146	0.0569
2.4099	0.0133	0.0130	0.0156	0.0569
2.4659	0.0133	0.0133	0.0167	0.0569
2.5220	0.0133	0.0136	0.0178	0.0569
2.5780	0.0133	0.0139	0.0190	0.0569
2.6341	0.0133	0.0142	0.0203	0.0569
2.6901	0.0133	0.0145	0.0215	0.0569
2.7462	0.0133	0.0148	0.0229	0.0569
2.8022	0.0133	0.0151	0.0242	0.0569
2.8582	0.0133	0.0154	0.0256	0.0569
2.9143	0.0133	0.0157	0.0271	0.0569
2.9703	0.0133	0.0160	0.0286	0.0569
3.0264	0.0133	0.0163	0.0302	0.0569
3.0824	0.0133	0.0166	0.0318	0.0569
3.1385	0.0133	0.0169	0.0335	0.0569
3.1945	0.0133	0.0172	0.0352	0.0569
3.2505	0.0133	0.0175	0.0370	0.0569
3.3066	0.0133	0.0178	0.0388	0.0569
3.3626	0.0133	0.0181	0.0407	0.0569
3.4187	0.0133	0.0184	0.0427	0.0569
3.4747	0.0133	0.0187	0.0447	0.0569
3.5308	0.0133	0.0190	0.0467	0.0569
3.5868	0.0133	0.0193	0.0489	0.0569

3.6429	0.0133	0.0196	0.0511	0.0569
3.6989	0.0133	0.0199	0.0534	0.0569
3.7549	0.0133	0.0202	0.0558	0.0569
3.8110	0.0133	0.0205	0.1260	0.0569
3.8670	0.0133	0.0208	0.1260	0.0569
3.9231	0.0133	0.0211	0.1260	0.0569
3.9791	0.0133	0.0214	0.1260	0.0569
4.0352	0.0133	0.0216	0.1260	0.0569
4.0912	0.0133	0.0219	0.1260	0.0569
4.1473	0.0133	0.0222	0.1260	0.0569
4.2033	0.0133	0.0225	0.1260	0.0569
4.2593	0.0133	0.0228	0.1260	0.0569
4.3154	0.0133	0.0231	0.1260	0.0569
4.3714	0.0133	0.0234	0.1260	0.0569
4.4275	0.0133	0.0237	0.1260	0.0569
4.4835	0.0133	0.0240	0.1260	0.0569
4.5000	0.0133	0.0241	0.1260	0.0569

CAVFS 1 Surface 1 Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Wetted Surface
4.5000	0.0133	0.0241	0.0000	0.1830	0.0000
4.5560	0.0133	0.0249	0.0000	0.1830	0.0000
4.6121	0.0133	0.0256	0.0000	0.1830	0.0000
4.6681	0.0133	0.0264	0.0000	0.1830	0.0000
4.7242	0.0133	0.0271	0.0000	0.1830	0.0000
4.7802	0.0133	0.0278	0.0000	0.1830	0.0000
4.8363	0.0133	0.0286	0.0000	0.1830	0.0000
4.8923	0.0133	0.0293	0.0000	0.1830	0.0000
4.9484	0.0133	0.0301	0.0000	0.1830	0.0000
5.0044	0.0133	0.0308	0.0000	0.1830	0.0000
5.0604	0.0133	0.0316	0.0000	0.1830	0.0000
5.1000	0.0133	0.0321	0.0000	0.1830	0.0000

Name : CAVFS 1 Surface 1

Element Flows To:

Outlet 1	**Outlet 2**
Gravel Trench Bed 1	CAVFS 1

Name : Gravel Trench Bed 1
Bottom Length: 385.00 ft.
Bottom Width: 1.50 ft.
Trench bottom slope 1: 0 To 1
Trench Left side slope 0: 0 To 1
Trench right side slope 2: 0 To 1
Material thickness of first layer: 2.5
Pour Space of material for first layer: 0.33
Material thickness of second layer: 0
Pour Space of material for second layer: 0
Material thickness of third layer: 0
Pour Space of material for third layer: 0
Infiltration On
Infiltration rate: 1.42
Infiltration safety factor: 1

Total Volume Infiltrated (ac-ft.): 0.081
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 0.081
Percent Infiltrated: 100
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 1.5 ft.
Riser Diameter: 8 in.

Element Flows To:
Outlet 1 **Outlet 2**

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.013	0.000	0.000	0.000
0.0278	0.013	0.000	0.000	0.019
0.0556	0.013	0.000	0.000	0.019
0.0833	0.013	0.000	0.000	0.019
0.1111	0.013	0.000	0.000	0.019
0.1389	0.013	0.000	0.000	0.019
0.1667	0.013	0.000	0.000	0.019
0.1944	0.013	0.000	0.000	0.019
0.2222	0.013	0.001	0.000	0.019
0.2500	0.013	0.001	0.000	0.019
0.2778	0.013	0.001	0.000	0.019
0.3056	0.013	0.001	0.000	0.019
0.3333	0.013	0.001	0.000	0.019
0.3611	0.013	0.001	0.000	0.019
0.3889	0.013	0.001	0.000	0.019
0.4167	0.013	0.001	0.000	0.019
0.4444	0.013	0.001	0.000	0.019
0.4722	0.013	0.002	0.000	0.019
0.5000	0.013	0.002	0.000	0.019
0.5278	0.013	0.002	0.000	0.019
0.5556	0.013	0.002	0.000	0.019
0.5833	0.013	0.002	0.000	0.019
0.6111	0.013	0.002	0.000	0.019
0.6389	0.013	0.002	0.000	0.019
0.6667	0.013	0.002	0.000	0.019
0.6944	0.013	0.003	0.000	0.019
0.7222	0.013	0.003	0.000	0.019
0.7500	0.013	0.003	0.000	0.019
0.7778	0.013	0.003	0.000	0.019
0.8056	0.013	0.003	0.000	0.019
0.8333	0.013	0.003	0.000	0.019
0.8611	0.013	0.003	0.000	0.019
0.8889	0.013	0.003	0.000	0.019
0.9167	0.013	0.004	0.000	0.019
0.9444	0.013	0.004	0.000	0.019
0.9722	0.013	0.004	0.000	0.019
1.0000	0.013	0.004	0.000	0.019
1.0278	0.013	0.004	0.000	0.019

1.0556	0.013	0.004	0.000	0.019
1.0833	0.013	0.004	0.000	0.019
1.1111	0.013	0.004	0.000	0.019
1.1389	0.013	0.005	0.000	0.019
1.1667	0.013	0.005	0.000	0.019
1.1944	0.013	0.005	0.000	0.019
1.2222	0.013	0.005	0.000	0.019
1.2500	0.013	0.005	0.000	0.019
1.2778	0.013	0.005	0.000	0.019
1.3056	0.013	0.005	0.000	0.019
1.3333	0.013	0.005	0.000	0.019
1.3611	0.013	0.006	0.000	0.019
1.3889	0.013	0.006	0.000	0.019
1.4167	0.013	0.006	0.000	0.019
1.4444	0.013	0.006	0.000	0.019
1.4722	0.013	0.006	0.000	0.019
1.5000	0.013	0.006	0.000	0.019
1.5278	0.013	0.006	0.032	0.019
1.5556	0.013	0.006	0.092	0.019
1.5833	0.013	0.006	0.168	0.019
1.6111	0.013	0.007	0.255	0.019
1.6389	0.013	0.007	0.348	0.019
1.6667	0.013	0.007	0.441	0.019
1.6944	0.013	0.007	0.531	0.019
1.7222	0.013	0.007	0.610	0.019
1.7500	0.013	0.007	0.678	0.019
1.7778	0.013	0.007	0.730	0.019
1.8056	0.013	0.007	0.769	0.019
1.8333	0.013	0.008	0.799	0.019
1.8611	0.013	0.008	0.841	0.019
1.8889	0.013	0.008	0.873	0.019
1.9167	0.013	0.008	0.903	0.019
1.9444	0.013	0.008	0.933	0.019
1.9722	0.013	0.008	0.961	0.019
2.0000	0.013	0.008	0.989	0.019
2.0278	0.013	0.008	1.017	0.019
2.0556	0.013	0.009	1.043	0.019
2.0833	0.013	0.009	1.069	0.019
2.1111	0.013	0.009	1.094	0.019
2.1389	0.013	0.009	1.118	0.019
2.1667	0.013	0.009	1.143	0.019
2.1944	0.013	0.009	1.166	0.019
2.2222	0.013	0.009	1.189	0.019
2.2500	0.013	0.009	1.212	0.019
2.2778	0.013	0.010	1.234	0.019
2.3056	0.013	0.010	1.256	0.019
2.3333	0.013	0.010	1.277	0.019
2.3611	0.013	0.010	1.299	0.019
2.3889	0.013	0.010	1.319	0.019
2.4167	0.013	0.010	1.340	0.019
2.4444	0.013	0.010	1.360	0.019
2.4722	0.013	0.010	1.380	0.019
2.5000	0.013	0.010	1.399	0.019

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.27
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.147
Total Impervious Area:0.117

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.000195
5 year	0.000224
10 year	0.000236
25 year	0.000248
50 year	0.000254
100 year	0.000259

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.000	0.000
1950	0.000	0.000
1951	0.000	0.000
1952	0.000	0.000
1953	0.000	0.000
1954	0.000	0.000
1955	0.000	0.000
1956	0.000	0.000
1957	0.000	0.000
1958	0.000	0.000
1959	0.000	0.000
1960	0.000	0.000
1961	0.000	0.000
1962	0.000	0.000
1963	0.000	0.000
1964	0.000	0.000
1965	0.000	0.000
1966	0.000	0.000
1967	0.000	0.000

1968	0.000	0.000
1969	0.000	0.000
1970	0.000	0.000
1971	0.000	0.000
1972	0.000	0.000
1973	0.000	0.000
1974	0.000	0.000
1975	0.000	0.000
1976	0.000	0.000
1977	0.000	0.000
1978	0.000	0.000
1979	0.000	0.000
1980	0.000	0.000
1981	0.000	0.000
1982	0.000	0.000
1983	0.000	0.000
1984	0.000	0.000
1985	0.000	0.000
1986	0.000	0.000
1987	0.000	0.000
1988	0.000	0.000
1989	0.000	0.000
1990	0.000	0.000
1991	0.000	0.000
1992	0.000	0.000
1993	0.000	0.000
1994	0.000	0.000
1995	0.000	0.000
1996	0.000	0.000
1997	0.000	0.000
1998	0.000	0.000
1999	0.000	0.000
2000	0.000	0.000
2001	0.000	0.000
2002	0.000	0.000
2003	0.000	0.000
2004	0.000	0.000
2005	0.000	0.000
2006	0.000	0.000
2007	0.000	0.000
2008	0.000	0.000
2009	0.000	0.000

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	0.0002	0.0000
2	0.0002	0.0000
3	0.0002	0.0000
4	0.0002	0.0000
5	0.0002	0.0000
6	0.0002	0.0000
7	0.0002	0.0000
8	0.0002	0.0000
9	0.0002	0.0000
10	0.0002	0.0000

11	0.0002	0.0000
12	0.0002	0.0000
13	0.0002	0.0000
14	0.0002	0.0000
15	0.0002	0.0000
16	0.0002	0.0000
17	0.0002	0.0000
18	0.0002	0.0000
19	0.0002	0.0000
20	0.0002	0.0000
21	0.0002	0.0000
22	0.0002	0.0000
23	0.0002	0.0000
24	0.0002	0.0000
25	0.0002	0.0000
26	0.0002	0.0000
27	0.0002	0.0000
28	0.0002	0.0000
29	0.0002	0.0000
30	0.0002	0.0000
31	0.0002	0.0000
32	0.0002	0.0000
33	0.0002	0.0000
34	0.0002	0.0000
35	0.0002	0.0000
36	0.0002	0.0000
37	0.0002	0.0000
38	0.0002	0.0000
39	0.0002	0.0000
40	0.0002	0.0000
41	0.0002	0.0000
42	0.0002	0.0000
43	0.0002	0.0000
44	0.0002	0.0000
45	0.0002	0.0000
46	0.0002	0.0000
47	0.0002	0.0000
48	0.0002	0.0000
49	0.0002	0.0000
50	0.0002	0.0000
51	0.0002	0.0000
52	0.0002	0.0000
53	0.0002	0.0000
54	0.0002	0.0000
55	0.0002	0.0000
56	0.0001	0.0000
57	0.0001	0.0000
58	0.0001	0.0000
59	0.0001	0.0000
60	0.0001	0.0000
61	0.0001	0.0000

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

```
Flow(cfs) Predev  Mit Percentage Pass/Fail
0.0001    1159     0         0       Pass
0.0001    1119     0         0       Pass
0.0001    1097     0         0       Pass
0.0001    1060     0         0       Pass
0.0001    1033     0         0       Pass
0.0001    977      0         0       Pass
0.0001    961      0         0       Pass
0.0001    929      0         0       Pass
0.0001    895      0         0       Pass
0.0001    880      0         0       Pass
0.0001    839      0         0       Pass
0.0001    829      0         0       Pass
0.0001    791      0         0       Pass
0.0001    754      0         0       Pass
0.0001    737      0         0       Pass
0.0001    703      0         0       Pass
0.0001    685      0         0       Pass
0.0001    662      0         0       Pass
0.0001    658      0         0       Pass
0.0001    636      0         0       Pass
0.0001    612      0         0       Pass
0.0001    604      0         0       Pass
0.0001    588      0         0       Pass
0.0001    568      0         0       Pass
0.0001    543      0         0       Pass
0.0001    520      0         0       Pass
0.0001    510      0         0       Pass
0.0001    484      0         0       Pass
0.0001    475      0         0       Pass
0.0001    460      0         0       Pass
0.0001    447      0         0       Pass
0.0001    422      0         0       Pass
0.0001    413      0         0       Pass
0.0001    408      0         0       Pass
0.0002    397      0         0       Pass
0.0002    392      0         0       Pass
0.0002    376      0         0       Pass
0.0002    368      0         0       Pass
0.0002    351      0         0       Pass
0.0002    336      0         0       Pass
0.0002    329      0         0       Pass
0.0002    309      0         0       Pass
0.0002    292      0         0       Pass
0.0002    270      0         0       Pass
0.0002    258      0         0       Pass
0.0002    247      0         0       Pass
0.0002    235      0         0       Pass
0.0002    230      0         0       Pass
0.0002    217      0         0       Pass
0.0002    211      0         0       Pass
0.0002    200      0         0       Pass
0.0002    191      0         0       Pass
0.0002    181      0         0       Pass
0.0002    170      0         0       Pass
```

0.0002	166	0	0	Pass
0.0002	156	0	0	Pass
0.0002	146	0	0	Pass
0.0002	138	0	0	Pass
0.0002	127	0	0	Pass
0.0002	123	0	0	Pass
0.0002	117	0	0	Pass
0.0002	111	0	0	Pass
0.0002	103	0	0	Pass
0.0002	92	0	0	Pass
0.0002	85	0	0	Pass
0.0002	75	0	0	Pass
0.0002	67	0	0	Pass
0.0002	63	0	0	Pass
0.0002	57	0	0	Pass
0.0002	50	0	0	Pass
0.0002	38	0	0	Pass
0.0002	35	0	0	Pass
0.0002	27	0	0	Pass
0.0002	23	0	0	Pass
0.0002	17	0	0	Pass
0.0002	7	0	0	Pass
0.0002	4	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0002	0	0	0	Pass
0.0003	0	0	0	Pass
0.0003	0	0	0	Pass
0.0003	0	0	0	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

```
LID Technique                 Used for    Total Volume   Volume    Infiltration  Cumulative
Percent     Water Quality  Percent       Comment
                              Treatment?  Needs          Through   Volume        Volume
Volume                     Water Quality
                                          Treatment      Facility  (ac-ft.)       Infiltration
Infiltrated                Treated
                                          (ac-ft)        (ac-ft)                 Credit
Gravel Trench Bed 1 POC            N      0.07                                         N
100.00
CAVFS  1 1                         N      12.91                                        N
99.10
Total Volume Infiltrated                  12.99          0.00      0.00
99.10       0.00           0%            No Treat. Credit
Compliance with LID Standard 8
Duration Analysis Result = Passed
```

Perlnd and Implnd Changes

No changes have been made.

APPENDIX

8.6 CONSTRUCTION BMPS

BMP C101: Preserving Natural Vegetation

Purpose

The purpose of preserving natural vegetation is to reduce erosion wherever practicable. Limiting site disturbance is the single most effective method for reducing erosion. For example, conifers can hold up to about 50 percent of all rain that falls during a storm. Up to 20-30 percent of this rain may never reach the ground but is taken up by the tree or evaporates. Another benefit is that the rain held in the tree can be released slowly to the ground after the storm.

Conditions of Use

Natural vegetation should be preserved on steep slopes, near perennial and intermittent watercourses or swales, and on building sites in wooded areas.

- As required by local governments.
- Phase construction to preserve natural vegetation on the project site for as long as possible during the construction period.

Design and Installation Specifications

Natural vegetation can be preserved in natural clumps or as individual trees, shrubs and vines.

The preservation of individual plants is more difficult because heavy equipment is generally used to remove unwanted vegetation. The points to remember when attempting to save individual plants are:

- Is the plant worth saving? Consider the location, species, size, age, vigor, and the work involved. Local governments may also have ordinances to save natural vegetation and trees.
- Fence or clearly mark areas around trees that are to be saved. It is preferable to keep ground disturbance away from the trees at least as far out as the dripline.

Plants need protection from three kinds of injuries:

- *Construction Equipment* - This injury can be above or below the ground level. Damage results from scarring, cutting of roots, and compaction of the soil. Placing a fenced buffer zone around plants to be saved prior to construction can prevent construction equipment injuries.
- *Grade Changes* - Changing the natural ground level will alter grades, which affects the plant's ability to obtain the necessary air, water, and minerals. Minor fills usually do not cause problems although sensitivity between species does vary and should be checked. Trees can typically tolerate fill of 6 inches or less. For shrubs and other plants, the fill should be less.

  When there are major changes in grade, it may become necessary to supply air to the roots of plants. This can be done by placing a layer of gravel and a tile system over the roots before the fill is made. The tile system should be laid out on the original grade leading from a dry well around the tree trunk. The system should then be covered with small stones to allow air to circulate over the root area.

Lowering the natural ground level can seriously damage trees and shrubs. The highest percentage of the plant roots are in the upper 12 inches of the soil and cuts of only 2-3 inches can cause serious injury. To protect the roots it may be necessary to terrace the immediate area around the plants to be saved. If roots are exposed, construction of retaining walls may be needed to keep the soil in place. Plants can also be preserved by leaving them on an undisturbed, gently sloping mound. To increase the chances for survival, it is best to limit grade changes and other soil disturbances to areas outside the dripline of the plant.

- *Excavations* - Protect trees and other plants when excavating for drainfields, power, water, and sewer lines. Where possible, the trenches should be routed around trees and large shrubs. When this is not possible, it is best to tunnel under them. This can be done with hand tools or with power augers. If it is not possible to route the trench around plants to be saved, then the following should be observed:
  - Cut as few roots as possible. When you have to cut, cut clean. Paint cut root ends with a wood dressing like asphalt base paint if roots will be exposed for more than 24-hours.
  - Backfill the trench as soon as possible.
  - Tunnel beneath root systems as close to the center of the main trunk to preserve most of the important feeder roots.

Some problems that can be encountered with a few specific trees are:

- Maple, Dogwood, Red alder, Western hemlock, Western red cedar, and Douglas fir do not readily adjust to changes in environment and special care should be taken to protect these trees.
- The windthrow hazard of Pacific silver fir and madrona is high, while that of Western hemlock is moderate. The danger of windthrow increases where dense stands have been thinned. Other species (unless they are on shallow, wet soils less than 20 inches deep) have a low windthrow hazard.
- Cottonwoods, maples, and willows have water-seeking roots. These can cause trouble in sewer lines and infiltration fields. On the other hand, they thrive in high moisture conditions that other trees would not.
- Thinning operations in pure or mixed stands of Grand fir, Pacific silver fir, Noble fir, Sitka spruce, Western red cedar, Western hemlock, Pacific dogwood, and Red alder can cause serious disease problems. Disease can become established through damaged limbs, trunks, roots, and freshly cut stumps. Diseased and weakened trees are also susceptible to insect attack.

Maintenance Standards

Inspect flagged and/or fenced areas regularly to make sure flagging or fencing has not been removed or damaged. If the flagging or fencing has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

If tree roots have been exposed or injured, “prune” cleanly with an appropriate pruning saw or loppers directly above the damaged roots and recover with native soils. Treatment of sap flowing trees (fir, hemlock, pine, soft maples) is not advised as sap forms a natural healing barrier.

BMP C102: Buffer Zones

Purpose

Creation of an undisturbed area or strip of natural vegetation or an established suitable planting that will provide a living filter to reduce soil erosion and stormwater runoff velocities.

Conditions of Use

Buffer zones are used along streams, wetlands and other bodies of water that need protection from erosion and sedimentation. Contractors can use vegetative buffer zone BMPs to protect natural swales and they can incorporate them into the natural landscaping of an area.

Do not use critical-areas buffer zones as sediment treatment areas. These areas shall remain completely undisturbed. The local permitting authority may expand the buffer widths temporarily to allow the use of the expanded area for removal of sediment.

The types of buffer zones can change the level of protection required as shown below:

Designated Critical Area Buffers - buffers that protect Critical Areas, as defined by the Washington State Growth Management Act, and are established and managed by the local permitting authority. These should not be disturbed and must protected with sediment control BMPs to prevent impacts. The local permitting authority may expand the buffer widths temporarily to allow the use of the expanded area for removal of sediment.

Vegetative Buffer Zones - areas that may be identified in undisturbed vegetation areas or managed vegetation areas that are outside any Designated Critical Area Buffer. They may be utilized to provide an additional sediment control area and/or reduce runoff velocities. If being used for preservation of natural vegetation, they should be arranged in clumps or strips. They can be used to protect natural swales and incorporated into the natural landscaping area.

Design and Installation Specifications

- Preserving natural vegetation or plantings in clumps, blocks, or strips is generally the easiest and most successful method.
- Leave all unstable steep slopes in natural vegetation.
- Mark clearing limits and keep all equipment and construction debris out of the natural areas and buffer zones. Steel construction fencing is the most effective method to protect sensitive areas and buffers. Alternatively, wire-backed silt fence on steel posts is marginally effective. Flagging alone is typically not effective.
- Keep all excavations outside the dripline of trees and shrubs.
- Do not push debris or extra soil into the buffer zone area because it will cause damage by

burying and smothering vegetation.

- Vegetative buffer zones for streams, lakes or other waterways shall be established by the local permitting authority or other state or federal permits or approvals.

Maintenance Standards

Inspect the area frequently to make sure flagging remains in place and the area remains undisturbed. Replace all damaged flagging immediately. Remove all materials located in the buffer area that may impede the ability of the vegetation to act as a filter.

BMP C103: High-Visibility Fence

Purpose

High-visibility fencing is intended to:

- Restrict clearing to approved limits.
- Prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed.
- Limit construction traffic to designated construction entrances, exits, or internal roads.
- Protect areas where marking with survey tape may not provide adequate protection.

Conditions of Use

To establish clearing limits plastic, fabric, or metal fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left uncleared.
- As necessary to control vehicle access to and on the site.

Design and Installation Specifications

High-visibility plastic fence shall be composed of a high-density polyethylene material and shall be at least four feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every six inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The fence color shall be high-visibility orange. The fence tensile strength shall be 360 lbs/ft using the ASTM D4595 testing method.

If appropriate install fabric silt fence in accordance with BMP C233: Silt Fence to act as high-visibility fence. Silt fence shall be at least 3 feet high and must be highly visible to meet the requirements of this BMP.

Metal fences shall be designed and installed according to the manufacturer's specifications.

Metal fences shall be at least 3 feet high and must be highly visible.

Fences shall not be wired or stapled to trees.

Maintenance Standards

If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

BMP C105: Stabilized Construction Access

Purpose

Stabilized construction accesses are established to reduce the amount of sediment transported onto paved roads outside the project site by vehicles or equipment. This is done by constructing a stabilized pad of quarry spalls at entrances and exits for project sites.

Conditions of Use

Construction accesses shall be stabilized wherever traffic will be entering or leaving a construction site if paved roads or other paved areas are within 1,000 feet of the site.

For residential subdivision construction sites, provide a stabilized construction access for each residence, rather than only at the main subdivision entrance. Stabilized surfaces shall be of sufficient length/width to provide vehicle access/parking, based on lot size and configuration.

On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized accesses not shown in the initial Construction SWPPP. It is difficult to determine exactly where access to these projects will take place; additional materials will enable the contractor to install them where needed.

Design and Installation Specifications

See Figure II-3.1: Stabilized Construction Access for details. Note: the 100’ minimum length of the access shall be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (100’).

Construct stabilized construction accesses with a 12-inch thick pad of 4-inch to 8-inch quarry spalls, a 4-inch course of asphalt treated base (ATB), or use existing pavement. Do not use crushed concrete, cement, or calcium chloride for construction access stabilization because these products raise pH levels in stormwater and concrete discharge to waters of the State is prohibited.

A separation geotextile shall be placed under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet the standards listed in Table II-3.2: Stabilized Construction Access Geotextile Standards.

Table II-3.2: Stabilized Construction Access Geotextile Standards

Geotextile Property	Required Value
Grab Tensile Strength (ASTM D4751)	200 psi min.

Table II-3.2: Stabilized Construction Access Geotextile Standards (continued)

Geotextile Property	Required Value
Grab Tensile Elongation (ASTM D4632)	30% max.
Mullen Burst Strength (ASTM D3786-80a)	400 psi min.
AOS (ASTM D4751)	20-45 (U.S. standard sieve size)

- Consider early installation of the first lift of asphalt in areas that will be paved; this can be used as a stabilized access. Also consider the installation of excess concrete as a stabilized access. During large concrete pours, excess concrete is often available for this purpose.
- Fencing (see BMP C103: High-Visibility Fence) shall be installed as necessary to restrict traffic to the construction access.
- Whenever possible, the access shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.
- Construction accesses should avoid crossing existing sidewalks and back of walk drains if at all possible. If a construction access must cross a sidewalk or back of walk drain, the full length of the sidewalk and back of walk drain must be covered and protected from sediment leaving the site.

Alternative Material Specification

WSDOT has raised safety concerns about the Quarry Spall rock specified above. WSDOT observes that the 4-inch to 8-inch rock sizes can become trapped between Dually truck tires, and then released off-site at highway speeds. WSDOT has chosen to use a modified specification for the rock while continuously verifying that the Stabilized Construction Access remains effective. To remain effective, the BMP must prevent sediment from migrating off site. To date, there has been no performance testing to verify operation of this new specification. Jurisdictions may use the alternative specification, but must perform increased off-site inspection if they use, or allow others to use, it.

Stabilized Construction Accesses may use material that meets the requirements of WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* Section 9-03.9(1) (WSDOT, 2016) for ballast except for the following special requirements.

The grading and quality requirements are listed in Table II-3.3: Stabilized Construction Access Alternative Material Requirements.

Table II-3.3: Stabilized Construction Access Alternative Material Requirements

Sieve Size	Percent Passing
2½″	99-100

Table II-3.3: Stabilized Construction Access Alternative Material Requirements (continued)

Sieve Size	Percent Passing
2″	65-100
¾″	40-80
No. 4	5 max.
No. 100	0-2
% Fracture	75 min.

- All percentages are by weight.
- The sand equivalent value and dust ratio requirements do not apply.
- The fracture requirement shall be at least one fractured face and will apply the combined aggregate retained on the No. 4 sieve in accordance with FOP for AASHTO T 335.

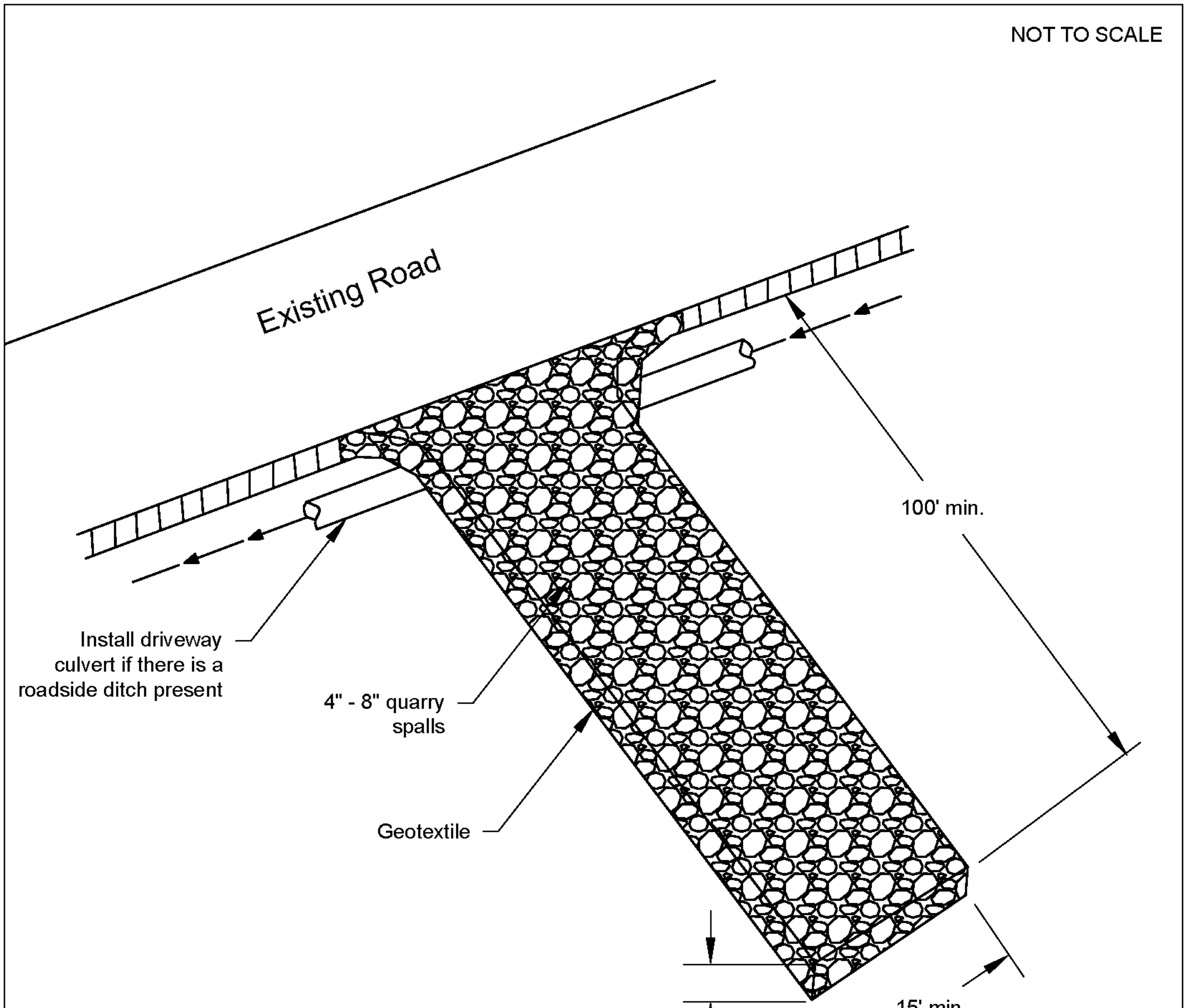
Maintenance Standards

Quarry spalls shall be added if the pad is no longer in accordance with the specifications.

- If the access is not preventing sediment from being tracked onto pavement, then alternative measures to keep the streets free of sediment shall be used. This may include replacement/cleaning of the existing quarry spalls, street sweeping, an increase in the dimensions of the access, or the installation of BMP C106: Wheel Wash.
- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be removed or stabilized on site. The pavement shall not be cleaned by washing down the street, except when high efficiency sweeping is ineffective and there is a threat to public safety. If it is necessary to wash the streets, the construction of a small sump to contain the wash water shall be considered. The sediment would then be washed into the sump where it can be controlled.
- Perform street sweeping by hand or with a high efficiency sweeper. Do not use a non-high efficiency mechanical sweeper because this creates dust and throws soils into storm systems or conveyance ditches.
- Any quarry spalls that are loosened from the pad, which end up on the roadway shall be removed immediately.
- If vehicles are entering or exiting the site at points other than the construction access(es), BMP C103: High-Visibility Fence shall be installed to control traffic.

- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

Figure II-3.1: Stabilized Construction Access



Notes:

1. Driveway shall meet the requirements of the permitting agency.
2. It is recommended that the access be crowned so that runoff drains off the pad.

DEPARTMENT OF ECOLOGY
State of Washington

Stabilized Construction Access

Revised June 2018

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C106: Wheel Wash

Purpose

Wheel washes reduce the amount of sediment transported onto paved roads by washing dirt from the wheels of motor vehicles prior to the motor vehicles leaving the construction site.

Conditions of Use

- Use a wheel wash when BMP C105: Stabilized Construction Access is not preventing sediment from being tracked off site.
- Wheel washing is generally an effective BMP when installed with careful attention to topography. For example, a wheel wash can be detrimental if installed at the top of a slope abutting a right-of-way where the water from the dripping truck can run unimpeded into the street.
- Pressure washing combined with an adequately sized and surfaced pad with direct drainage to a large 10-foot x 10-foot sump can be very effective.
- Wheel wash wastewater is not stormwater. It is commonly called process water, and must be discharged to a separate on-site treatment system that prevents discharge to waters of the State, or to the sanitary sewer with local sewer district approval.
- Wheel washes may use closed-loop recirculation systems to conserve water use.
- Wheel wash wastewater shall not include wastewater from concrete washout areas.
- When practical, the wheel wash should be placed in sequence with BMP C105: Stabilized Construction Access. Locate the wheel wash such that vehicles exiting the wheel wash will enter directly onto BMP C105: Stabilized Construction Access. In order to achieve this, BMP C105: Stabilized Construction Access may need to be extended beyond the standard installation to meet the exit of the wheel wash.

Design and Installation Specifications

Suggested details are shown in Figure II-3.2: Wheel Wash. The Local Permitting Authority may allow other designs. A minimum of 6 inches of asphalt treated base (ATB) over crushed base material or 8 inches over a good subgrade is recommended to pave the wheel wash.

Crushed rock, gravel base, etc., shall be added as required to maintain a stable driving surface and to stabilize any areas that have eroded.

Following construction, these areas shall be restored to pre-construction condition or better to prevent future erosion.

Perform street cleaning at the end of each day or more often if necessary.

BMP C120: Temporary and Permanent Seeding

Purpose

Seeding reduces erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Conditions of Use

Use seeding throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days.

The optimum seeding windows for western Washington are April 1 through June 30 and September 1 through October 1.

Between July 1 and August 30 seeding requires irrigation until 75 percent grass cover is established.

Between October 1 and March 30 seeding requires a cover of mulch or an erosion control blanket until 75 percent grass cover is established.

Review all disturbed areas in late August to early September and complete all seeding by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.

Mulch is required at all times for seeding because it protects seeds from heat, moisture loss, and transport due to runoff. Mulch can be applied on top of the seed or simultaneously by hydroseeding. See BMP C121: Mulching for specifications.

Seed and mulch all disturbed areas not otherwise vegetated at final site stabilization. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions, or geotextiles) which will prevent erosion. See BMP T5.13: Post-Construction Soil Quality and Depth.

Design and Installation Specifications

General

- Install channels intended for vegetation before starting major earthwork and hydroseed with a Bonded Fiber Matrix. For vegetated channels that will have high flows, install erosion control blankets over the top of hydroseed. Before allowing water to flow in vegetated channels, establish 75 percent vegetation cover. If vegetated channels cannot be established by seed before water flow; install sod in the channel bottom — over top of hydromulch and erosion control blankets.

- Confirm the installation of all required surface water control measures to prevent seed from washing away.
- Hydroseed applications shall include a minimum of 1,500 pounds per acre of mulch with 3 percent tackifier. See BMP C121: Mulching for specifications.
- Areas that will have seeding only and not landscaping may need compost or meal-based mulch included in the hydroseed in order to establish vegetation. Re-install native topsoil on the disturbed soil surface before application. See BMP T5.13: Post-Construction Soil Quality and Depth.
- When installing seed via hydroseeding operations, only about 1/3 of the seed actually ends up in contact with the soil surface. This reduces the ability to establish a good stand of grass quickly. To overcome this, consider increasing seed quantities by up to 50 percent.
- Enhance vegetation establishment by dividing the hydromulch operation into two phases:
  - Phase 1- Install all seed and fertilizer with 25-30 percent mulch and tackifier onto soil in the first lift.
  - Phase 2- Install the rest of the mulch and tackifier over the first lift.

  Or, enhance vegetation by:
  - Installing the mulch, seed, fertilizer, and tackifier in one lift.
  - Spread or blow straw over the top of the hydromulch at a rate of 800-1000 pounds per acre.
  - Hold straw in place with a standard tackifier.

  Both of these approaches will increase cost moderately but will greatly improve and enhance vegetative establishment. The increased cost may be offset by the reduced need for:
  - Irrigation.
  - Reapplication of mulch.
  - Repair of failed slope surfaces.

  This technique works with standard hydromulch (1,500 pounds per acre minimum) and Bonded Fiber Matrix/ Mechanically Bonded Fiber Matrix (BFM/MBFMs) (3,000 pounds per acre minimum).
- Seed may be installed by hand if:
  - Temporary and covered by straw, mulch, or topsoil.
  - Permanent in small areas (usually less than 1 acre) and covered with mulch, topsoil, or erosion blankets.
- The seed mixes listed in Table II-3.4: Temporary and Permanent Seed Mixes include

recommended mixes for both temporary and permanent seeding.

- Apply these mixes, with the exception of the wet area seed mix, at a rate of 120 pounds per acre. This rate can be reduced if soil amendments or slow-release fertilizers are used. Apply the wet area seed mix at a rate of 60 pounds per acre.
- Consult the local suppliers or the local conservation district for their recommendations. The appropriate mix depends on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic. Alternative seed mixes approved by the local authority may be used, depending on the soil type and hydrology of the area.

Table II-3.4: Temporary and Permanent Seed Mixes

Common Name	Latin Name	% Weight	% Purity	% Germination
Temporary Erosion Control Seed Mix A standard mix for areas requiring a temporary vegetative cover.				
Chewings or annual blue grass	*Festuca rubra var. commutata* or *Poa anna*	40	98	90
Perennial rye	*Lolium perenne*	50	98	90
Redtop or colonial bentgrass	*Agrostis alba* or *Agrostis tenuis*	5	92	85
White dutch clover	*Trifolium repens*	5	98	90
Landscaping Seed Mix A recommended mix for landscaping seed.				
Perennial rye blend	*Lolium perenne*	70	98	90
Chewings and red fescue blend	*Festuca rubra var. commutata* or *Festuca rubra*	30	98	90
Low-Growing Turf Seed Mix A turf seed mix for dry situations where there is no need for watering. This mix requires very little maintenance.				
Dwarf tall fescue (several varieties)	*Festuca arundinacea var.*	45	98	90
Dwarf perennial rye (Barclay)	*Lolium perenne var. barclay*	30	98	90
Red fescue	*Festuca rubra*	20	98	90
Colonial bentgrass	*Agrostis tenuis*	5	98	90
Bioswale Seed Mix A seed mix for bioswales and other intermittently wet areas.				
Tall or meadow fes-	*Festuca arundin-*	75-80	98	90

Table II-3.4: Temporary and Permanent Seed Mixes (continued)

Common Name	Latin Name	% Weight	% Purity	% Germination
cue	*acea* or *Festuca elatior*			
Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	92	85
Redtop bentgrass	*Agrostis alba* or *Agrostis gigantea*	5-10	90	80
Wet Area Seed Mix A low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Consult Hydraulic Permit Authority (HPA) for seed mixes if applicable.				
Tall or meadow fescue	*Festuca arundinacea* or *Festuca elatior*	60-70	98	90
Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	98	85
Meadow foxtail	*Alepocurus pratensis*	10-15	90	80
Alsike clover	*Trifolium hybridum*	1-6	98	90
Redtop bentgrass	*Agrostis alba*	1-6	92	85
Meadow Seed Mix A recommended meadow seed mix for infrequently maintained areas or non-maintained areas where colonization by native plants is desirable. Likely applications include rural road and utility right-of-way. Seeding should take place in September or very early October in order to obtain adequate establishment prior to the winter months. Consider the appropriateness of clover, a fairly invasive species, in the mix. Amending the soil can reduce the need for clover.				
Redtop or Oregon bentgrass	*Agrostis alba* or *Agrostis oregonensis*	20	92	85
Red fescue	*Festuca rubra*	70	98	90
White dutch clover	*Trifolium repens*	10	98	90

Roughening and Rototilling

- The seedbed should be firm and rough. Roughen all soil no matter what the slope. Track walk slopes before seeding if engineering purposes require compaction. Backblading or smoothing of slopes greater than 4H:1V is not allowed if they are to be seeded.
- Restoration-based landscape practices require deeper incorporation than that provided by a simple single-pass rototilling treatment. Wherever practical, initially rip the subgrade to improve long-term permeability, infiltration, and water inflow qualities. At a minimum,

permanent areas shall use soil amendments to achieve organic matter and permeability performance defined in engineered soil/landscape systems. For systems that are deeper than 8 inches complete the rototilling process in multiple lifts, or prepare the engineered soil system per specifications and place to achieve the specified depth.

Fertilizers

- Conducting soil tests to determine the exact type and quantity of fertilizer is recommended. This will prevent the over-application of fertilizer.
- Organic matter is the most appropriate form of fertilizer because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form.
- In general, use 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer at a rate of 90 pounds per acre. Always use slow-release fertilizers because they are more efficient and have fewer environmental impacts. Do not add fertilizer to the hydromulch machine, or agitate, more than 20 minutes before use. Too much agitation destroys the slow-release coating.
- There are numerous products available that take the place of chemical fertilizers. These include several with seaweed extracts that are beneficial to soil microbes and organisms. If 100 percent cottonseed meal is used as the mulch in hydroseed, chemical fertilizer may not be necessary. Cottonseed meal provides a good source of long-term, slow-release, available nitrogen.

Bonded Fiber Matrix and Mechanically Bonded Fiber Matrix

- On steep slopes use Bonded Fiber Matrix (BFM) or Mechanically Bonded Fiber Matrix (MBFM) products. Apply BFM/MBFM products at a minimum rate of 3,000 pounds per acre with approximately 10 percent tackifier. Achieve a minimum of 95 percent soil coverage during application. Numerous products are available commercially. Most products require 24-36 hours to cure before rainfall and cannot be installed on wet or saturated soils. Generally, products come in 40-50 pound bags and include all necessary ingredients except for seed and fertilizer.
- Install products per manufacturer's instructions.
- BFMs and MBFMs provide good alternatives to blankets in most areas requiring vegetation establishment. Advantages over blankets include:
    - BFM and MBFMs do not require surface preparation.
    - Helicopters can assist in installing BFM and MBFMs in remote areas.
    - On slopes steeper than 2.5H:1V, blanket installers may require ropes and harnesses for safety.
    - Installing BFM and MBFMs can save at least $1,000 per acre compared to blankets.

Maintenance Standards

Reseed any seeded areas that fail to establish at least 75 percent cover (100 percent cover for areas that receive sheet or concentrated flows). If reseeding is ineffective, use an alternate method such as sodding, mulching, nets, or blankets.

- Reseed and protect by mulch any areas that experience erosion after achieving adequate cover. Reseed and protect by mulch any eroded area.
- Supply seeded areas with adequate moisture, but do not water to the extent that it causes run-off.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C121: Mulching

Purpose

Mulching soils provides immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures. There are a variety of mulches that can be used. This section discusses only the most common types of mulch.

Conditions of Use

As a temporary cover measure, mulch should be used:

- For less than 30 days on disturbed areas that require cover.
- At all times for seeded areas, especially during the wet season and during the hot summer months.
- During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.

Mulch may be applied at any time of the year and must be refreshed periodically.

For seeded areas, mulch may be made up of 100 percent:

- cottonseed meal;
- fibers made of wood, recycled cellulose, hemp, or kenaf;

- compost;
- or blends of these.

Tackifier shall be plant-based, such as guar or alpha plantago, or chemical-based such as polyacrylamide or polymers.

Generally, mulches come in 40-50 pound bags. Seed and fertilizer are added at time of application.

Recycled cellulose may contain polychlorinated biphenyl (PCBs). Ecology recommends that products should be evaluated for PCBs prior to use.

Refer to BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection for conditions of use. PAM shall not be directly applied to water or allowed to enter a water body.

Any mulch or tackifier product used shall be installed per the manufacturer's instructions.

Design and Installation Specifications

For mulch materials, application rates, and specifications, see Table II-3.6: Mulch Standards and Guidelines. Consult with the local supplier or the local conservation district for their recommendations. Increase the application rate until the ground is 95% covered (i.e. not visible under the mulch layer). Note: Thickness may be increased for disturbed areas in or near sensitive areas or other areas highly susceptible to erosion.

Where the option of "Compost" is selected, it should be a coarse compost that meets the size gradations listed in Table II-3.5: Size Gradations of Compost as Mulch Material when tested in accordance with Test Method 02.02-B found in *Test Methods for the Examination of Composting and Compost* (Thompson, 2001).

Table II-3.5: Size Gradations of Compost as Mulch Material

Sieve Size	Percent Passing
3"	100%
1"	90% - 100%
3/4"	70% - 100%
1/4"	40% - 100%

Mulch used within the ordinary high-water mark of surface waters should be selected to minimize potential flotation of organic matter. Composted organic materials have higher specific gravities (densities) than straw, wood, or chipped material. Consult the Hydraulic Permit Authority (HPA) for mulch mixes if applicable.

Maintenance Standards

The thickness of the mulch cover must be maintained.

Any areas that experience erosion shall be remulched and/or protected with a net or blanket. If the erosion problem is drainage related, then the problem shall be fixed and the eroded area remulched.

Table II-3.6: Mulch Standards and Guidelines

Mulch Material	Guideline	Description
Straw	**Quality Standards**	Air-dried; free from undesirable seed and coarse material.
	Application Rates	2"-3" thick; 5 bales per 1,000 sf or 2-3 tons per acre
	Remarks	Cost-effective protection when applied with adequate thickness. Hand-application generally requires greater thickness than blown straw. The thickness of straw may be reduced by half when used in conjunction with seeding. In windy areas straw must be held in place by crimping, using a tackifier, or covering with netting. Blown straw always has to be held in place with a tackifier as even light winds will blow it away. Straw, however, has several deficiencies that should be considered when selecting mulch materials. It often introduces and/or encourages the propagation of weed species and it has no significant long-term benefits It should also not be used within the ordinary high-water elevation of surface waters (due to flotation).
Hydromulch	**Quality Standards**	No growth inhibiting factors.
	Application Rates	Approx. 35-45 lbs per 1,000 sf or 1,500 - 2,000 lbs per acre
	Remarks	Shall be applied with hydromulcher. Shall not be used without seed and tackifier unless the application rate is at least doubled. Fibers longer than about 3/4 - 1 inch clog hydromulch equipment. Fibers should be kept to less than 3/4 inch.
Compost	**Quality Standards**	No visible water or dust during handling. Must be produced per WAC 173-350, Solid Waste Handling Standards, but may have up to 35% biosolids.
	Application Rates	2" thick min.; approx. 100 tons per acre (approx. 750 lbs per cubic yard)
	Remarks	More effective control can be obtained by increasing thickness to 3". Excellent mulch for protecting final grades until landscaping because it can be directly seeded or tilled into soil as an amendment. Compost used for mulch has a coarser size gradation than compost used for BMP C125: Topsoiling / Composting or BMP T5.13: Post-Construction Soil Quality and Depth. It is more stable and practical to use in wet areas and during rainy weather conditions. Do not use near wetlands or near phosphorous impaired water bodies.
Chipped Site Vegetation	**Quality Standards**	Gradations from fines to 6 inches in length for texture, variation, and interlocking properties. Include a mix of various sizes so that the average size is between 2- and 4- inches.
	Application Rates	2" thick min.;

Table II-3.6: Mulch Standards and Guidelines (continued)

Mulch Material	Guideline	Description
	Remarks	This is a cost-effective way to dispose of debris from clearing and grubbing, and it eliminates the problems associated with burning. Generally, it should not be used on slopes above approx. 10% because of its tendency to be transported by runoff. It is not recommended within 200 feet of surface waters. If permanent seeding or planting is expected shortly after mulch, the decomposition of the chipped vegetation may tie up nutrients important to grass establishment. Note: thick application of this material over existing grass, herbaceous species, and some groundcovers could smother and kill vegetation.
Wood-Based Mulch	**Quality Standards**	No visible water or dust during handling. Must be purchased from a supplier with a Solid Waste Handling Permit or one exempt from solid waste regulations.
	Application Rates	2" thick min.; approx. 100 tons per acre (approx. 750 lbs. per cubic yard)
	Remarks	This material is often called "wood straw" or "hog fuel". The use of mulch ultimately improves the organic matter in the soil. Special caution is advised regarding the source and composition of wood-based mulches. Its preparation typically does not provide any weed seed control, so evidence of residual vegetation in its composition or known inclusion of weed plants or seeds should be monitored and prevented (or minimized).
Wood Strand Mulch	**Quality Standards**	A blend of loose, long, thin wood pieces derived from native conifer or deciduous trees with high length-to-width ratio.
	Application Rates	2" thick min.
	Remarks	Cost-effective protection when applied with adequate thickness. A minimum of 95-percent of the wood strand shall have lengths between 2 and 10-inches, with a width and thickness between 1/16 and 1/2-inches. The mulch shall not contain resin, tannin, or other compounds in quantities that would be detrimental to plant life. Sawdust or wood shavings shall not be used as mulch. [Specification 9-14.4(4) from the *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT, 2016)

~~BMP C122: Nets and Blankets~~

~~*Purpose*~~

~~Erosion control nets and blankets are intended to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become well established. In addition, some nets and blankets can be used to permanently reinforce turf to protect drainage ways during high flows.~~

BMP C125: Topsoiling / Composting

Purpose

Topsoiling and composting provide a suitable growth medium for final site stabilization with vegetation. While not a permanent cover practice in itself, topsoiling and composting are an integral component of providing permanent cover in those areas where there is an unsuitable soil surface for plant growth. Use this BMP in conjunction with other BMPs such as BMP C120: Temporary and Permanent Seeding, BMP C121: Mulching, or BMP C124: Sodding. Implementation of this BMP may meet the post-construction requirements of BMP T5.13: Post-Construction Soil Quality and Depth.

Native soils and disturbed soils that have been organically amended not only retain much more stormwater, but also serve as effective biofilters for urban pollutants and, by supporting more vigorous plant growth, reduce the water, fertilizer and pesticides needed to support installed landscapes. Topsoil does not include any subsoils but only the material from the top several inches including organic debris.

Conditions of Use

- Permanent landscaped areas shall contain healthy topsoil that reduces the need for fertilizers, improves overall topsoil quality, provides for better vegetative health and vitality, improves hydrologic characteristics, and reduces the need for irrigation.
- Leave native soils and the duff layer undisturbed to the maximum extent practicable. Stripping of existing, properly functioning soil system and vegetation for the purpose of topsoiling during construction is not acceptable. Preserve existing soil systems in undisturbed and uncompacted conditions if functioning properly.
- Areas that already have good topsoil, such as undisturbed areas, do not require soil amendments.
- Restore, to the maximum extent practical, native soils disturbed during clearing and grading to a condition equal to or better than the original site condition’s moisture-holding capacity. Use on-site native topsoil, incorporate amendments into on-site soil, or import blended topsoil to meet this requirement.
- Topsoiling is a required procedure when establishing vegetation on shallow soils, and soils of critically low pH (high acid) levels.
- Beware of where the topsoil comes from, and what vegetation was on site before disturbance. Invasive plant seeds may be included and could cause problems for establishing native plants, landscaped areas, or grasses.
- Topsoil from the site will contain mycorrhizal bacteria that are necessary for healthy root growth and nutrient transfer. These native mycorrhiza are acclimated to the site and will provide optimum conditions for establishing grasses. Use commercially available mycorrhiza products when using off-site topsoil.

Design and Installation Specifications

Meet the following requirements for disturbed areas that will be developed as lawn or landscaped areas at the completed project site:

- Maximize the depth of the topsoil wherever possible to provide the maximum possible infiltration capacity and beneficial growth medium. Topsoil shall have:
    - A minimum depth of 8-inches. Scarify subsoils below the topsoil layer at least 4-inches with some incorporation of the upper material to avoid stratified layers, where feasible. Ripping or re-structuring the subgrade may also provide additional benefits regarding the overall infiltration and interflow dynamics of the soil system.
    - A minimum organic content of 10% dry weight in planting beds, and 5% organic matter content in turf areas. Incorporate organic amendments to a minimum 8-inch depth except where tree roots or other natural features limit the depth of incorporation.
    - A pH between 6.0 and 8.0 or matching the pH of the undisturbed soil.
    - If blended topsoil is imported, then fines should be limited to 25 percent passing through a 200 sieve.
- Mulch planting beds with 2 inches of organic material
- Accomplish the required organic content, depth, and pH by returning native topsoil to the site, importing topsoil of sufficient organic content, and/or incorporating organic amendments. When using the option of incorporating amendments to meet the organic content requirement, use compost that meets the compost specification for Bioretention (See BMP T7.30: Bioretention), with the exception that the compost may have up to 35% biosolids or manure.
- Sections 3 through 7 of *Building Soil: Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington* (Stenn et al., 2016), provides useful guidance for implementing whichever option is chosen. It includes guidance for pre-approved default strategies and guidance for custom strategies. Check with your local jurisdiction concerning its acceptance of this guidance.
- The final composition and construction of the soil system will result in a natural selection or favoring of certain plant species over time. For example, incorporation of topsoil may favor grasses, while layering with mildly acidic, high-carbon amendments may favor more woody vegetation.
- Allow sufficient time in scheduling for topsoil spreading prior to seeding, sodding, or planting.
- Take care when applying top soil to subsoils with contrasting textures. Sandy topsoil over clayey subsoil is a particularly poor combination, as water creeps along the junction between the soil layers and causes the topsoil to slough. If topsoil and subsoil are not properly bonded, water will not infiltrate the soil profile evenly and it will be difficult to establish vegetation. The best method to promote bonding is to actually work the topsoil into the layer below for a depth of at least 6 inches.
- Field exploration of the site shall be made to determine if there is surface soil of sufficient quantity and quality to justify stripping. Topsoil shall be friable and loamy (loam, sandy loam,

silt loam, sandy clay loam, and clay loam). Avoid areas of natural ground water recharge.

- Stripping shall be confined to the immediate construction area. A 4-inch to 6-inch stripping depth is common, but depth may vary depending on the particular soil. All surface runoff control structures shall be in place prior to stripping.
- Do not place topsoil while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed sodding or seeding.
- In any areas requiring grading, remove and stockpile the duff layer and topsoil on site in a designated, controlled area, not adjacent to public resources and critical areas. Reapply stockpiled topsoil to other portions of the site where feasible.
- Locate the topsoil stockpile so that it meets specifications and does not interfere with work on the site. It may be possible to locate more than one pile in proximity to areas where topsoil will be used.
- Stockpiling of topsoil shall occur in the following manner:
    - Side slopes of the stockpile shall not exceed 2H:1V.
    - Between October 1 and April 30:
        - An interceptor dike with gravel outlet and silt fence shall surround all topsoil.
        - Within 2 days complete erosion control seeding, or covering stockpiles with clear plastic, or other mulching materials.
    - Between May 1 and September 30:
        - An interceptor dike with gravel outlet and silt fence shall surround all topsoil if the stockpile will remain in place for a longer period of time than active construction grading.
        - Within 7 days complete erosion control seeding, or covering stockpiles with clear plastic, or other mulching materials.
- When native topsoil is to be stockpiled and reused the following should apply to ensure that the mycorrhizal bacterial, earthworms, and other beneficial organisms will not be destroyed:
    - Re-install topsoil within 4 to 6 weeks.
    - Do not allow the saturation of topsoil with water.
    - Do not use plastic covering.

Maintenance Standards

- Inspect stockpiles regularly, especially after large storm events. Stabilize any areas that have eroded.
- Establish soil quality and depth toward the end of construction and once established, protect from compaction, such as from large machinery use, and from erosion.

- Plant and mulch soil after installation.
- Leave plant debris or its equivalent on the soil surface to replenish organic matter.
- Reduce and adjust, where possible, the use of irrigation, fertilizers, herbicides and pesticides, rather than continuing to implement formerly established practices.

~~BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection~~

~~*Purpose*~~

~~Polyacrylamide (PAM) is used on construction sites to prevent soil erosion.~~

~~Applying PAM to bare soil in advance of a rain event significantly reduces erosion and controls sediment in two ways. First, PAM increases the soil's available pore volume, thus increasing infiltration and reducing the quantity of stormwater runoff. Second, it increases flocculation of suspended particles and aids in their deposition, thus reducing stormwater runoff turbidity and improving water quality.~~

~~*Conditions of Use*~~

~~PAM shall not be directly applied to water or allowed to enter a water body. Stormwater runoff shall pass through a sediment pond prior to discharging to surface waters.~~

~~PAM can be applied to bare soil under the following conditions:~~

- ~~During rough grading operations.~~
- ~~In Staging areas.~~
- ~~Balanced cut and fill earthwork.~~
- ~~Haul roads prior to placement of crushed rock surfacing.~~
- ~~Compacted soil roadbase.~~
- ~~Stockpiles.~~
- ~~After final grade and before paving or final seeding and planting.~~
- ~~Pit sites.~~
- ~~Sites having a winter shut down. In the case of winter shut down, or where soil will remain unworked for several months, PAM should be used together with mulch.~~

~~*Design and Installation Specifications*~~

- ~~Do not use PAM on a slope that flows directly into a stream or wetland.~~
- ~~Do not add PAM to water discharging from the site.~~

BMP C140: Dust Control

Purpose

Dust control prevents wind transport of dust from disturbed soil surfaces onto roadways, drainage ways, and surface waters.

Conditions of Use

Use dust control in areas (including roadways) subject to surface and air movement of dust where on-site or off-site impacts to roadways, drainage ways, or surface waters are likely.

Design and Installation Specifications

- Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
- Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition. Maintain the original ground cover as long as practical.
- Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.
- Sprinkle the site with water until the surface is wet. Repeat as needed. To prevent carryout of mud onto the street, refer to BMP C105: Stabilized Construction Access and BMP C106: Wheel Wash.
- Irrigation water can be used for dust control. Irrigation systems should be installed as a first step on sites where dust control is a concern.
- Spray exposed soil areas with a dust palliative, following the manufacturer’s instructions and cautions regarding handling and application. Used oil is prohibited from use as a dust suppressant. Local governments may approve other dust palliatives such as calcium chloride or PAM.
- PAM (BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection) added to water at a rate of 0.5 pounds per 1,000 gallons of water per acre and applied from a water truck is more effective than water alone. This is due to increased infiltration of water into the soil and reduced evaporation. In addition, small soil particles are bonded together and are not as easily transported by wind. Adding PAM may reduce the quantity of water needed for dust control. Note that the application rate specified here applies to this BMP, and is not the same application rate that is specified in BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection, but the downstream protections still apply.

  Refer to BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection for conditions of use. PAM shall not be directly applied to water or allowed to enter a water body.
- Contact your local Air Pollution Control Authority for guidance and training on other dust control measures. Compliance with the local Air Pollution Control Authority constitutes

compliance with this BMP.

- Use vacuum street sweepers.
- Remove mud and other dirt promptly so it does not dry and then turn into dust.
- Techniques that can be used for unpaved roads and lots include:
  - Lower speed limits. High vehicle speed increases the amount of dust stirred up from unpaved roads and lots.
  - Upgrade the road surface strength by improving particle size, shape, and mineral types that make up the surface and base materials.
  - Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those smaller than .075 mm) to 10 to 20 percent.
  - Use geotextile fabrics to increase the strength of new roads or roads undergoing reconstruction.
  - Encourage the use of alternate, paved routes, if available.
  - Apply chemical dust suppressants using the admix method, blending the product with the top few inches of surface material. Suppressants may also be applied as surface treatments.
  - Limit dust-causing work on windy days.
  - Pave unpaved permanent roads and other trafficked areas.

Maintenance Standards

Respray area as necessary to keep dust to a minimum.

~~BMP C150: Materials on Hand~~

~~Purpose~~

~~Keep quantities of erosion prevention and sediment control materials on the project site at all times to be used for regular maintenance and emergency situations such as unexpected heavy rains. Having these materials on-site reduces the time needed to replace existing or implement new BMPs when inspections indicate that existing BMPs are not meeting the Construction SWPPP requirements. In addition, contractors can save money by buying some materials in bulk and storing them at their office or yard.~~

~~Conditions of Use~~

- ~~Construction projects of any size or type can benefit from having materials on hand. A small commercial development project could have a roll of plastic and some gravel available for immediate protection of bare soil and temporary berm construction. A large earthwork project, such as highway construction, might have several tons of straw, several rolls of plastic, flexible~~

BMP C160: Certified Erosion and Sediment Control Lead

Purpose

The project proponent designates at least one person as the responsible representative in charge of erosion and sediment control (ESC), and water quality protection. The designated person shall be responsible for ensuring compliance with all local, state, and federal erosion and sediment control and water quality requirements. Construction sites one acre or larger that discharge to waters of the State must designate a Certified Erosion and Sediment Control Lead (CESCL) as the responsible representative.

Conditions of Use

A CESCL shall be made available on projects one acre or larger that discharge stormwater to surface waters of the state. Sites less than one acre may have a person without CESCL certification conduct inspections.

The CESCL shall:

- Have a current certificate proving attendance in an erosion and sediment control training course that meets the minimum ESC training and certification requirements established by Ecology.

  Ecology has provided the minimum requirements for CESCL course training, as well as a list of ESC training and certification providers at:

  https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Certified-erosion-sediment-control

  OR

- Be a Certified Professional in Erosion and Sediment Control (CPESC). For additional information go to:

  http://www.envirocertintl.org/cpesc/

Specifications

- CESCL certification shall remain valid for three years.
- The CESCL shall have authority to act on behalf of the contractor or project proponent and shall be available, or on-call, 24 hours per day throughout the period of construction.
- The Construction SWPPP shall include the name, telephone number, fax number, and address of the designated CESCL. See II-2 Construction Stormwater Pollution Prevention Plans (Construction SWPPPs).
- A CESCL may provide inspection and compliance services for multiple construction projects in the same geographic region, but must be on site whenever earthwork activities are

occurring that could generate release of turbid water.

- Duties and responsibilities of the CESCL shall include, but are not limited to the following:
    - Maintaining a permit file on site at all times which includes the Construction SWPPP and any associated permits and plans.
    - Directing BMP installation, inspection, maintenance, modification, and removal.
    - Updating all project drawings and the Construction SWPPP with changes made.
    - Completing any sampling requirements including reporting results using electronic Discharge Monitoring Reports (WebDMR).
    - Facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies or the owner.
    - Keeping daily logs, and inspection reports. Inspection reports should include:
        - Inspection date/time.
        - Weather information; general conditions during inspection and approximate amount of precipitation since the last inspection.
        - Visual monitoring results, including a description of discharged stormwater. The presence of suspended sediment, turbid water, discoloration, and oil sheen shall be noted, as applicable.
        - Any water quality monitoring performed during inspection.
        - General comments and notes, including a brief description of any BMP repairs, maintenance or installations made as a result of the inspection.
        - A summary or list of all BMPs implemented, including observations of all erosion/sediment control structures or practices. The following shall be noted:
            1. Locations of BMPs inspected.
            2. Locations of BMPs that need maintenance.
            3. Locations of BMPs that failed to operate as designed or intended.
            4. Locations of where additional or different BMPs are required.

~~BMP C162: Scheduling~~

~~*Purpose*~~

~~Sequencing a construction project reduces the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking.~~

~~and staples.~~

  - ~~In the case of grass-lined ditches and swales, check dams and accumulated sediment shall be removed when the grass has matured sufficiently to protect the ditch or swale unless the slope of the swale is greater than 4 percent. The area beneath the check dams shall be seeded and mulched immediately after dam removal.~~

~~*Maintenance Standards*~~

- ~~Inspect TSDs for performance and sediment accumulation during and after each rainfall that produces runoff. Remove sediment when it reaches one half the height of the TSD.~~
- ~~Anticipate submergence and deposition above the TSD and erosion from high flows around the edges of the TSD. Immediately repair any damage or any undercutting of the TSD.~~

BMP C209: Outlet Protection

Purpose

Outlet protection prevents scour at conveyance outlets and minimizes the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.

Conditions of Use

Use outlet protection at the outlets of all ponds, pipes, ditches, or other conveyances that discharge to a natural or manmade drainage feature such as a stream, wetland, lake, or ditch.

Design and Installation Specifications

- The receiving channel at the outlet of a pipe shall be protected from erosion by lining a minimum of 6 feet downstream and extending up the channel sides a minimum of 1–foot above the maximum tailwater elevation, or 1-foot above the crown, whichever is higher. For pipes larger than 18 inches in diameter, the outlet protection lining of the channel shall be four times the diameter of the outlet pipe.
- Standard wingwalls, tapered outlets, and paved channels should also be considered when appropriate for permanent culvert outlet protection (WSDOT, 2015).
- BMP C122: Nets and Blankets or BMP C202: Riprap Channel Lining provide suitable options for lining materials.
- With low flows, BMP C201: Grass-Lined Channels can be an effective alternative for lining material.
- The following guidelines shall be used for outlet protection with riprap:
  - If the discharge velocity at the outlet is less than 5 fps, use 2-inch to 8-inch riprap. Minimum thickness is 1-foot.
  - For 5 to 10 fps discharge velocity at the outlet, use 24-inch to 48-inch riprap. Minimum

    thickness is 2 feet.

  - For outlets at the base of steep slope pipes (pipe slope greater than 10 percent), use an engineered energy dissipator.

  - Filter fabric or erosion control blankets should always be used under riprap to prevent scour and channel erosion. See BMP C122: Nets and Blankets.

- Bank stabilization, bioengineering, and habitat features may be required for disturbed areas. This work may require a Hydraulic Project Approval (HPA) from the Washington State Department of Fish and Wildlife. See I-2.11 Hydraulic Project Approvals.

Maintenance Standards

- Inspect and repair as needed.

- Add rock as needed to maintain the intended function.

- Clean energy dissipator if sediment builds up.

BMP C220: Inlet Protection

Purpose

Inlet protection prevents coarse sediment from entering drainage systems prior to permanent stabilization of the disturbed area.

Conditions of Use

Use inlet protection at inlets that are operational before permanent stabilization of the disturbed areas that contribute runoff to the inlet. Provide protection for all storm drain inlets downslope and within 500 feet of a disturbed or construction area, unless those inlets are preceded by a sediment trapping BMP.

Also consider inlet protection for lawn and yard drains on new home construction. These small and numerous drains coupled with lack of gutters can add significant amounts of sediment into the roof drain system. If possible, delay installing lawn and yard drains until just before landscaping, or cap these drains to prevent sediment from entering the system until completion of landscaping. Provide 18-inches of sod around each finished lawn and yard drain.

Table II-3.10: Storm Drain Inlet Protection lists several options for inlet protection. All of the methods for inlet protection tend to plug and require a high frequency of maintenance. Limit contributing drainage areas for an individual inlet to one acre or less. If possible, provide emergency overflows with additional end-of-pipe treatment where stormwater ponding would cause a hazard.

Table II-3.10: Storm Drain Inlet Protection

Type of Inlet Protection	Emergency Overflow	Applicable for Paved/ Earthen Surfaces	Conditions of Use
Drop Inlet Protection			
Excavated drop inlet protection	Yes, temporary flooding may occur	Earthen	Applicable for heavy flows. Easy to maintain. Large area requirement: 30'x30'/acre
Block and gravel drop inlet protection	Yes	Paved or Earthen	Applicable for heavy concentrated flows. Will not pond.
Gravel and wire drop inlet protection	No	Paved or Earthen	Applicable for heavy concentrated flows. Will pond. Can withstand traffic.
Catch basin filters	Yes	Paved or Earthen	Frequent maintenance required.
Curb Inlet Protection			
Curb inlet protection with wooden weir	Small capacity overflow	Paved	Used for sturdy, more compact installation.
Block and gravel curb inlet protection	Yes	Paved	Sturdy, but limited filtration.
Culvert Inlet Protection			
Culvert inlet sediment trap	N/A	N/A	18 month expected life.

Design and Installation Specifications

Excavated Drop Inlet Protection

Excavated drop inlet protection consists of an excavated impoundment around the storm drain inlet. Sediment settles out of the stormwater prior to entering the storm drain. Design and installation specifications for excavated drop inlet protection include:

- Provide a depth of 1-2 ft as measured from the crest of the inlet structure.
- Slope sides of excavation should be no steeper than 2H:1V.
- Minimum volume of excavation is 35 cubic yards.
- Shape the excavation to fit the site, with the longest dimension oriented toward the longest inflow area.
- Install provisions for draining to prevent standing water.
- Clear the area of all debris.

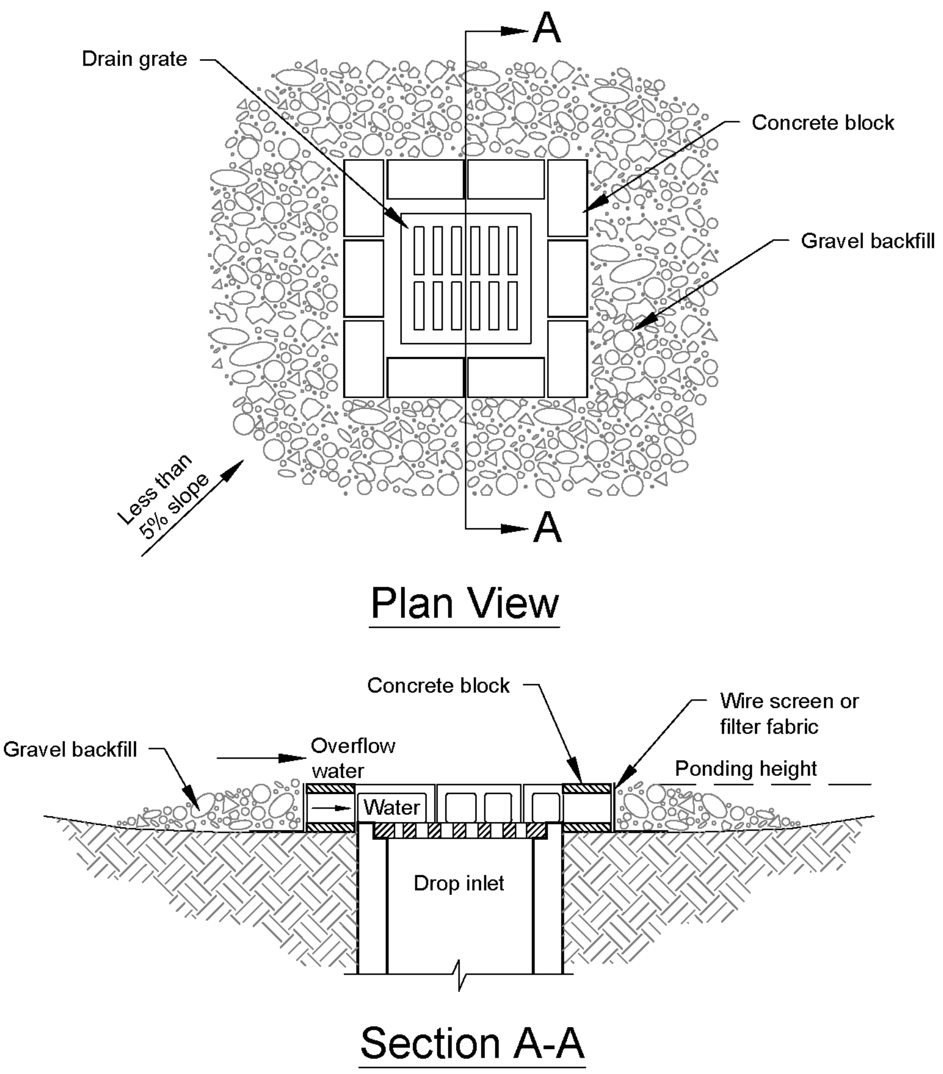
- Grade the approach to the inlet uniformly.
- Drill weep holes into the side of the inlet.
- Protect weep holes with screen wire and washed aggregate.
- Seal weep holes when removing structure and stabilizing area.
- Build a temporary dike, if necessary, to the down slope side of the structure to prevent bypass flow.

Block and Gravel Filter

A block and gravel filter is a barrier formed around the inlet with standard concrete blocks and gravel. See Figure II-3.17: Block and Gravel Filter. Design and installation specifications for block gravel filters include:

- Provide a height of 1 to 2 feet above the inlet.
- Recess the first row of blocks 2-inches into the ground for stability.
- Support subsequent courses by placing a pressure treated wood 2x4 through the block opening.
- Do not use mortar.
- Lay some blocks in the bottom row on their side to allow for dewatering the pool.
- Place hardware cloth or comparable wire mesh with ½-inch openings over all block openings.
- Place gravel to just below the top of blocks on slopes of 2H:1V or flatter.
- An alternative design is a gravel berm surrounding the inlet, as follows:
    - Provide a slope of 3H:1V on the upstream side of the berm.
    - Provide a slope of 2H:1V on the downstream side of the berm.
    - Provide a 1-foot wide level stone area between the gravel berm and the inlet.
    - Use stones 3 inches in diameter or larger on the upstream slope of the berm.
    - Use gravel ½- to ¾-inch at a minimum thickness of 1-foot on the downstream slope of the berm.

Figure II-3.17: Block and Gravel Filter



Notes:

1. Drop inlet sediment barriers are to be used for small, nearly level drainage areas. (less than 5%)
2. Excavate a basin of sufficient size adjacent to the drop inlet.
3. The top of the structure (ponding height) must be well below the ground elevation downslope to prevent runoff from bypassing the inlet. A temporary dike may be necessary on the downslope side of the structure.

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Block and Gravel Filter

Revised June 2016

Gravel and Wire Mesh Filter

Gravel and wire mesh filters are gravel barriers placed over the top of the inlet. This method does not provide an overflow. Design and installation specifications for gravel and wire mesh filters include:

- Use a hardware cloth or comparable wire mesh with ½-inch openings.
    - Place wire mesh over the drop inlet so that the wire extends a minimum of 1-foot beyond each side of the inlet structure.
    - Overlap the strips if more than one strip of mesh is necessary.
- Place coarse aggregate over the wire mesh.
    - Provide at least a 12-inch depth of aggregate over the entire inlet opening and extend at least 18-inches on all sides.

Catch Basin Filters

Catch basin filters are designed by manufacturers for construction sites. The limited sediment storage capacity increases the amount of inspection and maintenance required, which may be daily for heavy sediment loads. To reduce maintenance requirements, combine a catch basin filter with another type of inlet protection. This type of inlet protection provides flow bypass without overflow and therefore may be a better method for inlets located along active rights-of-way. Design and installation specifications for catch basin filters include:

- Provides 5 cubic feet of storage.
- Requires dewatering provisions.
- Provides a high-flow bypass that will not clog under normal use at a construction site.
- Insert the catch basin filter in the catch basin just below the grating.

Curb Inlet Protection with Wooden Weir

Curb inlet protection with wooden weir is an option that consists of a barrier formed around a curb inlet with a wooden frame and gravel. Design and installation specifications for curb inlet protection with wooden weirs include:

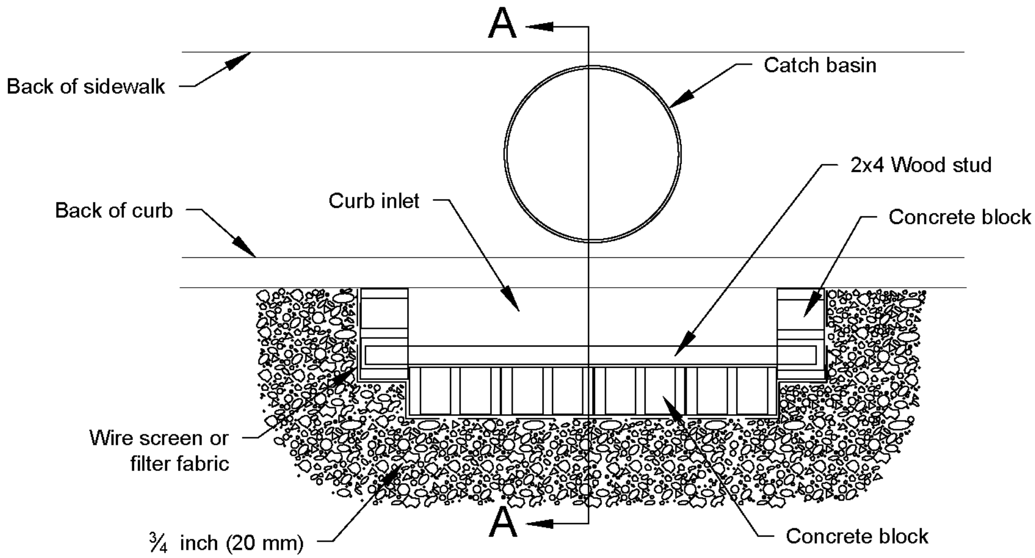
- Use wire mesh with ½-inch openings.
- Use extra strength filter cloth.
- Construct a frame.
- Attach the wire and filter fabric to the frame.
- Pile coarse washed aggregate against the wire and fabric.
- Place weight on the frame anchors.

Block and Gravel Curb Inlet Protection

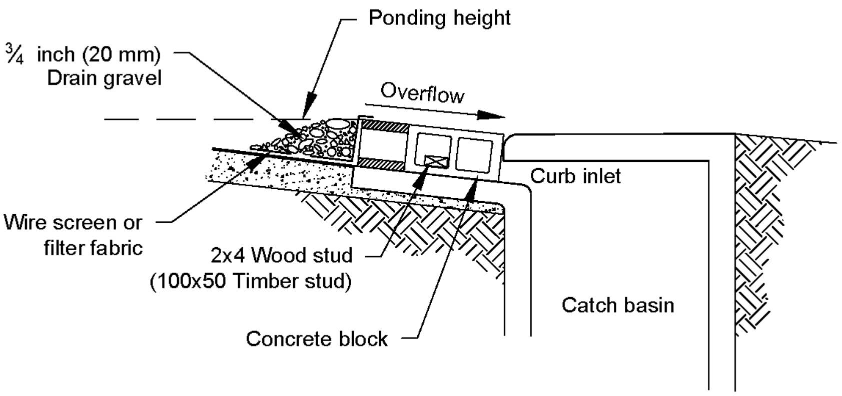
Block and gravel curb inlet protection is a barrier formed around a curb inlet with concrete blocks and gravel. See Figure II-3.18: Block and Gravel Curb Inlet Protection. Design and installation specifications for block and gravel curb inlet protection include:

- Use wire mesh with ½-inch openings.
- Place two concrete blocks on their sides abutting the curb at either side of the inlet opening. These are spacer blocks.
- Place a 2x4 stud through the outer holes of each spacer block to align the front blocks.
- Place blocks on their sides across the front of the inlet and abutting the spacer blocks.
- Place wire mesh over the outside vertical face.
- Pile coarse aggregate against the wire to the top of the barrier.

Figure II-3.18: Block and Gravel Curb Inlet Protection



Plan View



Section A-A

Notes:

1. Use block and gravel type sediment barrier when curb inlet is located in gently sloping street segment, where water can pond and allow sediment to separate from runoff.
2. Barrier shall allow for overflow from severe storm event.
3. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

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Block and Gravel Curb Inlet Protection

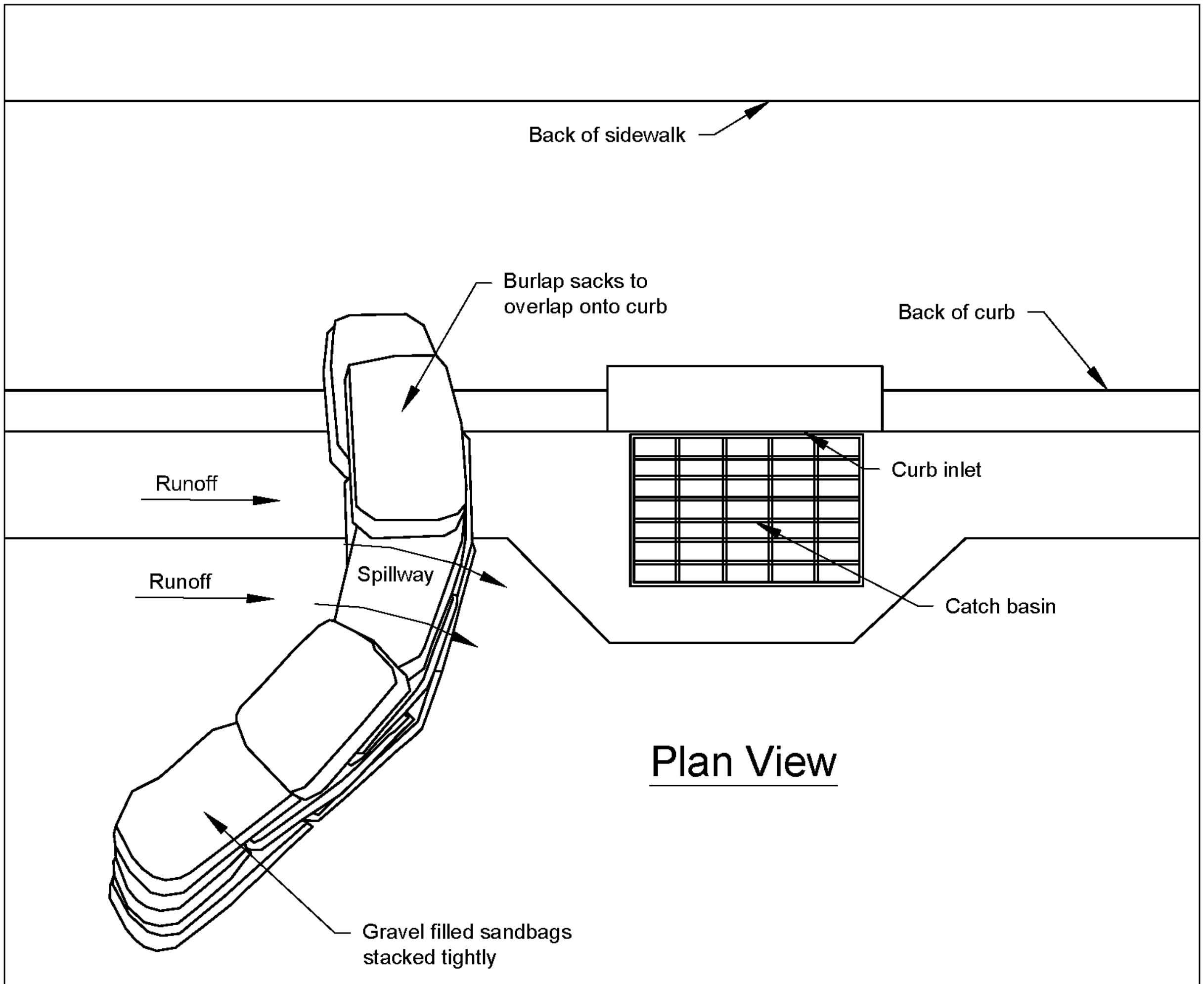
Revised June 2016

Curb and Gutter Sediment Barrier

Curb and gutter sediment barrier is a sandbag or rock berm (riprap and aggregate) 3 feet high and 3 feet wide in a horseshoe shape. See Figure II-3.19: Curb and Gutter Barrier. Design and installation specifications for curb and gutter sediment barrier include:

- Construct a horseshoe shaped berm, faced with coarse aggregate if using riprap, 3 feet high and 3 feet wide, at least 2 feet from the inlet.
- Construct a horseshoe shaped sedimentation trap on the upstream side of the berm. Size the trap to sediment trap standards for protecting a culvert inlet.

Figure II-3.19: Curb and Gutter Barrier



Notes:

1. Place curb type sediment barriers on gently sloping street segments, where water can pond and allow sediment to separate from runoff.
2. Sandbags of either burlap or woven 'geotextile' fabric, are filled with gravel, layered and packed tightly.
3. Leave a one sandbag gap in the top row to provide a spillway for overflow.
4. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

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Curb and Gutter Barrier

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Maintenance Standards

- Inspect all forms of inlet protection frequently, especially after storm events. Clean and replace clogged catch basin filters. For rock and gravel filters, pull away the rocks from the inlet and clean or replace. An alternative approach would be to use the clogged rock as fill and put fresh rock around the inlet.
- Do not wash sediment into storm drains while cleaning. Spread all excavated material evenly over the surrounding land area or stockpile and stabilize as appropriate.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

~~BMP C231: Brush Barrier~~

~~Purpose~~

~~The purpose of brush barriers is to reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.~~

~~Conditions of Use~~

- ~~Brush barriers may be used downslope of disturbed areas that are less than one-quarter acre.~~
- ~~Brush barriers are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be directed to a sediment trapping BMP. The only circumstance in which overland flow can be treated solely by a brush barrier, rather than by a sediment trapping BMP, is when the area draining to the barrier is small.~~
- ~~Brush barriers should only be installed on contours.~~

~~Design and Installation Specifications~~

- ~~Height: 2 feet (minimum) to 5 feet (maximum).~~
- ~~Width: 5 feet at base (minimum) to 15 feet (maximum).~~
- ~~Filter fabric (geotextile) may be anchored over the brush berm to enhance the filtration ability of the barrier. Ten-ounce burlap is an adequate alternative to filter fabric.~~

APPENDIX

8.7 SOURCE CONTROL BMPS

IV-1 Source Control BMPs Applicable to All Sites

S410 BMPs for Correcting Illicit Discharges to Storm Drains

Description of Pollutant Sources: Illicit discharges are unpermitted sanitary or process wastewater discharges to a storm sewer or to surface water, rather than to a sanitary sewer, industrial process wastewater, or other appropriate treatment. They can also include swimming pool water, filter backwash, cleaning solutions/washwaters, cooling water, etc. Experience has shown that illicit discharges are common, particularly in older buildings.

Pollutant Control Approach: Identify and eliminate unpermitted discharges or obtain an NPDES permit, where necessary, particularly at industrial and commercial facilities.

Applicable Operational BMPs:

- For all real properties, responsible parties must examine their plumbing systems to identify any potential illicit discharges. Review site plans, engineering drawings, or other sources of information for the plumbing systems on the property.
- If an illicit discharge is suspected, trace the source using an appropriate method such as visual reconnaissance, smoke test, flow test, dye test with a nontoxic dye, or closed circuit television (CCTV) inspection. These tests are to be performed by qualified personnel such as a plumbing contractor. Note: Contact Ecology prior to performing a dye test which may result in a discharge to a receiving water.
- If illicit connections are found, permanently plug or disconnect the connections.
- Eliminate prohibited discharges to storm sewer, ground water, or surface water.
- Convey unpermitted discharges to a sanitary sewer if allowed by the local sewer authority, or to other approved treatment.
- Obtain all necessary permits for altering or repairing side sewers and plumbing fixtures. Restrictions on certain types of discharges, particularly industrial process waters, may require pretreatment of discharges before they enter the sanitary sewer. It is the responsibility of the property owner or business operator to obtain the necessary permits and to replace the connection.
- Obtain appropriate state and local permits for these discharges.

Recommended Additional Operational BMPs:

At commercial and industrial facilities, conduct a survey of wastewater discharge connections to storm drains and to surface water as follows:

- Conduct a field survey of buildings, particularly older buildings, and other industrial areas to locate storm drains from buildings and paved surfaces. Note where these discharge.
- During non-stormwater conditions, inspect each storm drain for non-stormwater discharges. Record the locations of all non-stormwater discharges. Include all permitted discharges.
- If useful, prepare a map of each area. Show on the map the known location of storm sewers, sanitary sewers, and permitted and unpermitted discharges. Aerial photos may be useful. Check records such as piping schematics to identify known side sewer connections and show these on the map. Consider using smoke, dye, or chemical analysis tests to detect connections between two conveyance systems (e.g., process water and stormwater). If desirable, conduct TV inspections of the storm drains and record the footage on videotape.
- Compare the observed locations of connections with the information on the map and revise the map accordingly. Note suspect connections that are inconsistent with the field survey.
- Identify all connections to storm sewers or to surface water and take the actions specified above as applicable BMPs.

S453 BMPs for Formation of a Pollution Prevention Team

The pollution prevention team should be responsible for implementing and maintaining all BMPs and treatment for the site. This team should be able to address any corrective actions needed on site to mitigate potential stormwater contamination. The team members should:

- Consist of those people who are familiar with the facility and its operations.
- Possess the knowledge and skills to assess conditions and activities that could impact stormwater quality at your facility, and who can evaluate the effectiveness of control measures.
- Assign pollution prevention team staff to be on duty on a daily basis to cover applicable permittee facilities when those facilities are in operation.
- Have the primary responsibility for developing and overseeing facility activities necessary to comply with stormwater requirements.
- Have access to all applicable permit, monitoring, SWPPP, and other records.
- Be trained in the operation, maintenance and inspections of all BMPs and reporting procedures.
- Establish responsibilities for inspections, operation, maintenance, and emergencies.
- Regularly meet to review overall facility operations and BMP effectiveness.

S454 BMPs for Preventive Maintenance / Good Housekeeping

Preventative maintenance and good housekeeping practices reduce the potential for stormwater to come into contact with pollutants and can reduce maintenance intervals for the drainage system and sewer system.

Applicable BMPs:

- Prevent the discharge of unpermitted liquid or solid wastes, process wastewater, and sewage to ground or surface water, or to storm drains that discharge to surface water, or to the ground. Conduct all oily parts cleaning, steam cleaning, or pressure washing of equipment or containers inside a building, or on an impervious contained area, such as a concrete pad. Direct contaminated stormwater from such an area to a sanitary sewer where allowed by local sewer authority, or to other approved treatment.
- Promptly contain and clean up solid and liquid pollutant leaks and spills including oils, solvents, fuels, and dust from manufacturing operations on an exposed soil, vegetation, or paved area.
- If a contaminated surface must be pressure washed, collect the resulting washwater for proper disposal (usually involves plugging storm drains, or otherwise preventing discharge and pumping or vactoring up washwater, for discharge to sanitary sewer or for vactor truck transport to a waste water treatment plant for disposal).
- Do not hose down pollutants from any area to the ground, storm drains, conveyance ditches, or receiving water. Convey pollutants before discharge to a treatment system approved by the local jurisdiction.
- Sweep all appropriate surfaces with vacuum sweepers quarterly, or more frequently as needed, for the collection and disposal of dust and debris that could contaminate stormwater. Use mechanical sweepers, and manual sweeping as necessary to access areas that a vacuum sweeper can't reach to ensure that all surface contaminants are routinely removed.
- Do not pave over contaminated soil unless it has been determined that ground water has not been and will not be contaminated by the soil. Call Ecology for assistance.
- Construct impervious areas that are compatible with the materials handled. Portland cement concrete, asphalt, or equivalent material may be considered.
- Use drip pans to collect leaks and spills from industrial/commercial equipment such as cranes at ship/boat building and repair facilities, log stackers, industrial parts, trucks and other vehicles stored outside.
- At industrial and commercial facilities, drain oil and fuel filters before disposal. Discard empty oil and fuel filters, oily rags, and other oily solid waste into appropriately closed and properly labeled containers, and in compliance with the Uniform Fire Code or International Building Code.
- For the storage of liquids use containers, such as steel and plastic drums, that are rigid and

durable, corrosion resistant to the weather and fluid content, non-absorbent, water tight, rodent-proof, and equipped with a close fitting cover.

- For the temporary storage of solid wastes contaminated with liquids or other potential polluted materials use dumpsters, garbage cans, drums, and comparable containers, which are durable, corrosion resistant, non-absorbent, non-leaking, and equipped with either a solid cover or screen cover to prevent littering. If covered with a screen, the container must be stored under a roof or other form of adequate cover.
- Where exposed to stormwater, use containers, piping, tubing, pumps, fittings, and valves that are appropriate for their intended use and for the contained liquid.
- Clean oils, debris, sludge, etc. from all stormwater facilities regularly, including catch basins, settling/detention basins, oil/water separators, boomed areas, and conveyance systems to prevent the contamination of stormwater. Refer to Ecology Requirements for Generators of Dangerous Wastes in I-2.15 Other Requirements for references to assist in handling potentially dangerous waste.
- Promptly repair or replace all substantially cracked or otherwise damaged paved secondary containment, high-intensity parking, and any other drainage areas, subjected to pollutant material leaks or spills. Promptly repair or replace all leaking connections, pipes, hoses, valves, etc., which can contaminate stormwater.
- Do not connect floor drains in potential pollutant source areas to storm drains, surface water, or to the ground.

Recommended BMPs:

- Where feasible, store potential stormwater pollutant materials inside a building or under a cover and/or containment.
- Minimize use of toxic cleaning solvents, such as chlorinated solvents, and other toxic chemicals.
- Use environmentally safe raw materials, products, additives, etc. such as substitutes for zinc used in rubber production.
- Recycle waste materials such as solvents, coolants, oils, degreasers, and batteries to the maximum extent feasible. Contact Ecology's *Hazardous Waste & Toxics Reduction Program* at https://ecology.wa.gov/About-us/Get-to-know-us/Our-Programs/Hazardous-Waste-Toxics-Reduction for recommendations on recycling or disposal of vehicle waste liquids and other waste materials.
- Empty drip pans immediately after a spill or leak is collected in an uncovered area.
- Stencil warning signs at stormwater catch basins and drains, e.g., “Dump no waste – Drains to waterbody”.
- Use solid absorbents, e.g., clay and peat absorbents and rags for cleanup of liquid spills/leaks, where practicable.
- Promptly repair/replace/reseal damaged paved areas at industrial facilities.

- Recycle materials, such as oils, solvents, and wood waste, to the maximum extent practicable.

Note: Evidence of stormwater contamination by oils and grease can include the presence of visible sheen, color, or turbidity in the runoff, or present or historical operational problems at the facility. Operators can use simple pH tests, for example with litmus or pH paper. These tests can screen for high or low pH levels (anything outside a 6.5-8.5 range) due to contamination in stormwater.

S455 BMPs for Spill Prevention and Cleanup

Description of Pollutant Sources: Spills and leaks can damage public infrastructure, interfere with sewage treatment, and cause a threat to human health or the environment. Spills are often preventable if appropriate chemical and waste handling techniques are practiced effectively and the spill response plan is immediately implemented. Additional spill control requirements may be required based on the specific activity occurring on site.

Applicable BMPs:

Spill Prevention

- Clearly label or mark all containers that contain potential pollutants.
- Store and transport liquid materials in appropriate containers with tight-fitting lids.
- Place drip pans underneath all containers, fittings, valves, and where materials are likely to spill or leak.
- Use tarpaulins, ground cloths, or drip pans in areas where materials are mixed, carried, and applied to capture any spilled materials.
- Train employees on the safe techniques for handling materials used on the site and to check for leaks and spills.

Spill Plan

- Develop and implement a spill plan and update it annually or whenever there is a change in activities or staff responsible for spill cleanup. Post a written summary of the plan at areas with a high potential for spills, such as loading docks, product storage areas, waste storage areas, and near a phone. The spill plan may need to be posted at multiple locations. Describe the facility, including the owner's name, address, and telephone number; the nature of the facility activity; and the general types of chemicals used at the facility.
- Designate spill response employees to be on-site during business activities. Provide a current list of the names and telephone numbers (home and office) of designated spill response employees who are responsible for implementing the spill plan.
- Provide a site plan showing the locations of storage areas for chemicals, inlets/catch basins, spill kits and other relevant infrastructure or materials information.
- Describe the emergency cleanup and disposal procedures. Note the location of all spill kits in

the spill plan.

- List the names and telephone numbers of public agencies to contact in the event of a spill.

Spill Cleanup Kits

- Store all cleanup kits near areas with a high potential for spills so that they are easily accessible in the event of a spill. The contents of the spill kit must be appropriate to the types and quantities of materials stored or otherwise used at the facility, and refilled when the materials are used. Spill kits must be located within 25 feet of all fueling/fuel transfer areas, including on-board mobile fuel trucks.

  Note: Ecology recommends that the kit(s) include salvage drums or containers, such as high density polyethylene, polypropylene or polyethylene sheet-lined steel; polyethylene or equivalent disposal bags; an emergency response guidebook; safety gloves/clothes/equipment; shovels or other soil removal equipment; and oil containment booms and absorbent pads; all stored in an impervious container.

Spill Cleanup and Proper Disposal of Waste

- Stop, contain, and clean up all spills immediately upon discovery.
- Implement the spill plan immediately.
- Contact the designated spill response employees.
- Block off and seal nearby inlets/catch basins to prevent materials from entering the drainage system or combined sewer.
- Use the appropriate material to clean up the spill.
- Do not use emulsifiers or dispersants such as liquid detergents or degreasers unless disposed of proplerly. Emulsifiers and dispersants are not allowed to be used on surface water, or in a place where they may enter storm drains, surface waters, treatments systems, or sanitary sewers.
- Immediately notify Ecology and the local jurisdiction if a spill has reached or may reach a sanitary or storm sewer, ground water, or surface water. Notification must comply with state and federal spill reporting requirements.
- Do not wash absorbent material into interior floor drains or inlets/catch basins.
- Place used spill control materials in appropriate containers and dispose of according to regulations.

S456 BMPs for Employee Training

Train all employees that work in pollutant source areas about the following topics:

- Identifying Pollution Prevention Team Members.
- Identifying pollutant sources.

- Understanding pollutant control measures.
- Spill prevention and response.
- Emergency response procedures.
- Handling practices that are environmentally acceptable. Particularly those related to vehicle/equipment liquids such as fuels, and vehicle/equipment cleaning.

Additional specialized training may be needed for staff who will be responsible for handling hazardous materials.

S457 BMPS for Inspections

Qualified personnel shall conduct inspections monthly. Make and maintain a record of each inspection on-site. The following requirements apply to inspections:

- Be conducted by someone familiar with the facility's site, operations, and BMPs.
- Verify the accuracy of the pollutant source descriptions in the SWPPP.
- Assess all BMPs that have been implemented for effectiveness and needed maintenance and locate areas where additional BMPs are needed.
- Reflect current conditions on the site.
- Include written observations of the presence of floating materials, suspended solids, oil and grease, discoloration, turbidity and odor in the stormwater discharges; in outside vehicle maintenance/repair; and liquid handling, and storage areas. In areas where acid or alkaline materials are handled or stored use a simple litmus or pH paper to identify those types of stormwater contaminants where needed.
- Eliminate or obtain a permit for unpermitted non-stormwater discharges to storm drains or receiving waters, such as process wastewater and vehicle/equipment washwater.
- Identify actions to address inspection deficiencies.

S458 BMPs for Record Keeping

See the applicable permit for specific record-keeping requirements and retention schedules for the following reports. At a minimum, retain the following reports for five years:

- Inspection reports which should include:
    - Time and date of the inspection
    - Locations inspected
    - Statement on status of compliance with the permit
    - Summary report of any remediation activities required
    - Name, title, and signature of person conducting the inspection

- Reports on spills of oil or hazardous substances in greater than Reportable Quantities (Code of Federal Regulations Title 40 Parts 302.4 and 117). Report spills of the following: antifreeze, oil, gasoline, or diesel fuel, that cause:
  - A violation of the State of Washington's Water Quality Standards.
  - A film or sheen upon or discoloration of the waters of the State or adjoining shorelines.
  - A sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines.

  To report a spill or to determine if a spill is a substance of a Reportable Quantity, call the Ecology regional office and ask for an oil spill operations or a dangerous waste specialist:

  - Northwest Region (425)649-7000
  - Southwest Region (360)407-6300
  - Eastern Region (509)329-3400
  - Central Region (509) 575-2490

  In addition, call the Washington Emergency Management Division at 1-800-258-5990 or 1-800-OILS-911 AND the National Response Center at 1-800-424-8802.

  Also, refer to *Focus on Emergency Spill Response* (Ecology, 2009).

The following is additional recommended record keeping:

Maintain records of all related pollutant control and pollutant generating activities such as training, materials purchased, material use and disposal, maintenance performed, etc.

~~can cause air pollution include grain dust, sawdust, coal, gravel, crushed rock, cement, and boiler fly ash. Air emissions can contaminate stormwater. The objective of this BMP is to reduce the stormwater pollutants caused by dust generation and control.~~

~~**Pollutant Control Approach:** Prevent dust generation and emissions where feasible, regularly clean-up dust that can contaminate stormwater, and convey dust contaminated stormwater to proper treatment.~~

~~Applicable BMPs:~~

- ~~Clean, as needed, powder material handling equipment and vehicles.~~
- ~~Regularly sweep dust accumulation areas that can contaminate stormwater. Conduct sweeping using vacuum filter equipment to minimize dust generation and to ensure optimal dust removal.~~
- ~~Use dust filtration/collection systems such as baghouse filters, cyclone separators, etc. to control vented dust emissions that could contaminate stormwater. Control of zinc dusts in rubber production is one example.~~
- ~~Maintain on-site controls to prevent vehicle track-out.~~
- ~~Maintain dust collection devices on a regular basis.~~

~~Recommended BMPs:~~

- ~~In manufacturing operations, train employees to handle powders carefully to prevent generation of dust.~~
- ~~Use water spray to flush dust accumulations to sanitary sewers where allowed by the local sewer authority or to other appropriate treatment system.~~
- ~~Use approved dust suppressants such as those listed in *Methods for Dust Control* (Ecology, 2016b). Application of some products may not be appropriate in close proximity to receiving waters or conveyances close to receiving waters. For more information check with Ecology or the local jurisdiction.~~

~~Recommended Treatment BMPs~~

~~Install sedimentation basins, wet ponds, wet vaults, catch basin filters, vegetated filter strips, or equivalent sediment removal BMPs.~~

S411 BMPs for Landscaping and Lawn / Vegetation Management

Description of Pollutant Sources: Landscaping can include grading, soil transfer, vegetation planting, and vegetation removal. Examples include weed control on golf course lawns, access roads, and utility corridors and during landscaping; and residential lawn/plant care. Proper management of vegetation can minimize excess nutrients and pesticides.

Pollutant Control Approach: Maintain appropriate vegetation to control erosion and the discharge of stormwater pollutants. Prevent debris contamination of stormwater. Where practicable, grow plant species appropriate for the site, or adjust the soil properties of the site to grow desired plant species.

Applicable BMPs:

- Install engineered soil/landscape systems to improve the infiltration and regulation of stormwater in landscaped areas.
- Select the right plants for the planting location based on proposed use, available maintenance,soil conditions, sun exposure, water availability, height, sight factors, and space available.
- Ensure that plants selected for planting are not on the noxious weed list. For example, butterfly bush often gets planted as an ornamental but is actually on the noxious weed list.

  The Washington State Noxious Weed List can be found at the following webpage:

  https://www.nwcb.wa.gov/printable-noxious-weed-list
- Do not dispose of collected vegetation into waterways or storm sewer systems.
- Do not blow vegetation or other debris into the drainage system.
- Dispose of collected vegetation such as grass clippings, leaves, sticks by composting or recycling.
- Remove, bag, and dispose of class A & B noxious weeds in the garbage immediately.
- Do not compost noxious weeds as it may lead to spreading through seed or fragment if the composting process is not hot enough.
- Use manual and/or mechanical methods of vegetation removal (pincer-type weeding tools, flame weeders, or hot water weeders as appropriate) rather than applying herbicides, where practical.
- Use at least an eight-inch "topsoil" layer with at least 8 percent organic matter to provide a sufficient vegetation-growing medium.
  - Organic matter is the least water-soluble form of nutrients that can be added to the soil. Composted organic matter generally releases only between 2 and 10 percent of its total nitrogen annually, and this release corresponds closely to the plant growth cycle. Return natural plant debris and mulch to the soil, to continue recycling nutrients indefinitely.
- Select the appropriate turfgrass mixture for the climate and soil type.
  - Certain tall fescues and rye grasses resist insect attack because the symbiotic endophytic fungi found naturally in their tissues repel or kill common leaf and stem-eating lawn insects.

        - The fungus causes no known adverse effects to the host plant or to humans.
        - Tall fescues and rye grasses do not repel root-feeding lawn pests such as Crane Fly larvae.
        - Tall fescues and rye grasses are toxic to ruminants such as cattle and sheep
    - Endophytic grasses are commercially available; use them in areas such as parks or golf courses where grazing does not occur.
    - Local agricultural or gardening resources such as Washington State University Extension office can offer advice on which types of grass are best suited to the area and soil type.
- Use the following seeding and planting BMPs, or equivalent BMPs, to obtain information on grass mixtures, temporary and permanent seeding procedures, maintenance of a recently planted area, and fertilizer application rates: BMP C120: Temporary and Permanent Seeding, BMP C121: Mulching, BMP C123: Plastic Covering, and BMP C124: Sodding.
- Adjusting the soil properties of the subject site can assist in selection of desired plant species. Consult a soil restoration specialist for site-specific conditions.

Recommended Additional BMPs:

- Conduct mulch-mowing whenever practicable.
- Use native plants in landscaping. Native plants do not require extensive fertilizer or pesticide applications. Native plants may also require less watering.
- Use mulch or other erosion control measures on soils exposed for more than one week during the dry season (May 1 to September 30) or two days during the rainy season (October 1 to April 30).
- Till a topsoil mix or composted organic material into the soil to create a well-mixed transition layer that encourages deeper root systems and drought-resistant plants.
- Apply an annual topdressing application of 3/8” compost. Amending existing landscapes and turf systems by increasing the percent organic matter and depth of topsoil can:
    - Substantially improve the permeability of the soil.
    - Increase the disease and drought resistance of the vegetation.
    - Reduces the demand for fertilizers and pesticides.
- Disinfect gardening tools after pruning diseased plants to prevent the spread of disease.
- Prune trees and shrubs in a manner appropriate for each species.
- If specific plants have a high mortality rate, assess the cause and replace with another more appropriate species.
- When working around and below mature trees, follow the most current American National Standards Institute (ANSI) ANSI A300 standards (see

http://www.tcia.org/TCIA/BUSINESS/ANSI_A300_Standards_/TCIA/BUSINESS/A300_Standards/A300_Standards.aspx?hkey=202ff566-4364-4686-b7c1-2a365af59669) and International Society of Arboriculture BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil).

- Monitor tree support systems (stakes, guys, etc.).
  - Repair and adjust as needed to provide support and prevent tree damage.
  - Remove tree supports after one growing season or maximum of 1 year.
  - Backfill stake holes after removal.
- When continued, regular pruning (more than one time during the growing season) is required to maintain visual sight lines for safety or clearance along a walk or drive, consider relocating the plant to a more appropriate location.
- Make reasonable attempts to remove and dispose of class C noxious weeds.
- Re-seed bare turf areas until the vegetation fully covers the ground surface.
- Watch for and respond to new occurrences of especially aggressive weeds such as Himalayan blackberry, Japanese knotweed, morning glory, English ivy, and reed canary grass to avoid invasions.
- Plant and protect trees per BMP T5.16: Tree Retention and Tree Planting.
- Aerate lawns regularly in areas of heavy use where the soil tends to become compacted. Conduct aeration while the grasses in the lawn are growing most vigorously. Remove layers of thatch greater than ¾-inch deep.
- Set the mowing height at the highest acceptable level and mow at times and intervals designed to minimize stress on the turf. Generally mowing only 1/3 of the grass blade height will prevent stressing the turf.
  - Mowing is a stress-creating activity for turfgrass.
  - Grass decreases its productivity when mowed too short and there is less growth of roots and rhizomes. The turf becomes less tolerant of environmental stresses, more disease prone and more reliant on outside means such as pesticides, fertilizers, and irrigation to remain healthy.

Additional BMP Information:

- King County's *Best Management Practices for Golf Course Development and Operation* (King County, 1993) has additional BMPs for Turfgrass Maintenance and Operation.
- King County, Seattle Public Utilities, and the Saving Water Partnership have created the following natural lawn and garden care resources that include guidance on building healthy soil with compost and mulch, selecting appropriate plants, watering, using alternatives to pesticides, and implementing natural lawn care techniques.

    - *Natural Yard Care - Five steps to make your piece of the planet a healthier place to live* (King County and SPU, 2008)
    - *The Natural Lawn & Garden Series: Smart Watering* (Saving Water Partnership, 2006)
    - *Natural Lawn Care for Western Washington* (Saving Water Partnership, 2007)
    - *The Natural Lawn & Garden Series: Growing Healthy Soil; Choosing the Right Plants; and Natural Pest, Weed and Disease Control* (Saving Water Partnership, 2012)

- The International Society of Arboriculture (ISA) is a group that promotes the professional practice of arboriculture and fosters a greater worldwide awareness of the benefits of trees through research, technology, and education. ISA standards used for managing trees, shrubs, and other woody plants are the American National Standards Institute (ANSI) A300 standards. The ANSI A300 standards are voluntary industry consensus standards developed by the Tree Care Industry Association (TCIA) and written by the Accredited Standards Committee (ASC). The ANSI standards can be found on the ISA website: www.isa-arbor.com/education/publications/index.aspx
- Washington State University's *Gardening in Washington State* website at http://gardening.wsu.edu contains Washington State specific information about vegetation management based on the type of landscape.
- See the *Pacific Northwest Plant Disease Management Handbook* (Pscheidt and Ocamb, 2016) for information on disease recognition and for additional resources.

~~S425 BMPs for Soil Erosion and Sediment Control at Industrial Sites~~

~~**Description of Pollutant Sources:** Industrial activities on soil areas; exposed and disturbed soils; steep grading; etc. can be sources of sediments that can contaminate stormwater runoff.~~

~~**Pollutant Control Approach:** Limit the exposure of erodible soil, stabilize, or cover erodible soil where necessary to prevent erosion, and/or provide treatment for stormwater contaminated with TSS caused by eroded soil.~~

~~Applicable BMPs:~~

- ~~Limit the exposure of erodible soil.~~
- ~~Stabilize entrances/exits to prevent track-out. See BMP C105: Stabilized Construction Access.~~
- ~~Stabilize or cover erodible soil to prevent erosion. Cover practice options include:~~
    - ~~Use vegetative cover such as grass, trees, shrubs, on erodible soil areas.~~
    - ~~Cover exposed areas with mats such as clear plastic, jute, synthetic fiber. See BMP C122: Nets and Blankets and BMP C123: Plastic Covering.~~

Maintenance Operations

- Use drip pans or absorbents wherever concrete, asphalt, asphalt emulsion, paint product, and drips are likely to spill, such as beneath discharge points from equipment.
- Cover and contain nearby storm drains to keep runoff from entering the drainage system.
- Collect and contain all solids, slurry, and rinse water. Do not allow these to enter gutters, storm drains, or drainage ditches or onto the paved surface of a roadway or driveway.
- Designate an area onsite for washing hand tools and collect that water for disposal.
- Conduct all fueling of equipment in accordance with S419 BMPs for Mobile Fueling of Vehicles and Heavy Equipment.
- Do not use diesel fuel for cleaning or prepping asphalt tools and equipment.
- Sweep areas as frequently as needed. Collect all loose aggregate and dust for disposal. Do not hose down areas into storm drains.
- Store all fuel, paint, and other products on secondary containment.
- Conduct paint striping operations during dry weather.

Recommended Additional BMPs:

- Where feasible and practicable, use roadway deicing chemicals that cause the least adverse environmental impact. Apply only as needed using minimum quantities. Consider the Pacific Northwest Snowfighters Qualified Products List when selecting roadway de-icers and anti-icers.
- Intensify roadway and drainage structure cleaning in early spring to help remove particulates from road surfaces.
- Include limits on toxic metals in the specifications for de/anti-icers.
- Install catch basin inserts to collect excess sediment and debris as necessary. Inspect and maintain catch basin inserts to ensure they are working correctly.
- Research admixtures (e.g. corrosion inhibitors, surfactants) to determine what additional pollutants may be an issue. Verify with the local jurisdiction if there are any restrictions on admixtures.

S415 BMPs for Maintenance of Public and Private Utility Corridors and Facilities

Description of Pollutant Sources: Corridors and facilities at petroleum product pipelines, natural gas pipelines, water pipelines, electrical power transmission corridors, and rights-of-way can be sources of pollutants such as herbicides used for vegetation management, and eroded soil particles from unpaved access roads. At pump stations, waste materials generated during maintenance activities may be temporarily stored outside. Additional potential pollutant sources include the leaching of preservatives from wood utility poles, PCBs in older transformers, water removed from underground transformer vaults, and leaks/spills from petroleum pipelines. The following are potential pollutants: oil and grease, TSS, BOD, organics, PCBs, pesticides, and heavy metals.

Pollutant Control Approach: Implementation of spill control plans as well as control of fertilizer and pesticide applications, soil erosion, and site debris that can contaminate stormwater.

Applicable Operational BMPs:

- Minimize the amount of herbicides and other pesticides used to maintain access roads and facilities.
- Implement S411 BMPs for Landscaping and Lawn / Vegetation Management.
- Comply with WSDA Pesticide Regulations (see I-2.15 Other Requirements).
- When removing water or sediments from electric transformer vaults, determine the presence of contaminants before disposing of the water and sediments.
    - This includes inspecting for the presence of oil or sheen, and determining from records or testing if the transformers contain PCBs.
    - If records or tests indicate that the sediments or water are contaminated above applicable levels, manage these media in accordance with applicable federal and state regulations, including the federal PCB rules (40 CFR 761) and the state MTCA cleanup regulations (Chapter 173-340 WAC).
    - Water removed from the vaults can be discharged in accordance with the federal 40 CFR 761.79, and state regulations (Chapter 173-201A WAC and Chapter 173-200 WAC), or via the sanitary sewer if the requirements, including applicable permits, for such a discharge are met. (See also Requirements for Stormwater Discharges to Public Sanitary Sewers, Septic Systems, Dead-End Sumps, and Industrial Waste Treatment Systems and Ecology Requirements for Generators of Dangerous Wastes in I-2.15 Other Requirements).
- Stabilize access roads or areas of bare ground with gravel, crushed rock, or another method to prevent erosion. Use and manage vegetation to minimize bare ground/soils that may be susceptible to erosion.
- Provide maintenance practices to prevent stormwater from accumulating and draining across and/or onto roadways. Convey stormwater through roadside ditches and culverts. The road should be crowned, outsloped, water barred, or otherwise left in a condition not conducive to erosion. Appropriately maintaining grassy roadside ditches discharging to surface waters is an effective way of removing some pollutants associated with sediments carried by stormwater.
- Maintain ditches and culverts at an appropriate frequency to ensure that plugging and flooding across the roadbed, with resulting overflow erosion, does not occur.
- Apply the appropriate BMPs in this Volume for the storage of waste materials that can contaminate stormwater.

Recommended Operational BMPs:

- When selecting utility poles for a specific location, consider the potential environmental effects of the pole or poles during storage, handling, and end-use, as well as its cost, safety, efficacy, and expected life. Use wood products treated with chemical preservatives made in accordance with generally accepted industry standards such as the American Wood Preservers Association Standards (see http://www.awpa.com/standards/). Consider alternative materials or technologies if placing poles in or near an environmentally sensitive area, such as a wetland or a drinking water well. Alternative technologies include poles constructed with material (s) other than wood such as fiberglass composites, metal, or concrete. Consider other technologies and materials, such as sleeves or caissons for wood poles, when they are determined to be practicable and available.
- As soon as practicable remove all litter from wire cutting/replacing operations.
- Implement temporary erosion and sediment control in areas cleared of trees and vegetation and during the construction of new roads.

S416 BMPs for Maintenance of Roadside Ditches

Description of Pollutant Sources: Common road debris including eroded soil, oils, vegetative particles, and heavy metals can be sources of stormwater pollutants.

Pollutant Control Approach: Maintain roadside ditches to preserve the condition and capacity for which they were originally constructed, and to minimize bare or thinly vegetated ground surfaces. Maintenance practices should provide for erosion and sediment control (see S411 BMPs for Landscaping and Lawn / Vegetation Management).

Additional Regulations: Note that work in wet areas may be regulated by local, state, or federal regulations that impose additional obligations on the responsible party. Check with the appropriate authorities prior to beginning work in those areas.

Applicable Operational BMPs:

- Inspect roadside ditches regularly to identify sediment accumulations and localized erosion.
- Clean ditches on a regular basis, as needed. Keep ditches free of rubbish and debris.
- Vegetation in ditches often prevents erosion and cleanses runoff waters. Remove vegetation only when flow is blocked or excess sediments have accumulated. Conduct ditch maintenance (seeding, fertilizer application, harvesting) in late spring and/or early fall, where possible. This allows re-establishment of vegetative cover by the next wet season thereby minimizing erosion of the ditch as well as making the ditch effective as a biofilter.
- Do not apply fertilizer unless needed to maintain vegetative growth.
- In the area between the edge of the pavement and the bottom of the ditch, commonly known as the “bare earth zone,” use grass vegetation, wherever possible. Establish vegetation from the edge of the pavement, if possible, or at least from the top of the slope of the ditch.
- Maintain diversion ditches on top of cut slopes constructed to prevent slope erosion by

intercepting surface drainage to retain their diversion shape and capability.

- Use temporary erosion and sediment control measures or re-vegetate as necessary to prevent erosion during ditch reshaping.
- Do not leave ditch cleanings on the roadway surfaces. Sweep, collect, and dispose of dirt and debris remaining on the pavement at the completion of ditch cleaning operations as described below:
    - Consider screening roadside ditch cleanings, not contaminated by spills or other releases and not associated with a stormwater treatment system such as a bioswale, to remove litter. Separate screenings into soil and vegetative matter (leaves, grass, needles, branches, etc.) categories. Compost or dispose of the vegetative matter in a municipal waste landfill. Consult with the jurisdictional health department to discuss use or disposal options for the soil portion. For more information, see Appendix IV-B: Management of Street Waste Solids and Liquids.
    - Roadside ditch cleanings contaminated by spills or other releases known or suspected to contain dangerous waste must be handled following the Dangerous Waste Regulations (Chapter 173 303 WAC). If testing determines materials are not dangerous waste but contaminants are present, consult with the jurisdictional health department for disposal options.
- Examine culverts on a regular basis for scour or sedimentation at the inlet and outlet, and repair as necessary. Give priority to those culverts conveying perennial and/or salmon-bearing streams and culverts near streams in areas of high sediment load, such as those near subdivisions during construction. Maintain trash racks to avoid damage, blockage, or erosion of culverts.

Recommended Treatment BMPs:

Install biofiltration swales and filter strips (see V-7 Biofiltration BMPs) to treat roadside runoff wherever practicable and use engineered topsoils wherever necessary to maintain adequate vegetation. These systems can improve infiltration and stormwater pollutant control upstream of roadside ditches.

S417 BMPs for Maintenance of Stormwater Drainage and Treatment Systems

Description of Pollutant Sources: Facilities include roadside catch basins on arterials and within residential areas, conveyance systems, detention facilities such as ponds and vaults, oil/water separators, biofilters, settling basins, infiltration systems, and all other types of stormwater treatment systems presented in Volume V. Oil and grease, hydrocarbons, debris, heavy metals, sediments and contaminated water are found in catch basins, oil and water separators, settling basins, etc.

Pollutant Control Approach: Provide maintenance and cleaning of debris, sediments, and other pollutants from stormwater collection, conveyance, and treatment systems to maintain proper operation.

Applicable Operational BMPs:

Maintain stormwater treatment facilities per the operations and maintenance (O&M) procedures presented in Appendix V-A: BMP Maintenance Tables in addition to the following BMPs:

- Inspect and clean treatment BMPs, conveyance systems, and catch basins as needed, and determine necessary O&M improvements.
- Promptly repair any deterioration threatening the structural integrity of stormwater facilities. These include replacement of clean-out gates, catch basin lids, and rock in emergency spillways.
- Ensure adequacy of storm sewer capacities and prevent heavy sediment discharges to the sewer system.
- Regularly remove debris and sludge from BMPs used for peak-rate control, treatment, etc. and discharge to a sanitary sewer if approved by the sewer authority, or truck to an appropriate local or state government approved disposal site.
- Clean catch basins when the depth of deposits reaches 60 percent of the sump depth as measured from the bottom of basin to the invert of the lowest pipe into or out of the basin. However, in no case should there be less than six inches clearance from the debris surface to the invert of the lowest pipe. Some catch basins (for example, WSDOT's *Catch Basin Type 1L* (WSDOT, 2011)) may have as little as 12 inches sediment storage below the invert. These catch basins need frequent inspection and cleaning to prevent scouring. Where these catch basins are part of a stormwater collection and treatment system, the system owner/operator may choose to concentrate maintenance efforts on downstream control devices as part of a systems approach.
- Properly dispose of all solids, polluted material, and stagnant water collected through system cleaning. Do not decant water back into the drainage system from eductor trucks or vacuum equipment since there may be residual contaminants in the cleaning equipment. Do not jet material downstream into the public drainage system.
- Clean woody debris in a catch basin as frequently as needed to ensure proper operation of the catch basin.
- Post warning signs; “Dump No Waste - Drains to Ground Water,” “Streams,” “Lakes,” or emboss on or adjacent to all storm drain inlets where possible.
- Disposal of sediments and liquids from the catch basins must comply with Appendix IV-B: Management of Street Waste Solids and Liquids.

S421 BMPs for Parking and Storage of Vehicles and Equipment

Description of Pollutant Sources: Public and commercial parking lots such as retail store, fleet vehicle (including rent-a-car lots and car dealerships), equipment sale and rental parking lots, and parking lot driveways, can be sources of toxic hydrocarbons and other organic compounds, including oils and greases, metals, and suspended solids.

Pollutant Control Approach: If the parking lot meets the site use thresholds to determine if the site is expected to generate high concentrations of oil, as defined in Step 2: Determine if an Oil Control BMP is Required in III-1.2 Choosing Your Runoff Treatment BMPs, provide oil removal equipment for the contaminated stormwater runoff.

Applicable Operational BMPs:

- If a parking lot must be washed, discharge the washwater to a sanitary sewer, if allowed by the local sewer authority, or other approved wastewater treatment system, or collect washwater for off-site disposal.
- Do not hose down the area to a storm sewer or receiving water. Vacuum sweep parking lots, storage areas, and driveways regularly to collect dirt, waste, and debris. Mechanical or hand sweeping may be necessary for areas where a vacuum sweeper cannot reach.
- Clean up vehicle and equipment fluid drips and spills immediately.
- Place drip pans below leaking vehicles (including inoperative vehicles and equipment) in a manner that catches leaks or spills, including employee vehicles. Drip pans must be managed to prevent overfilling and the contents disposed of properly.

Recommended Operational BMPs:

- Encourage employees to repair leaking personal vehicles.
- Encourage employees to carpool or use public transit through incentives.
- Encourage customers to use public transit by rewarding valid transit pass holders with discounts.
- Install catch basin inserts to collect excess sediment and oil if necessary. Inspect and maintain catch basin inserts to ensure they are working correctly.

Applicable Treatment BMPs:

Establishments subject to high-use intensity are significant sources of oil contamination of stormwater. Examples of potential high use areas include customer parking lots at fast food stores, grocery stores, taverns, restaurants, large shopping malls, discount warehouse stores, quick-lube shops, and banks.

Refer to Step 2: Determine if an Oil Control BMP is Required in III-1.2 Choosing Your Runoff Treatment BMPs for the site use thresholds that determine if an oil control BMP is required, and for a list of oil control BMPs.

~~S430 BMPs for Urban Streets~~

~~**Description of Pollutant Sources:** Urban streets can be the source of vegetative debris, paper, fine dust, vehicle liquids, tire and brake wear residues, heavy metals (lead and zinc), soil particles,~~

IV-2 Cleaning or Washing Source Control BMPs

S431 BMPs for Washing and Steam Cleaning Vehicles / Equipment / Building Structures

Description of Pollutant Sources: Pollutant sources include the commercial cleaning of vehicles, aircraft, vessels, and other transportation, restaurant kitchens, carpets, and industrial equipment, and large buildings with low- or high-pressure water or steam. This includes “charity” car washes at gas stations and commercial parking lots. The cleaning can include hand washing, scrubbing, sanding, etc. Washwater from cleaning activities can contain oil and grease, suspended solids, heavy metals, soluble organics, soaps, and detergents that can contaminate stormwater.

Permitting Requirements: Obtain all necessary permits for installing, altering, or repairing onsite drainage and side sewers. Restrictions on certain types of discharges may require pretreatment before they enter the sanitary sewer.

Pollutant Control Approach: The preferred approach is to cover and/or contain the cleaning activity, or conduct the activity inside a building, to separate the uncontaminated stormwater from the washwater sources. Convey washwater to a sanitary sewer after approval by the local sewer authority. Provide temporary storage before proper disposal, or recycling. Under this preferred approach, no discharge to the ground, to a storm drain, or to surface water should occur.

The Industrial Stormwater General Permit prohibits the discharge of process wastewater (e.g., vehicle washing wastewater) to ground water or surface water. Stormwater that commingles with process wastewater is considered process wastewater.

Facilities not covered under the Industrial Stormwater General Permit that are unable to follow one of the preferred approaches listed above may discharge washwater to the ground only after proper treatment in accordance with *Vehicle and Equipment Washwater Discharges Best Management Practices Manual* (Ecology, 2012).

The quality of any discharge to the ground after proper treatment must comply with Ecology’s Ground Water Quality Standards, Chapter 173-200 WAC.

Facilities not covered under the Industrial Stormwater General Permit that are unable to comply with one of the preferred approaches and want to discharge to storm sewer, must meet their local stormwater requirements. Local authorities may require treatment prior to discharge.

Contact the local Ecology Regional Office to discuss permitting options for discharge of washwater to surface water or to a storm drain after on-site treatment.

Applicable Structural Source Control BMPs:

Conduct vehicle/equipment washing in one of the following locations:

- At a commercial washing facility in which the washing occurs in an enclosure and drains to the sanitary sewer, or

- In a building constructed specifically for washing of vehicles and equipment, which drains to a sanitary sewer.

Conduct outside washing operations in a designated wash area with the following features:

- In a paved area, construct a spill containment pad to prevent the run-on of stormwater from adjacent areas. Slope the spill containment area to collect washwater in a containment pad drain system with perimeter drains, trench drains or catchment drains. Size the containment pad to extend out a minimum of four feet on all sides of the washed vehicles and/or equipment.
- Convey the washwater to a sump (like a grit separator) and then to a sanitary sewer (if allowed by the local Sewer Authority), or other appropriate wastewater treatment or recycle system. The containment sump must have a positive control outlet valve for spill control with live containment volume, and oil/water separation. Size the minimum live storage volume to contain the maximum expected daily washwater flow plus the sludge storage volume below the outlet pipe. Shut the outlet valve during the washing cycle to collect the washwater in the sump. The valve should remain shut for at least two hours following the washing operation to allow the oil and solids to separate before discharge to a sanitary sewer.
- Use a two way valve for discharges from the containment pad. This valve should be normally switched to direct water to treatment, but may be switched to the drainage system after that pad is clean to handle stormwater runoff. The stormwater can then drain into the conveyance/discharge system outside of the wash pad (essentially bypassing the sanitary sewer or recycle system). Post signs to inform people of the operation and purpose of the valve. Clean the concrete pad thoroughly until there is no foam or visible sheen in the washwater prior to closing the inlet valve and allowing uncontaminated stormwater to overflow and drain off the pad.

  Note that the purpose of the valve is to convey only washwater and contaminated stormwater to a treatment system.
- Collect the washwater from building structures and convey it to appropriate treatment such as a sanitary sewer system if it contains oils, soaps, or detergents. If the washwater does not contain oils, soaps, or detergents (in this case only a low pressure, clean, cold water rinse is allowed) then it could drain to soils that have sufficient natural attenuation capacity for dust and sediment.
- Sweep surfaces prior to cleaning/washing to remove excess sediment and other pollutants.
- If roof equipment or hood vents are cleaned, ensure that no washwater or process water is discharged to the roof drains or drainage systems.
- Label all mobile cleaning equipment as follows: "Properly dispose of all wastewater. Do not discharge to an inlet/catch basin, ditch, stream, or on the ground."

Recommended Additional BMPs:

- Mark the wash area at gas stations, multifamily residences and any other business where non-employees wash vehicles.

- Operators may use a manually operated positive control valve for uncovered wash pads, but a pneumatic or electric valve system is preferable. The valve may be on a timer circuit and opened upon completion of a wash cycle. After draining the sump or separator, the timer would then close the valve.
- Minimize the use of water and detergents in washing operations when practicable.
- Use phosphate-free biodegradable detergents when practicable.
- Use the least hazardous cleaning products available.
- Consider recycling the washwater.

Operators may use soluble/emulsifiable detergents in the wash medium and should use it with care and the appropriate treatment. Carefully consider the selection of soaps and detergents and treatment BMPs. Oil/water separators are ineffective in removing emulsified or water soluble detergents. Another treatment appropriate for emulsified and water soluble detergents may be required.

Exceptions:

- At gas stations (for charity car washes) or commercial parking lots, where it is not possible to discharge the washwater to a sanitary sewer, a temporary plug or a temporary sump pump can be used at the storm drain to collect the washwater for off-site disposal such as to a nearby sanitary sewer.
- New and used car dealerships may wash vehicles in the parking stalls as long as employees use a temporary plug system to collect the washwater for disposal as stated above, or an approved treatment system for the washwater is in place.

At industrial sites, contact Ecology for NPDES Permit requirements even when not using soaps, detergents, and/or other chemical cleaners in washing trucks.

~~S434 BMPs for Dock Washing~~

~~**Description of Pollutant Sources:** Washing docks (or wharves, piers, floats, and boat ramps) can result in the discharge dirt, bird feces, soaps, and detergents that can be toxic to aquatic life, especially after they take on contaminants while cleaning. The BMPs in this section do not address dry docks, graving docks, or marine railway cleaning operations.~~

~~**Pollutant Control Approach:** Use dry methods and equipment (scraping, sweeping, vacuuming) to remove debris and contaminants prior to cleaning with water to prevent these substances from entering surface water.~~

~~Applicable Operational BMPs:~~

~~**Surface Preparation and Spot Cleaning**~~

- ~~Scoop and collect debris and bird feces.~~
- ~~Sweep, capture, and dispose of debris from the dock as solid waste. Sweep or vacuum docks to minimize the need for chemical cleaners.~~

APPENDIX

8.8 OPERATIONS AND MAINTENANCE

Table V-A.5: Maintenance Standards - Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No Trash or debris located immediately in front of catch basin or on grate opening. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin). Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Top slab is free of holes and cracks. Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound. Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Basin replaced or repaired to design standards. Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Contamination and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Cover/grate is in place, meets design standards, and is secured
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place, meets the design standards, and is installed and aligned with the flow path.

Table V-A.19: Maintenance Standards - Media Filter Drain (MFD) (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
	zone/flow spreader		
	Poor vegetation coverage	Grass is sparse or bare, or eroded patches are observed in more than 10% of the grass strip surface area.	Determine why grass growth is poor and correct the offending condition. Reseed into loosened, fertile soil or compost; or, replant with plugs of grass from the upper slope.
	Vegetation	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Mow vegetation or remove nuisance vegetation to not impede flow. Mow grass to a height of 6 inches.
	Media filter drain mix replacement	Water is seen on the surface of the media filter drain mix long after the storms have ceased. Typically, the 6-month, 24-hour precipitation event should drain within 48 hours. More common storms should drain within 24 hours. Maintenance also needed on a 10-year cycle and during a preservation project.	Excavate and replace all of the media filter drain mix contained within the media filter drain.
	Excessive shading	Grass growth is poor because sunlight does not reach embankment.	If possible, trim back overhanging limbs and remove brushy vegetation on adjacent slopes.
	Trash and debris	Trash and debris have accumulated on embankment.	Remove trash and debris from embankment.
	Flooding of Media filter drain	When media filter drain is inundated by flood water	Evaluate media filter drain material for acceptable infiltration rate and replace if media filter drain does not meet long-term infiltration rate standards.

Table V-A.20: Maintenance Standards - Compost Amended Vegetated Filter Strip (CAVFS)

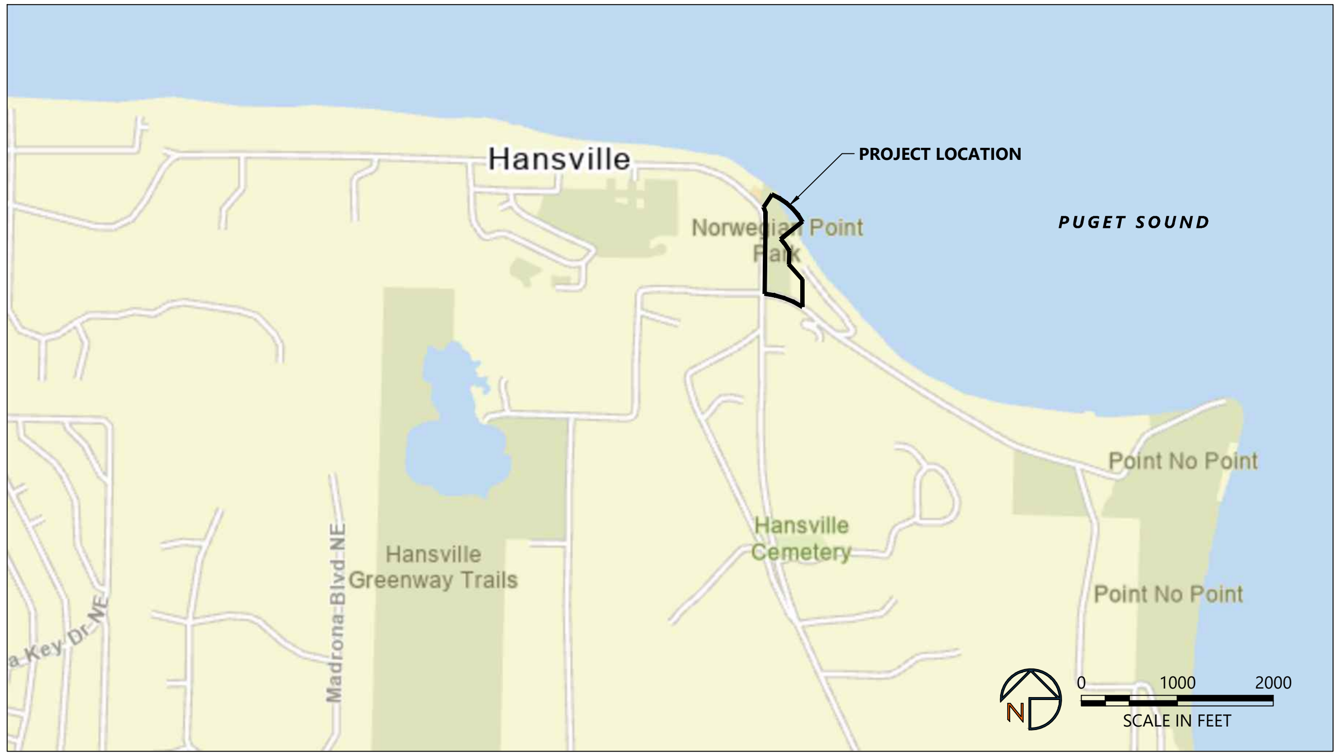
Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation on grass	Sediment depth exceeds 2 inches.	Remove sediment deposits. Relevel so slope is even and flows pass evenly through strip.
	Vegetation	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Mow grass and control nuisance vegetation so that flow is not impeded. Grass should be mowed to a height of 6 inches.
	Trash and debris	Trash and debris have accumulated on the vegetated filter strip.	Remove trash and debris from filter.
	Erosion/scouring	Areas have eroded or scoured due to flow channelization or high flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with a 50/50 mixture of crushed gravel and compost. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the vegetated filter strip should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident.
	Flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width

Attachment D

100% Design Drawings

100% DESIGN SUBMITTAL
FINN CREEK RESTORATION

WILD FISH CONSERVANCY



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ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "ORANGE" 🟧

Z:\Wildfish_Conservancy_2303\2303_2101_FinnCreek\Plan\PL-01-Cover and Notes.dwg 1 G-01

May 29, 2024 10:53am jennifer

BLUE COAST
ENGINEERING

Wild Fish
Conservancy
NORTHWEST

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J.COTE/G.CURTISS
DRAWN BY: G.CURTISS/E.PIPKIN
CHECKED BY: K.LIST
APPROVED BY: J.COTE
SCALE: AS NOTED
DATE: FEBRUARY 2024

FINN CREEK RESTORATION
100% DESIGN - NOT FOR CONSTRUCTION

TITLE SHEET

G-01

SHEET # **1** OF **32**

GENERAL CONSTRUCTION NOTES:

1. CONTRACTOR SHALL FURNISH ALL MATERIALS, EQUIPMENT, AND LABOR NECESSARY TO COMPLETE ALL WORK AS INDICATED ON THE DRAWINGS AND IN THE SPECIFICATIONS.
2. CONTRACTOR SHALL NOT DEVIATE FROM THE DRAWINGS AND SPECIFICATIONS WITHOUT RECEIVING PRIOR WRITTEN APPROVAL FROM THE OWNER'S REPRESENTATIVE.
3. DISCREPANCIES BETWEEN THE DRAWINGS AND THE SPECIFICATIONS SHALL BE BROUGHT TO THE ATTENTION OF THE OWNER'S REPRESENTATIVE PRIOR TO PROCEEDING WITH THE WORK.
4. THE CONTRACTOR SHALL RECEIVE, IN WRITING, AUTHORIZATION TO PROCEED BEFORE STARTING WORK ON ANY ITEM NOT CLEARLY DEFINED OR IDENTIFIED BY THE CONTRACT DOCUMENTS.
5. THE CONTRACTOR SHALL PLACE AND INSTALL ALL EQUIPMENT AND MATERIALS IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS UNLESS SPECIFICALLY INDICATED OTHERWISE BY THE OWNER'S REPRESENTATIVE OR WHERE LOCAL CODE OR REGULATIONS TAKE PRECEDENCE.
6. CONTRACTOR SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT INCLUDING SAFETY OF ALL PERSONS AND PROPERTY. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS.
7. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ALL CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES, AND PROCEDURES AND FOR COORDINATING ALL PORTIONS OF THE WORK TO MEET THE CONTRACTOR'S CONSTRUCTION SCHEDULE AS REQUIRED BY THE SPECIFICATIONS.
8. CONTRACTOR SHALL KEEP JOB SITE AREA CLEAN AND HAZARD-FREE. CONTRACTOR SHALL DISPOSE OF ALL DIRT, DEBRIS, AND RUBBISH FOR DURATION OF THE WORK. UPON COMPLETION OF WORK, CONTRACTOR SHALL REMOVE ALL MATERIAL AND EQUIPMENT NOT SPECIFIED AS REMAINING ON THE PROPERTY.
9. NOTES AND DETAILS ON THE DRAWINGS SHALL TAKE PRECEDENCE OVER GENERAL NOTES HEREON AND OVER THE SPECIFICATIONS WHERE A CONFLICT EXISTS.
10. DIMENSION CALLOUTS SHALL TAKE PRECEDENCE OVER SCALES SHOWN ON THE CONTRACT PLANS.

PERMIT AND REGULATORY REQUIREMENTS:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SATISFYING ALL APPLICABLE PERMIT REQUIREMENTS AND FOLLOWING ALL APPLICABLE ORDINANCES PER THE SPECIFICATIONS.
2. THE CONSTRUCTION PERMITS SHALL BE FURNISHED BY THE OWNER TO THE CONTRACTOR PRIOR TO COMMENCEMENT OF CONSTRUCTION.
3. THE CONTRACTOR SHALL REVIEW ALL PERMIT REQUIREMENTS AND NOTIFY THE OWNER OR OWNER'S REPRESENTATIVE OF ANY DISCREPANCIES BETWEEN THE DRAWINGS, SPECIFICATIONS, AND PERMIT REQUIREMENTS OR REGULATIONS.
4. ALL WORK SHALL SATISFY CONDITIONS AND REQUIREMENTS OF LOCAL, STATE, AND FEDERAL PERMITS, AS APPLICABLE. IN CASES WHERE CONDITIONS AND/OR REQUIREMENTS VARY FROM PERMIT TO PERMIT, THE MOST STRINGENT CONDITION AND/OR REQUIREMENT OR ORDINANCE GOVERNS THE PROJECT.

WORK RESTRICTIONS:

1. ALL WORK SHALL BE CONDUCTED WITHIN THE WORK AREA LIMITS AS SHOWN ON THE DRAWINGS INCLUDING CONTRACTOR OPERATION OF VEHICLES AND MACHINERY EXCEPT FOR ACCESS TO THE SITE ON PUBLIC ROADWAYS OR OFF-SITE STAGING AND STOCKPILING ACTIVITIES PER THE SPECIFICATIONS.
2. ALL WORK SHALL BE COMPLETED IN THE DRY, NO IN-WATER WORK SHALL BE CONDUCTED AS PART OF THIS WORK PER THE SPECIFICATIONS.
3. WORK AT OR BELOW THE OHWM ELEVATION SHALL BE COMPLETED ONLY BETWEEN JULY 2 AND MARCH 2.
4. CONTRACTOR SHALL NOT EXCAVATE OR DISTURB EXISTING SITE SEDIMENTS, MATERIALS, OR VEGETATION OUTSIDE OF THE HORIZONTAL AND VERTICAL EXTENTS INDICATED ON THE DRAWINGS.
5. THE AREAS WITHIN OR OUTSIDE OF THE WORK AREA LIMITS DISTURBED BY THE CONTRACTOR SHALL BE RESTORED TO PRE-CONSTRUCTION CONDITIONS AT NO ADDITIONAL COST. DISTURBED AREAS WITHIN THE WORK AREA LIMITS SHALL BE RESTORED TO PRE-CONSTRUCTION CONDITIONS AT THE DIRECTION OF THE OWNER'S REPRESENTATIVE.

UTILITY NOTES:

1. CONTRACTOR SHALL CONDUCT A COMPREHENSIVE SUBSURFACE AND ABOVE-GROUND UTILITY LOCATE WITHIN THE WORK AREA LIMITS AND SHALL BE RESPONSIBLE FOR PROTECTING IN PLACE ALL EXISTING UTILITIES THAT ARE NOT TO BE REPLACED AS PART OF THE WORK.
2. DAMAGE OF KNOWN OR UNKNOWN UTILITIES BY THE CONTRACTOR SHALL BE REPAIRED OR REPLACED AT NO ADDITIONAL COST TO THE OWNER.
3. 3. UTILITY INFORMATION SHOWN ON THE DRAWINGS WAS PROVIDED BY THE OWNER.

SURVEY NOTE:

EXISTING CONDITIONS TOPOGRAPHY IS BASED ON FEBRUARY 14, 2008 SURVEY PERFORMED BY AES CONSULTANTS, INC, PUBLICLY AVAILABLE 2018 LIDAR DATASET, 2022 WFC SURVEY, AND JANUARY 2022 BCE SURVEY.

HORIZONTAL DATUM:

WASHINGTON COORDINATE
SYSTEM, NORTH ZONE, US SURVEY FEET, NAD83

VERTICAL DATUM:

NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), US SURVEY FEET

TIDAL ELEVATIONS (FEET, NAVD88):

ORDINARY HIGH WATER LINE (OHWL)	VARIES SEE SHEET C-01
HIGH TIDE LINE (HAT):	+10.2
MEAN HIGHER HIGH WATER (MHHW):	+8.7
MEAN HIGH WATER (MHW):	+7.8
MEAN TIDE LEVEL (MTL):	+4.4
MEAN LOW WATER (MLW):	+1.0 MEAN LOWER LOW WATER (MLLW): -1.8

DATA SOURCE: NOAA TIDAL STATION #9445526, HANSVILLE, WA AND #9445016, FOULWEATHER BLUFF, WA & NOAA VDATUM ONLINE DATUM CONVERSION TOOL

TO CONVERT NAVD88 ELEVATIONS TO MLLW DATUM, ADD 1.8 FT TO ELEVATION IN NAVD88.

MATERIAL QUANTITIES:

MATERIAL QUANTITIES: REFER TO BID FORM

ABBREVIATIONS:

BCE	BLUE COAST ENGINEERING
BMP	BEST MANAGEMENT PRACTICES
CY	CUBIC YARDS
DIA.	DIAMETER
DWG	DRAWING
EL	ELEVATION
EX	EXISTING
FEET	FT
FG	FINISHED GRADE
IE	INVERT ELEVATION
L	LENGTH
LF	LINEAR FEET
LOC	LOCATION
MAX	MAXIMUM
MIN	MINIMUM
MHHW	MEAN HIGHER HIGH WATER
MLLW	MEAN LOWER LOW WATER
NAVD	NORTH AMERICAN VERTICAL DATUM
NTS	NOT TO SCALE
OHWM	ORDINARY HIGH WATER MARK
PP	POWER POLE
P.E.	PROFESSIONAL ENGINEER
R	RADIUS
ROW	RIGHT-OF-WAY
SD	STORM DRAIN
SS	SANITARY SEWER
STA	STATION
TESC	TEMPORARY EROSION AND SEDIMENT CONTROL
TYP	TYPICAL
W/	WITH
WFC	WILD FISH CONSERVANCY
WSDOT	WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
WSEL	WATER SURFACE ELEVATION

ONE INCH
AT FULL SIZE, IF NOT ONE
INCH SCALE ACCORDINGLY

PLAN INTENDED TO BE VIEWED
IN COLOR, ADJACENT BLOCK IS
"ORANGE" 🟧

BLUE COAST
ENGINEERING

Wild Fish
Conservancy
NORTHWEST

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J.COTE/G.CURTISS
DRAWN BY: G.CURTISS/E.PIPKIN
CHECKED BY: K.LIST
APPROVED BY: J.COTE
SCALE: AS NOTED
DATE: MARCH 2024

FINN CREEK RESTORATION
100% DESIGN - NOT FOR CONSTRUCTION

NOTES AND ABBREVIATIONS

G-02

SHEET # 2 OF 32

P:\Wildfish Conservancy_2303\2303_2101 Finn Creek\10_Design\CAD\Plan\PL-01-Cover and Notes.dwg 2 G-02

Mar 06, 2024 11:53am bluecoast

LEGEND:

- MAJOR CONTOUR (5' INTERVAL)
- MINOR CONTOUR (1' INTERVAL)
- OHWL ORDINARY HIGH WATER LINE
- HTL HIGH TIDE LINE
- MHHW MEAN HIGHER HIGH WATER
- STORM DRAIN CULVERT
- FENCE
- PARCEL BOUNDARY
- GUARD RAIL
- EDGE OF GRAVEL
- UNDERGROUND WATER
- UNDERGROUND CABLE
- UNDERGROUND FIBER OPTIC
- UNDERGROUND POWER
- OVERHEAD POWER
- OCM OVERHEAD COMMUNICATIONS
- ◉ ARCHAEOLOGICAL SITE (NOTE 6)
- MB MAIL BOX
- UTILITY POLE
- GUY POLE
- GUY ANCHOR
- PHONE PEDESTAL
- ELEC. BOX
- ELEC. METER
- Ⓒ COMMUNICATIONS MANHOLE
- drp U/G UTIL. DROP FROM POLE
- YARD LIGHT
- ROAD SIGN
- BOLLARD
- ⋈ WATER VALVE
- WATER METER
- FIRE HYDRANT
- ① PHOTO LOCATION POINT (NOTE 3)

NOTES:

1. CONTOURS ARE DEVELOPED FROM FEBRUARY 14, 2008 SURVEY PERFORMED BY AES CONSULTANTS, INC, PUBLICLY AVAILABLE 2018 LIDAR DATASET, 2022 WFC SURVEY, JANUARY 2022 BCE SURVEY, AND JULY 2023 KITSAP COUNTY SURVEY.
2. ELEVATIONS SHOWN ARE IN U.S. FEET, NAVD88 VERTICAL DATUM.
3. SEE SHEET C-02 FOR SITE PHOTOS. ARROW INDICATES DIRECTION OF PHOTO.
4. ALL UTILITY LOCATIONS ARE APPROXIMATE. CONTRACTOR SHALL LOCATE ALL UTILITIES WITHIN THE WORK AREA LIMITS PRIOR TO MOBILIZATION TO SITE AND SHALL PROTECT IN PLACE ALL UTILITIES. UTILITIES DAMAGED BY THE CONTRACTOR SHALL BE REPAIR OR REPLACED IN KIND AT NO ADDITIONAL COST TO THE OWNER. UNKNOWN UTILITIES MAY BE LOCATED WITHIN THE WORK AREA LIMITS THAT ARE NOT SHOWN.
5. ALL CONTOURS AND ELEVATIONS SHOWN ARE APPROXIMATE AND MAY HAVE CHANGED BETWEEN THE SURVEY AND THE START OF WORK. CONTRACTOR SHALL VERIFY EXISTING SITE CONDITIONS PRIOR TO THE START OF WORK. NO ADDITIONAL PAYMENT SHALL BE MADE DUE TO DISCREPANCIES BETWEEN THE ELEVATIONS SHOWN AND THE ELEVATIONS ON SITE AT THE START OF WORK.
6. ARCHAEOLOGICAL SITE 45KP158 IS LOCATED NEAR THE BEACH FISHING CABINS. MONITORING REQUIRED FOR ALL GROUND DISTURBING ACTIVITY WITHIN A 33' RADIUS (SHOWN ON DRAWING).
7. PARCEL DATA FROM KITSAP COUNTY GIS DEPARTMENT AND BOUNDARY SURVEY COMPLETED BY AGO LAND SURVEYING, LLC, DATED JUNE 17, 2022 .

0 50 100
SCALE IN FEET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "ORANGE" 🟧

\\BlueCoastNAS\Projects\Wildfish Conservancy_2303\2303_2101 Finn Creek\10_Design\CAD\Plan\PL-02-Existing Conditions.dwg 3 C-01

Mar 06, 2024 11:53am bluecoast

BLUE COAST ENGINEERING

Wild Fish Conservancy NORTHWEST

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J.COTE/G.CURTISS
DRAWN BY: G.CURTISS/E.PIPKIN
CHECKED BY: K.LIST
APPROVED BY: J.COTE
SCALE: AS NOTED
DATE: MARCH 2024

FINN CREEK RESTORATION
100% DESIGN - NOT FOR CONSTRUCTION

EXISTING CONDITIONS PLAN

C-01

SHEET # 3 OF 32

1 PARKING LOT & PUMPHOUSE
VIEW WEST

2 PARKING LOT & GAZEBO
VIEW NORTH

3 BEACH
VIEW NORTH

4 FINN CREEK & HANSVILLE RD

5 AERIAL VIEW NORTH

6 GRAVEL ROAD
VIEW SOUTH

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ONE INCH
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BLUE COAST
ENGINEERING

Wild Fish
Conservancy
NORTHWEST

JESSICA MAGEE COTE

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

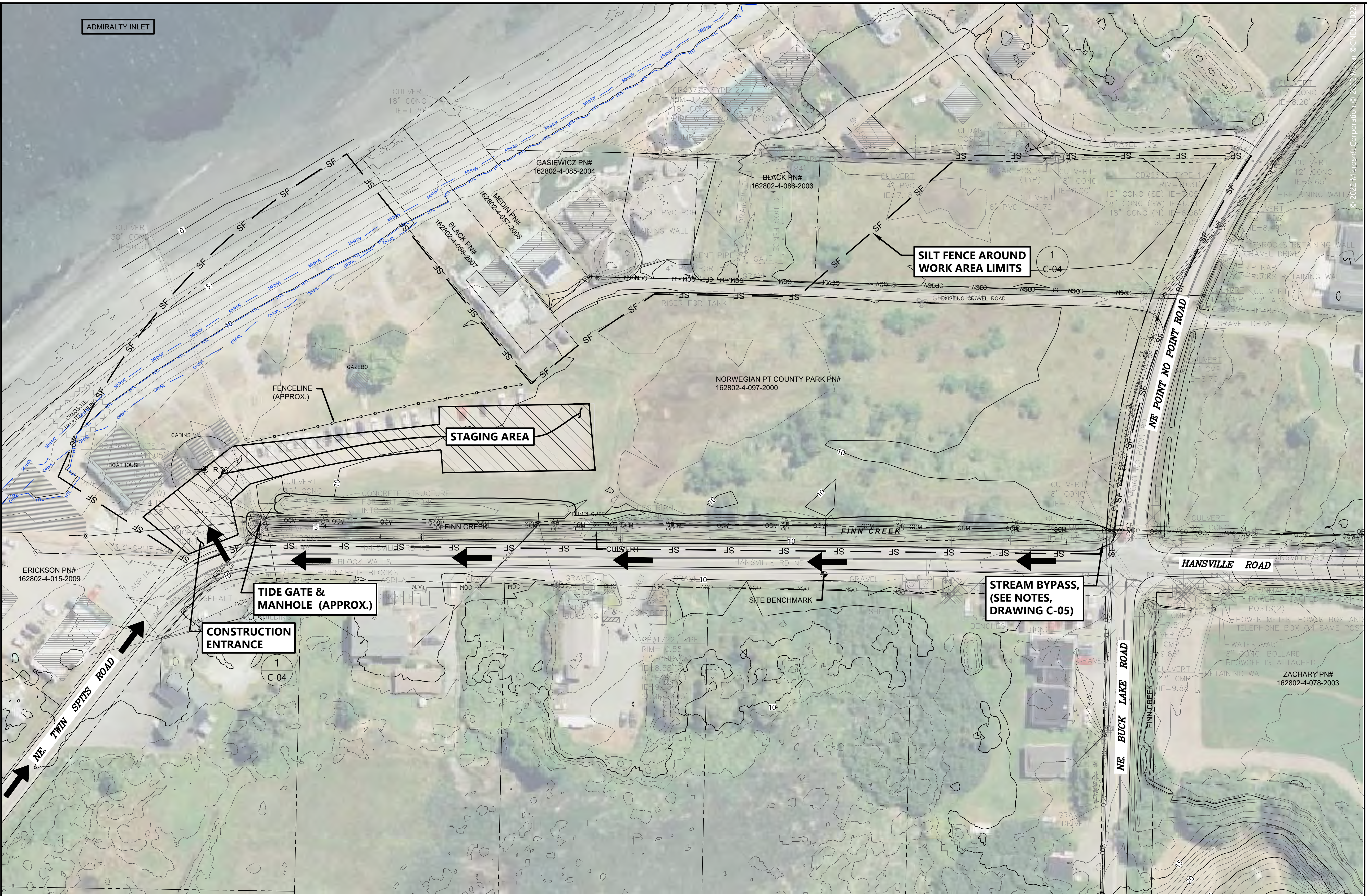
DESIGNED BY: J.COTE/G.CURTISS
DRAWN BY: G.CURTISS/E.PIPKIN
CHECKED BY: K.LIST
APPROVED BY: J.COTE
SCALE: AS NOTED
DATE: MARCH 2024

FINN CREEK RESTORATION
100% DESIGN - NOT FOR CONSTRUCTION

SITE PHOTOGRAPHS

C-02

SHEET # 4 OF 32



LEGEND:

🡐	ACCESS ROUTE
▨	STAGING AREA
SF	SILT FENCE
	MAJOR CONTOUR (5' INTERVAL)
	MINOR CONTOUR (1' INTERVAL)
OHWL	ORDINARY HIGH WATER LINE
HTL HTL	HIGH TIDE LINE
MHHW	MEAN HIGHER HIGH WATER
	STORM DRAIN CULVERT
x x x	FENCE
	PARCEL BOUNDARY
	GUARD RAIL
	EDGE OF GRAVEL
W	UNDERGROUND WATER
C	UNDERGROUND CABLE
FO	UNDERGROUND FIBER OPTIC
P	UNDERGROUND POWER
OP	OVERHEAD POWER
OCM OCM	OVERHEAD COMMUNICATIONS
MB	MAIL BOX
UP	UTILITY POLE
GP	GUY POLE
	GUY ANCHOR
T	PHONE PEDESTAL
E	ELEC. BOX
⊘	ELEC. METER
Ⓒ	COMMUNICATIONS MANHOLE
drp	U/G UTIL. DROP FROM POLE
	YARD LIGHT
	ROAD SIGN
Ⓑ	BOLLARD
⋈	WATER VALVE
W	WATER METER
	FIRE HYDRANT

NOTES:

1. CONTOURS ARE DEVELOPED FROM FEBRUARY 14, 2008 SURVEY PERFORMED BY AES CONSULTANTS, INC, PUBLICLY AVAILABLE 2018 LIDAR DATASET, 2022 WFC SURVEY, JANUARY 2022 BCE SURVEY, AND JULY 2023 KITSAP COUNTY SURVEY.
2. ELEVATIONS SHOWN ARE IN U.S. FEET, NAVD88 VERTICAL DATUM.

0 50 100
SCALE IN FEET

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PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "ORANGE" 🟧

BLUE COAST
ENGINEERING

Wild Fish Conservancy
NORTHWEST

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J.COTE/G.CURTISS
DRAWN BY: G.CURTISS/E.PIPKIN
CHECKED BY: K.LIST
APPROVED BY: J.COTE
SCALE: AS NOTED
DATE: MARCH 2024

FINN CREEK RESTORATION
100% DESIGN - NOT FOR CONSTRUCTION

ACCESS, STAGING, AND TESC

C-03

SHEET # 5 OF 32

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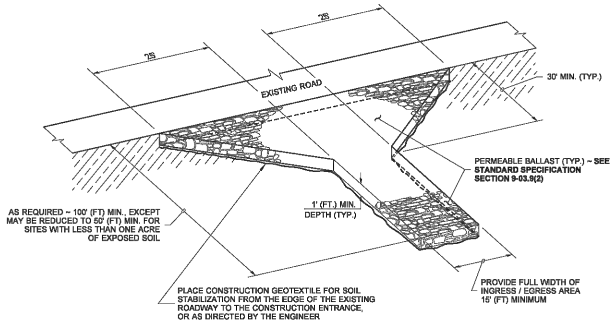


ISOMETRIC VIEW

STABILIZED CONSTRUCTION ENTRANCE

STABILIZED CONSTRUCTION ENTRANCE SHALL MEET THE REQUIREMENTS OF **STANDARD SPECIFICATION SECTION 8-01.3(7).**

STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT
Hartwig, Juli Jul 14 2016 2:06 PM
JULI DEE HARTWIG
LICENSE NO. 1422
DATE: 06-21-17

MISCELLANEOUS EROSION CONTROL DETAILS

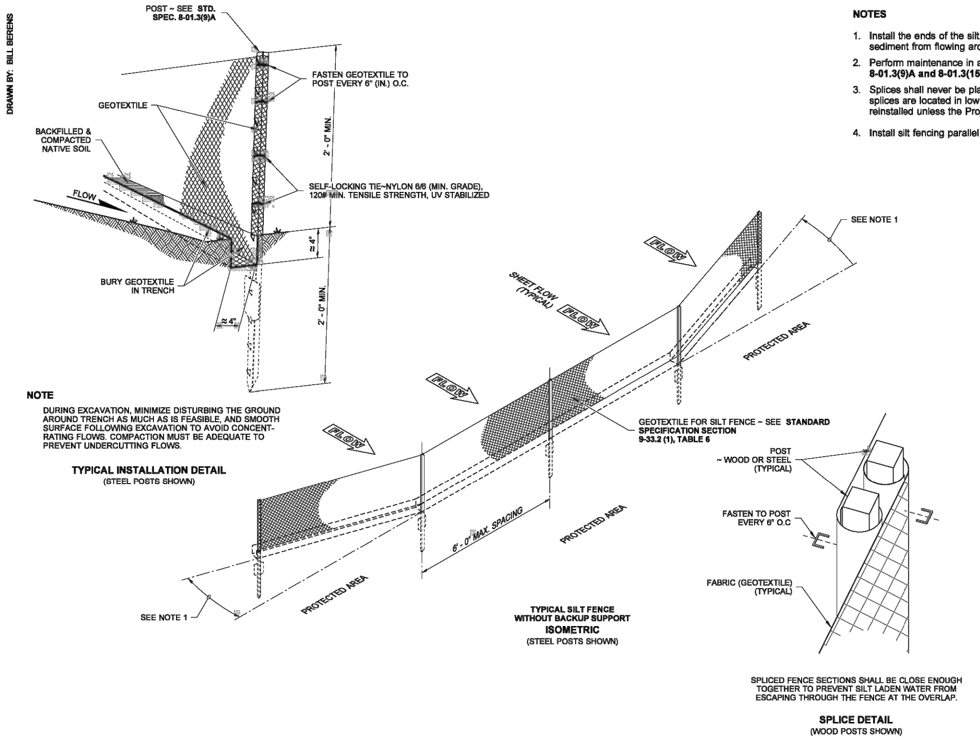
STANDARD PLAN I-80.10-02

SHEET 1 OF 1 SHEET

APPROVED FOR PUBLICATION
Carpenter, Jeff — Carpenter, Jeff Jul 15 2016 2:28 PM
STATE DESIGN ENGINEER
Washington State Department of Transportation

1 / C-03 DETAIL: CONSTRUCTION ENTRANCE
SCALE: N.T.S.

DRAWN BY: BILL BERENS



NOTE

DURING EXCAVATION, MINIMIZE DISTURBING THE GROUND AROUND TRENCH AS MUCH AS IS FEASIBLE, AND SMOOTH SURFACE FOLLOWING EXCAVATION TO AVOID CONCENTRATING FLOWS. COMPACTION MUST BE ADEQUATE TO PREVENT UNDERCUTTING FLOWS.

TYPICAL INSTALLATION DETAIL
(STEEL POSTS SHOWN)

TYPICAL SILT FENCE WITHOUT BACKUP SUPPORT
ISOMETRIC
(STEEL POSTS SHOWN)

SPLICED FENCE SECTIONS SHALL BE CLOSE ENOUGH TOGETHER TO PREVENT SILT LADEN WATER FROM ESCAPING THROUGH THE FENCE AT THE OVERLAP.

SPLICE DETAIL
(WOOD POSTS SHOWN)

NOTES

1. Install the ends of the silt fence to point slightly upslope to prevent sediment from flowing around the ends of the fence.
2. Perform maintenance in accordance with **Standard Specifications 8-01.3(9)A and 8-01.3(15)**.
3. Splices shall never be placed in low spots or sump locations. If splices are located in low or sump areas, the fence may need to be reinstalled unless the Project Engineer approves the installation.
4. Install silt fencing parallel to mapped contour lines.

STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT
SANDRA L. SALISBURY
CERTIFICATE NO. 000860

NOTE: THIS PLAN IS NOT A LEGAL ENGINEERING DOCUMENT BUT AN ELECTRONIC DUPLICATE. THE ORIGINAL, SIGNED BY THE ENGINEER AND APPROVED FOR PUBLICATION, IS KEPT ON FILE AT THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION. A COPY MAY BE OBTAINED UPON REQUEST.

SILT FENCE

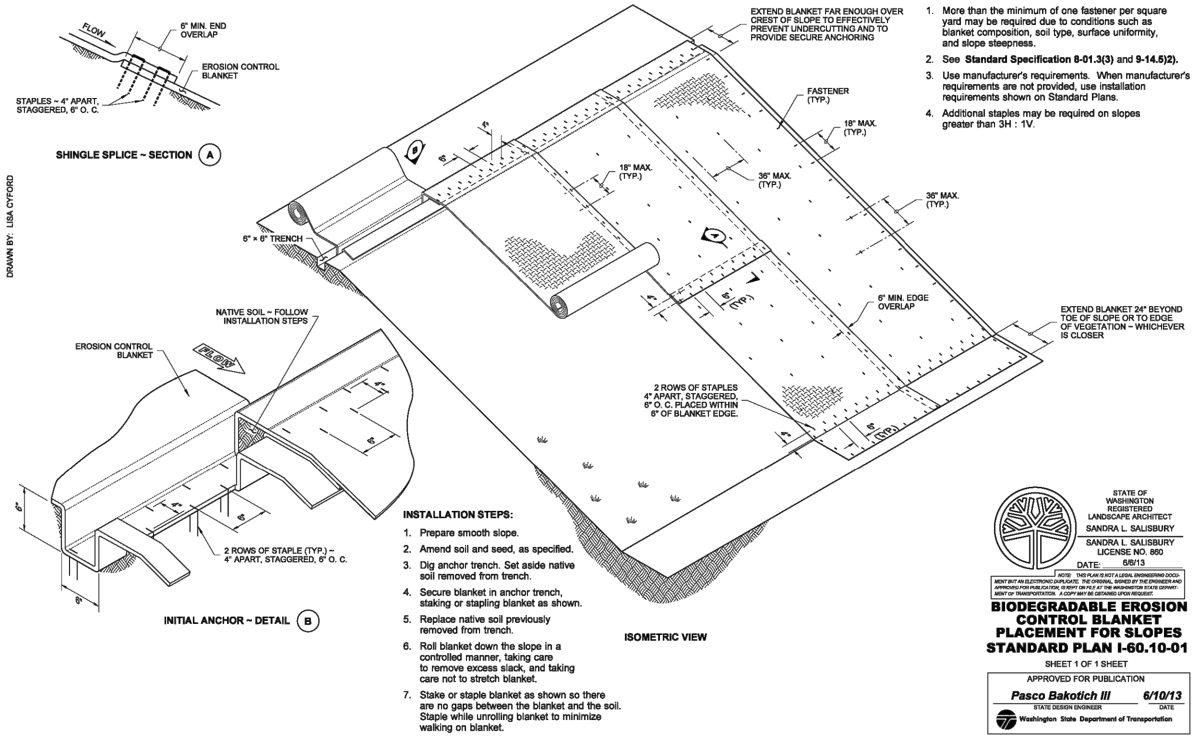
STANDARD PLAN I-30.15-02

SHEET 1 OF 1 SHEET

APPROVED FOR PUBLICATION
Pasco Bakotich III 3/22/13
STATE DESIGN ENGINEER DATE
Washington State Department of Transportation

2 / C-03 DETAIL: SILT FENCE
SCALE: N.T.S.

DRAWN BY: LISA CYFORD



NOTES

1. More than the minimum of one fastener per square yard may be required due to conditions such as blanket composition, soil type, surface uniformity, and slope steepness.
2. See **Standard Specification 8-01.3(3)** and **9-14.5)2).**
3. Use manufacturer's requirements. When manufacturer's requirements are not provided, use installation requirements shown on Standard Plans.
4. Additional staples may be required on slopes greater than 3H : 1V.

INSTALLATION STEPS:

1. Prepare smooth slope.
2. Amend soil and seed, as specified.
3. Dig anchor trench. Set aside native soil removed from trench.
4. Secure blanket in anchor trench, staking or stapling blanket as shown.
5. Replace native soil previously removed from trench.
6. Roll blanket down the slope in a controlled manner, taking care to remove excess slack, and taking care not to stretch blanket.
7. Stake or staple blanket as shown so there are no gaps between the blanket and the soil. Staple while unrolling blanket to minimize walking on blanket.

STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT
SANDRA L. SALISBURY
SANDRA L. SALISBURY
LICENSE NO. 860
DATE: 6/6/13

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BIODEGRADABLE EROSION CONTROL BLANKET PLACEMENT FOR SLOPES

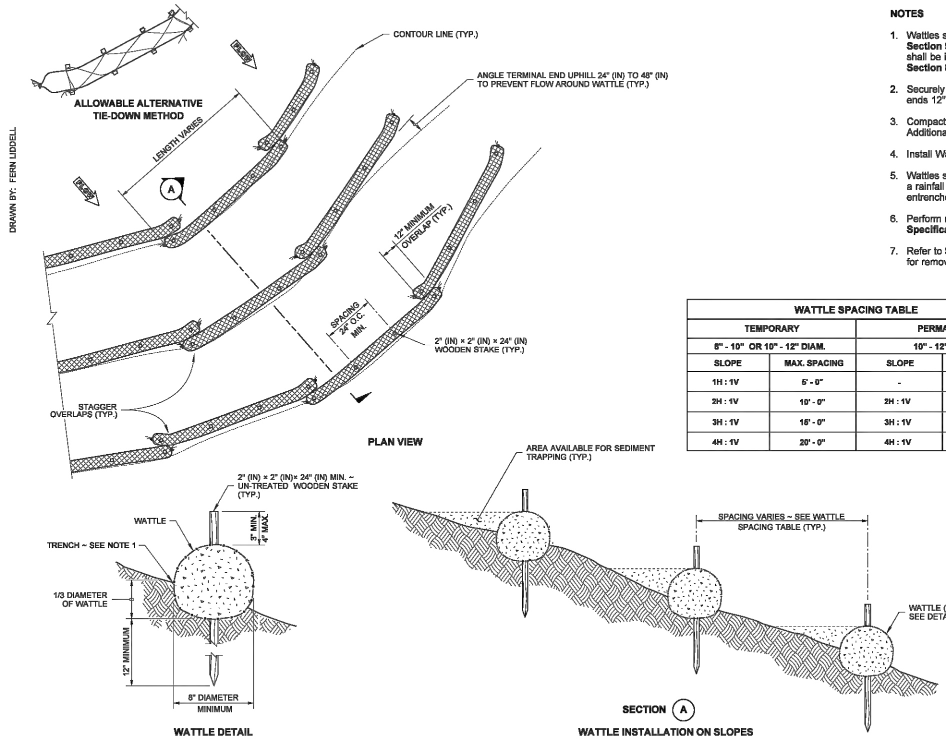
STANDARD PLAN I-60.10-01

SHEET 1 OF 1 SHEET

APPROVED FOR PUBLICATION
Pasco Bakotich III 6/10/13
STATE DESIGN ENGINEER DATE
Washington State Department of Transportation

3 / C-03 DETAIL: SLOPE EROSION PROTECTION
SCALE: N.T.S.

DRAWN BY: FERN LIDDELL



NOTES

1. Wattles shall be in accordance with **Standard Specification, Section 9-14.5(5).** Install Wattles along contours. Installation shall be in accordance with **Standard Specification, Section 8-01.3(10)**.
2. Securely knot each end of Wattle. Overlap adjacent Wattle ends 12" (in) behind one another and securely tie together.
3. Compact excavated soil and trenches to prevent undercutting. Additional staking may be necessary to prevent undercutting.
4. Install Wattle perpendicular to flow along contours.
5. Wattles shall be inspected regularly, and immediately after a rainfall produces runoff, to ensure they remain thoroughly entrenched and in contact with the soil.
6. Perform maintenance in accordance with **Standard Specification, Section 8-01.3(15).**
7. Refer to **Standard Specification, Section 8-01.3(16)** for removal.

WATTLE SPACING TABLE			
TEMPORARY		PERMANENT	
8" - 10" OR 10" - 12" DIAM.		10" - 12" DIAM.	
SLOPE	MAX. SPACING	SLOPE	MAX. SPACING
1H : 1V	5' - 0"	-	-
2H : 1V	10' - 0"	2H : 1V	5' - 0"
3H : 1V	15' - 0"	3H : 1V	10' - 0"
4H : 1V	20' - 0"	4H : 1V	15' - 0"

STATE OF WASHINGTON
JULI DEE HARTWIG
NO. 1422 EXP. 06/21/2021
LANDSCAPE ARCHITECT
Hartwig, Juli Jun 4 2019 8:05 AM

WATTLE INSTALLATION ON SLOPE

STANDARD PLAN I-30.30-02

SHEET 1 OF 1 SHEET

APPROVED FOR PUBLICATION
Roark, Steve Jun 12 2019 7:41 AM
STATE DESIGN ENGINEER
Washington State Department of Transportation

4 / C-03 DETAIL: WATTLE
SCALE: N.T.S.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "ORANGE" 🟧

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Mar 06, 2024 11:53am bluecoast

BLUE COAST ENGINEERING

Wild Fish Conservancy NORTHWEST

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J.COTE/G.CURTISS
DRAWN BY: G.CURTISS/E.PIPKIN
CHECKED BY: K.LIST
APPROVED BY: J.COTE
SCALE: AS NOTED
DATE: MARCH 2024

FINN CREEK RESTORATION
100% DESIGN - NOT FOR CONSTRUCTION

TESC DETAILS

C-04

SHEET # 6 OF 32

TESC NOTES:

1. CONTRACTOR TO VERIFY POTENTIAL STAGING AREAS ARE ADEQUATE.
2. CONTRACTOR MAY NOT CONDUCT WORK IN AREAS THAT ARE INUNDATED BY TIDAL WATERS, INCLUDING AREAS INUNDATED REPEATEDLY BY WAVES AND WAVE RUN-UP.
3. CONTRACTOR SHALL SUBMIT AS PART OF CONSTRUCTION WORK PLAN THE TEMPORARY EROSION AND SEDIMENTATION CONTROL (TESC) PLAN AND STREAM BYPASS PLAN WHICH MEETS REQUIREMENTS SHOWN HERE. TESC MEASURES INCLUDE BMPS SUCH AS BUT NOT LIMITED TO THE FOLLOWING: SILT FENCING, VEHICLE TRACK OUT PROTECTION, ABSORBANT WATTLES, STOCKPILE COVERS.
4. ALL UTILITY LOCATIONS ARE APPROXIMATE. CONTRACTOR SHALL LOCATE ALL UTILITIES WITHIN THE WORK AREA LIMITS PRIOR TO MOBILIZATION TO SITE AND SHALL PROTECT IN PLACE ALL UTILITIES. UTILITIES DAMAGED BY THE CONTRACTOR SHALL BE REPAIR OR REPLACED IN KIND AT NO ADDITIONAL COST TO THE OWNER. UNKNOWN UTILITIES MAY BE LOCATED WITHIN THE WORK AREA LIMITS THAT ARE NOT SHOWN.
5. ALL CONTRACTOR EQUIPMENT, VEHICLES, MATERIALS, TRAVEL, AND WORK MUST REMAIN WITHIN THE WORK AREA LIMITS.
6. TESC SHALL BE REQUIRED IF SEDIMENT OR SEDIMENT LADEN WATERS ARE OBSERVED LEAVING THEIR IN-SITU LOCATION. CONTRACTOR SHALL INSTALL TESC BASED ON THE OBSERVED SITE CONDITIONS AT THE DIRECTION OF THE OWNER'S REPRESENTATIVE. SEE SHEET C-04 FOR EXAMPLE TESC DETAILS, IF REQUIRED BY THE OWNER'S REPRESENTATIVE. ADDITIONAL TESC BMPS MAY BE REQUIRED THAT ARE NOT SHOWN ON SHEET C-04 BASED ON THE CONTRACTOR'S MEANS AND METHODS.

FISH EXCLUSION & STREAM DIVERSION NOTES:

1. ISOLATE FISH FROM THE WORK AREA BY USING EITHER A TOTAL OR PARTIAL BYPASS TO REROUTE THE STREAM THROUGH A TEMPORARY CHANNEL OR PIPE.
2. THE CONTRACTOR SHALL SEQUENCE THE WORK TO MINIMIZE THE DURATION OF DEWATERING.
3. THE CONTRACTOR SHALL USE THE LEAST-IMPACTING FEASIBLE METHOD TO TEMPORARILY BYPASS WATER FROM THE WORK AREA. CONSIDER THE PHYSICAL CHARACTERISTICS OF THE SITE AND THE ANTICIPATED VOLUME OF WATER FLOWING THROUGH THE WORK AREA.
4. THE HYDRAULIC CAPACITY OF THE STREAM BYPASS MUST BE EQUAL TO OR GREATER THAN THE PEAK FLOW EVENT EXPECTED WHEN THE BYPASS WILL BE OPERATED.
5. THE CONTRACTOR SHALL DESIGN THE TEMPORARY BYPASS TO MINIMIZE THE LENGTH OF THE DEWATERED STREAM CHANNEL.
6. DURING ALL PHASES OF BYPASS INSTALLATION AND DECOMMISSIONING, THE CONTRACTOR SHALL MAINTAIN FLOWS DOWNSTREAM OF THE PROJECT SITE TO ENSURE SURVIVAL OF ALL DOWNSTREAM FISH.
7. THE CONTRACTOR SHALL INSTALL A COFFERDAM OR SIMILAR DEVICE AT THE UPSTREAM AND DOWNSTREAM END OF THE BYPASS TO PREVENT BACKWATER FROM ENTERING THE WORK AREA.
8. THE CONTRACTOR SHALL RETURN DIVERTED WATER TO THE CHANNEL IMMEDIATELY DOWNSTREAM OF THE WORK AREA. DISSIPATE FLOW ENERGY FROM THE DIVERSION TO PREVENT SCOUR OR EROSION OF THE CHANNEL AND BANK.
9. IF THE DIVERSION INLET IS A GRAVITY DIVERSION THAT PROVIDES FISH PASSAGE, PLACE THE DIVERSION OUTLET WHERE IT FACILITATES GRADUAL AND SAFE REENTRY OF FISH INTO THE STREAM CHANNEL.
10. IF THE BYPASS IS A PUMPED DIVERSION, ONCE STARTED IT MUST RUN CONTINUOUSLY UNTIL IT IS NO LONGER NECESSARY TO BYPASS FLOWS. THIS REQUIRES BACK-UP PUMPS ON-SITE AND TWENTY-FOUR-HOUR MONITORING FOR OVERNIGHT OPERATION.
11. IF THE DIVERSION INLET IS A PUMP DIVERSION IN A FISH-BEARING STREAM, THE PUMP INTAKE STRUCTURE MUST HAVE A FISH SCREEN INSTALLED, OPERATED, AND MAINTAINED IN ACCORDANCE WITH RCW 77.57.010 AND 77.57.070. SCREEN THE PUMP INTAKE WITH ONE OF THE FOLLOWING:
    a. PERFORATED PLATE: 0.094 INCH (MAXIMUM OPENING DIAMETER);
    b. PROFILE BAR: 0.069 INCH (MAXIMUM WIDTH OPENING); OR
    c. WOVEN WIRE: 0.087 INCH (MAXIMUM OPENING IN THE NARROW DIRECTION).

    THE MINIMUM OPEN AREA FOR ALL TYPES OF FISH SCREENS IS TWENTY-SEVEN PERCENT. THE SCREENED INTAKE FACILITY MUST HAVE ENOUGH SURFACE AREA TO ENSURE THAT THE VELOCITY THROUGH THE SCREEN IS LESS THAN 0.4 FEET PER SECOND. MAINTAIN FISH SCREENS TO PREVENT INJURY OR ENTRAPMENT OF FISH.
12. THE FISH SCREEN MUST REMAIN IN PLACE WHENEVER WATER IS WITHDRAWN FROM THE STREAM THROUGH THE PUMP INTAKE.
13. THE CONTRACTOR SHALL REMOVE FISH SCREENS ON DEWATERING PUMPS IN THE ISOLATED WORK AREA ONLY AFTER ALL FISH ARE SAFE AND EXCLUDED FROM THE WORK AREA.
14. THE CONTRACTOR SHALL ISOLATE PUMP HOSE INTAKES WITH BLOCK NETS SO THAT FISH CANNOT GET NEAR THE INTAKE.
15. DIVERT STREAM AT HANSVILLE RD 36" CULVERT (HANSVILLE RD AND NE BUCK LAKE RD) THROUGH TEMPORARY BYPASS PIPE TO PUGET SOUND. INSTALL TEMPORARY FISH BLOCK NETS PRIOR TO COFFER DAM / BYPASS PIPE INSTALLATION. INSTALL ENERGY DISSIPATION PAD AT DOWNSTREAM BYPASS TO REDUCE SCOUR ON BEACH.

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Mar 06, 2024 11:53am bluecoast

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "ORANGE" 🟧

BLUE COAST ENGINEERING

Wild Fish Conservancy NORTHWEST

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J.COTE/G.CURTISS
DRAWN BY: G.CURTISS/E.PIPKIN
CHECKED BY: K.LIST
APPROVED BY: J.COTE
SCALE: AS NOTED
DATE: MARCH 2024

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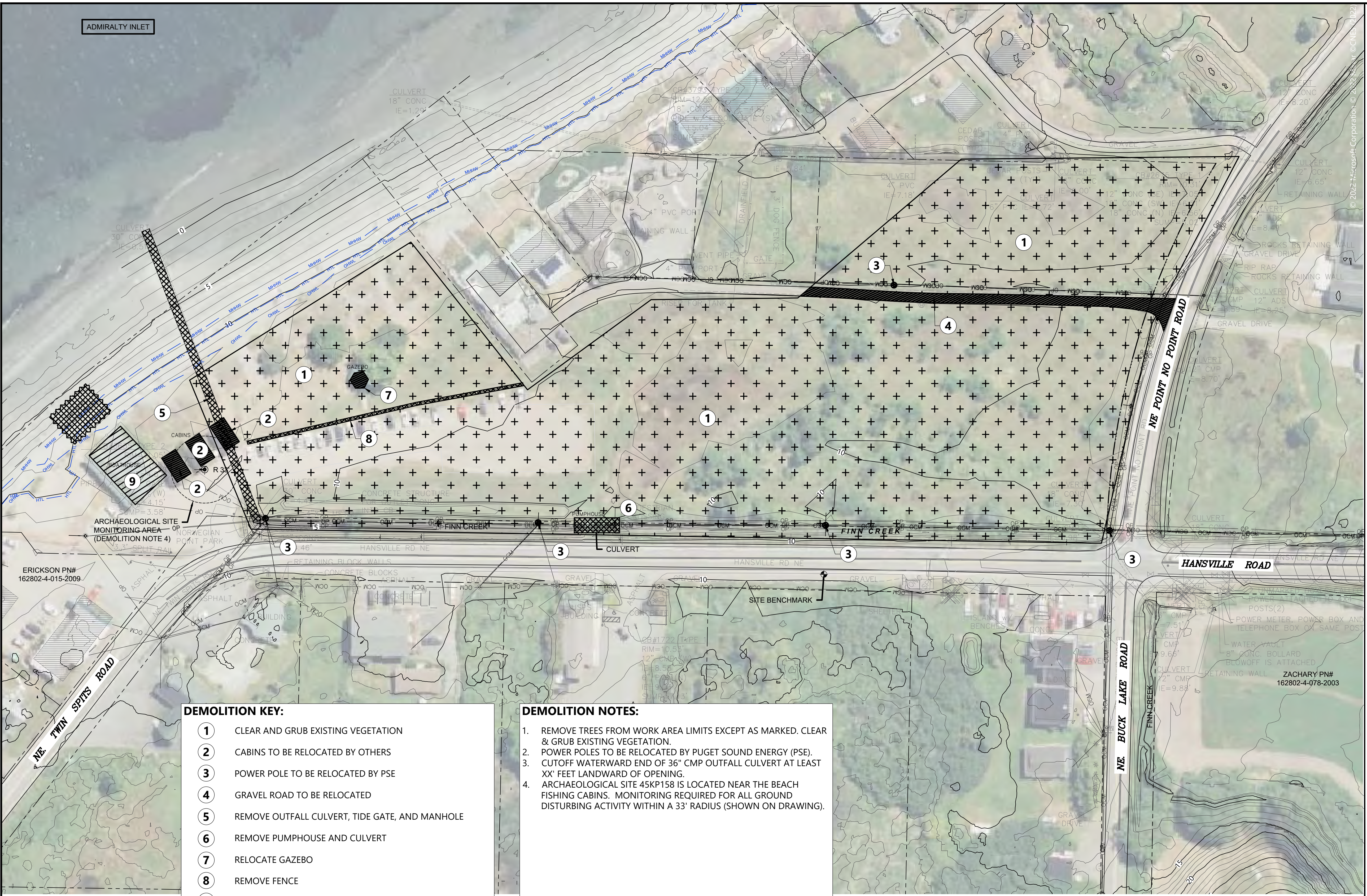
TESC AND FISH EXCLUSION & STREAM DIVERSION NOTES

C-05

SHEET # 7 OF 32



DEMOLITION KEY:

① CLEAR AND GRUB EXISTING VEGETATION
② CABINS TO BE RELOCATED BY OTHERS
③ POWER POLE TO BE RELOCATED BY PSE
④ GRAVEL ROAD TO BE RELOCATED
⑤ REMOVE OUTFALL CULVERT, TIDE GATE, AND MANHOLE
⑥ REMOVE PUMPHOUSE AND CULVERT
⑦ RELOCATE GAZEBO
⑧ REMOVE FENCE
⑨ PROTECT IN PLACE - BOATHOUSE

DEMOLITION NOTES:

1. REMOVE TREES FROM WORK AREA LIMITS EXCEPT AS MARKED. CLEAR & GRUB EXISTING VEGETATION.
2. POWER POLES TO BE RELOCATED BY PUGET SOUND ENERGY (PSE).
3. CUTOFF WATERWARD END OF 36" CMP OUTFALL CULVERT AT LEAST XX' FEET LANDWARD OF OPENING.
4. ARCHAEOLOGICAL SITE 45KP158 IS LOCATED NEAR THE BEACH FISHING CABINS. MONITORING REQUIRED FOR ALL GROUND DISTURBING ACTIVITY WITHIN A 33' RADIUS (SHOWN ON DRAWING).

LEGEND:

▩ FEATURE TO BE REMOVED
■ FEATURE TO BE RELOCATED
▨ FEAUTURE TO PROTECT IN PLACE
+ + + CLEAR AND GRUB VEGETATION
◉ ARCHAEOLOGICAL SITE (DEMOLITION NOTE 4)

MAJOR CONTOUR (5' INTERVAL)
MINOR CONTOUR (1' INTERVAL)
OHWL ORDINARY HIGH WATER LINE
HTL HIGH TIDE LINE
MHHW MEAN HIGHER HIGH WATER
STORM DRAIN CULVERT
x FENCE
PARCEL BOUNDARY
GUARD RAIL
EDGE OF GRAVEL
W UNDERGROUND WATER
C UNDERGROUND CABLE
FO UNDERGROUND FIBER OPTIC
P UNDERGROUND POWER
OP OVERHEAD POWER
OCM OVERHEAD COMMUNICATIONS
MB MAIL BOX
UP UTILITY POLE
GP GUY POLE
GUY ANCHOR
T PHONE PEDESTAL
E ELEC. BOX
ELEC. METER
Ⓒ COMMUNICATIONS MANHOLE
drp U/G UTIL. DROP FROM POLE
YARD LIGHT
ROAD SIGN
Ⓑ BOLLARD
⋈ WATER VALVE
W WATER METER
FIRE HYDRANT

NOTES:

1. CONTOURS ARE DEVELOPED FROM FEBRUARY 14, 2008 SURVEY PERFORMED BY AES CONSULTANTS, INC, PUBLICLY AVAILABLE 2018 LIDAR DATASET, 2022 WFC SURVEY, JANUARY 2022 BCE SURVEY, AND JULY 2023 KITSAP COUNTY SURVEY.
2. ELEVATIONS SHOWN ARE IN U.S. FEET, NAVD88 VERTICAL DATUM.

0 50 100
SCALE IN FEET

ONE INCH
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BLUE COAST ENGINEERING

Wild Fish Conservancy NORTHWEST

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DEMOLITION PLAN

C-06

SHEET # 8 OF 32

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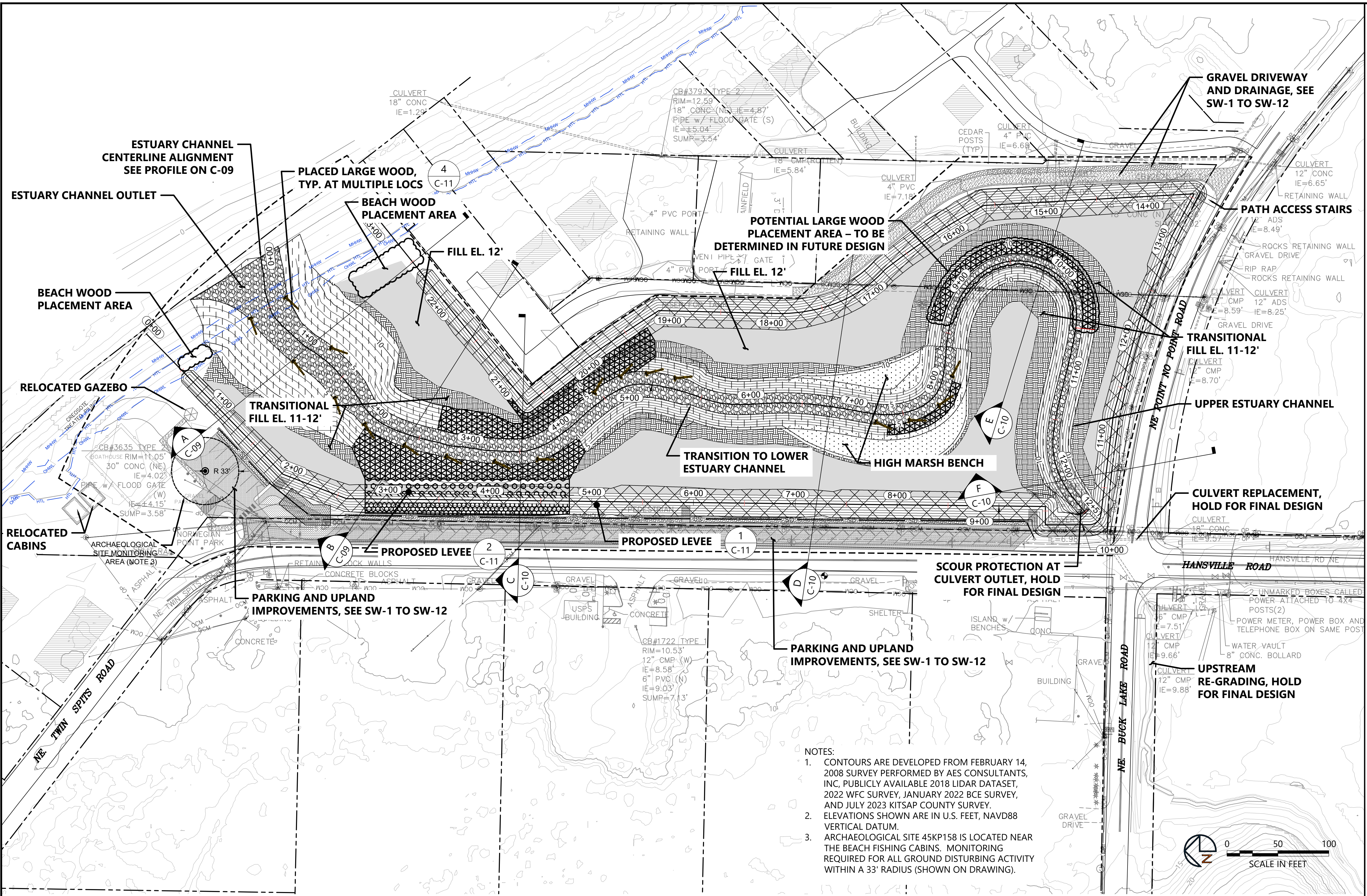

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2. ELEVATIONS SHOWN ARE IN U.S. FEET, NAVD88 VERTICAL DATUM.
3. ARCHAEOLOGICAL SITE 45KP158 IS LOCATED NEAR THE BEACH FISHING CABINS. MONITORING REQUIRED FOR ALL GROUND DISTURBING ACTIVITY WITHIN A 33' RADIUS (SHOWN ON DRAWING).

LEGEND:

- PROPOSED MAJOR CONTOUR (5' INTERVAL)
- PROPOSED MINOR CONTOUR (1' INTERVAL)
- EXISTING MAJOR CONTOUR (5' INTERVAL)
- EXISTING MINOR CONTOUR (1' INTERVAL)
- ARCHEOLOGICAL SITE (NOTE 3)
- SD — PROPOSED STORM DRAIN LINE
- OHWL — ORDINARY HIGH WATER LINE
- HTL — HIGH TIDE LINE
- MHHW — MEAN HIGHER HIGH WATER
- STORM DRAIN CULVERT
- PARCEL BOUNDARY
- FENCE
- GUARD RAIL
- EDGE OF GRAVEL
- UNDERGROUND WATER
- UNDERGROUND CABLE
- UNDERGROUND FIBER OPTIC
- UNDERGROUND POWER
- OVERHEAD POWER
- OVERHEAD COMMUNICATIONS
- MAIL BOX
- UTILITY POLE
- GUY POLE
- GUY ANCHOR
- PHONE PEDESTAL
- ELEC. BOX
- ELEC. METER
- COMMUNICATIONS MANHOLE
- drp U/G UTIL. DROP FROM POLE
- YARD LIGHT
- ROAD SIGN
- BOLLARD
- WATER VALVE
- WATER METER
- FIRE HYDRANT

MATERIALS LEGEND:

- SAND AND STREAMBED SEDIMENT
- CHANNEL AND ESTUARY
- FILL AREA, EL. +12' NAVD88
- LEVEE FOOTPRINT
- HIGH MARSH BENCH
- ARMORING
- COBBLE
- QUARRY SPALL
- TRANSITIONAL FILL AREA
- LARGE WOOD AREA
- LARGE WOOD PLACMENT (CHANNEL)

MATERIAL NOTE:
FOR MATERIAL TYPES, THICKNESS, AND DETAILS, REFER TO LANDSCAPE DRAWINGS, L-01 TO L-04.1.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "ORANGE" 🟧

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FINN CREEK RESTORATION
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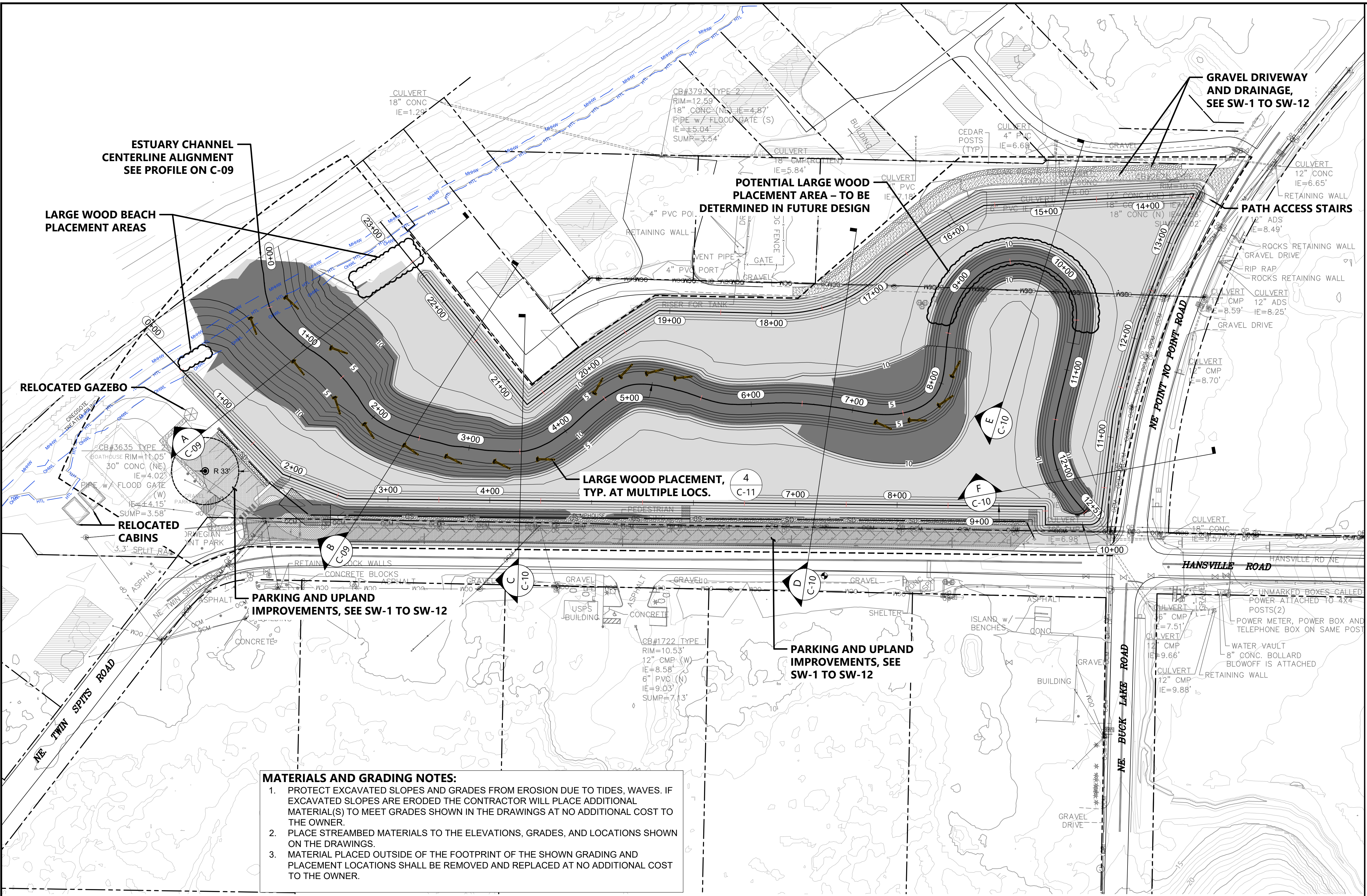
SITE PLAN

C-07

SHEET # 9 OF 32



MATERIALS AND GRADING NOTES:

1. PROTECT EXCAVATED SLOPES AND GRADES FROM EROSION DUE TO TIDES, WAVES. IF EXCAVATED SLOPES ARE ERODED THE CONTRACTOR WILL PLACE ADDITIONAL MATERIAL(S) TO MEET GRADES SHOWN IN THE DRAWINGS AT NO ADDITIONAL COST TO THE OWNER.
2. PLACE STREAMBED MATERIALS TO THE ELEVATIONS, GRADES, AND LOCATIONS SHOWN ON THE DRAWINGS.
3. MATERIAL PLACED OUTSIDE OF THE FOOTPRINT OF THE SHOWN GRADING AND PLACEMENT LOCATIONS SHALL BE REMOVED AND REPLACED AT NO ADDITIONAL COST TO THE OWNER.

LEGEND:

PROPOSED MAJOR CONTOUR (5' INTERVAL)
PROPOSED MINOR CONTOUR (1' INTERVAL)
CUT AREA
FILL AREA
LARGE WOOD AREA
LARGE WOOD PLACEMENT (CHANNEL)
EXISTING MAJOR CONTOUR (5' INTERVAL)
EXISTING MINOR CONTOUR (1' INTERVAL)
ORDINARY HIGH WATER LINE
HIGH TIDE LINE
MEAN HIGHER HIGH WATER
STORM DRAIN CULVERT
PARCEL BOUNDARY
FENCE
GUARD RAIL
EDGE OF GRAVEL
UNDERGROUND WATER
UNDERGROUND CABLE
UNDERGROUND FIBER OPTIC
UNDERGROUND POWER
OVERHEAD POWER
OVERHEAD COMMUNICATIONS
MAIL BOX
UTILITY POLE
GUY POLE
GUY ANCHOR
PHONE PEDESTAL
ELEC. BOX
ELEC. METER
COMMUNICATIONS MANHOLE
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YARD LIGHT
ROAD SIGN
BOLLARD
WATER VALVE
WATER METER
FIRE HYDRANT

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2. ELEVATIONS SHOWN ARE IN U.S. FEET, NAVD88 VERTICAL DATUM.

0 50 100
SCALE IN FEET

ONE INCH
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PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "ORANGE"

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REV	DATE	BY	APP'D	DESCRIPTION

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DRAWN BY: G.CURTISS/E.PIPKIN
CHECKED BY: K.LIST
APPROVED BY: J.COTE
SCALE: AS NOTED
DATE: MARCH 2024

FINN CREEK RESTORATION
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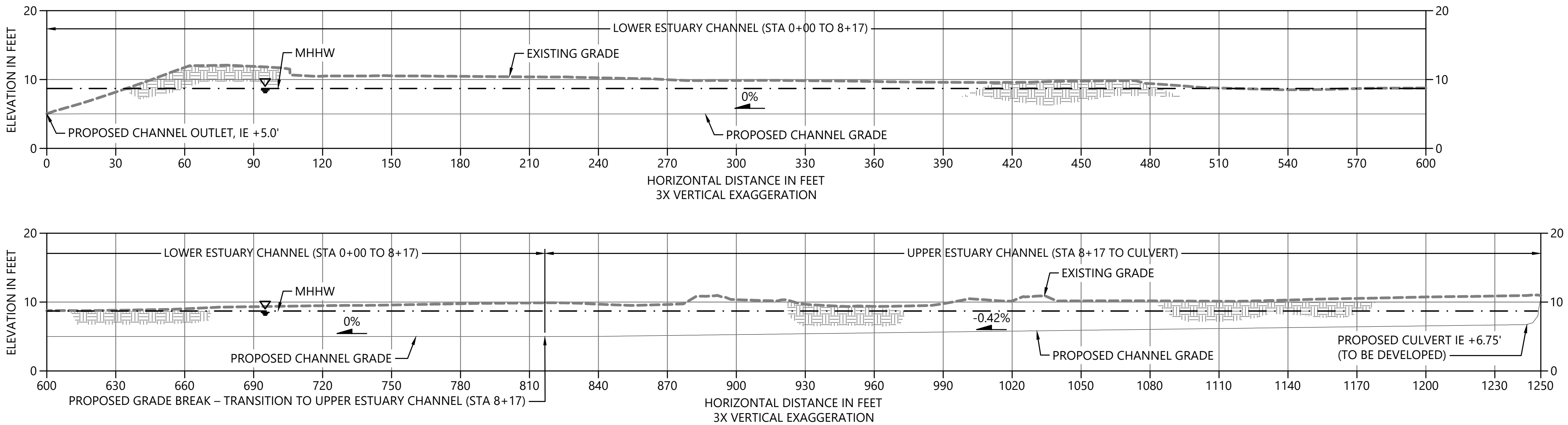
GRADING AND MATERIALS PLAN

C-08

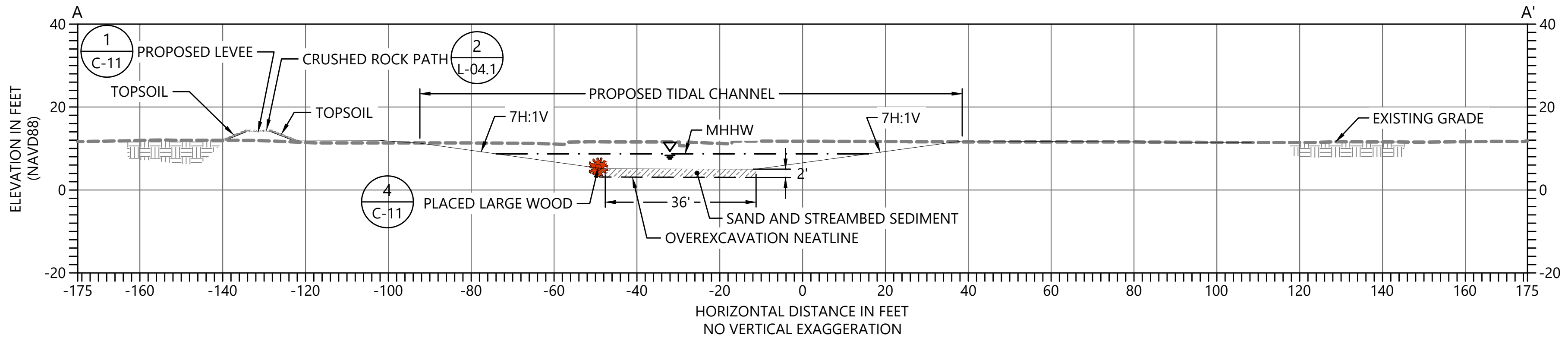
SHEET # 10 OF 32



Scale in Feet
0 30 60
0 10 20
Vertical Scale in Feet
Vertical Exaggeration x 3

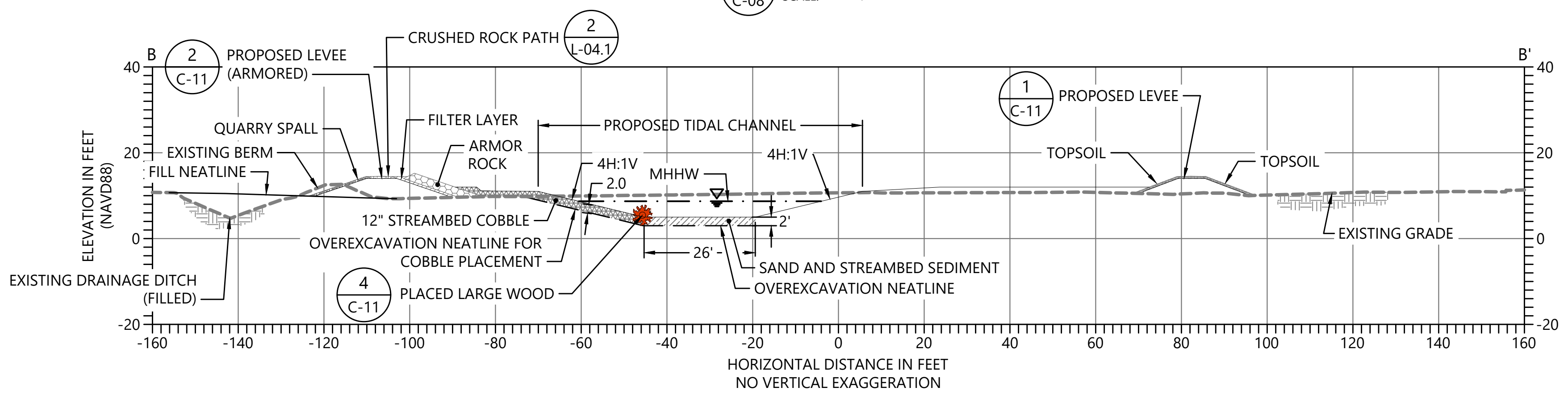
1 / C-07 PROFILE: LOWER AND UPPER ESTUARY CHANNELS

HORIZONTAL SCALE: 1" = 30'
VERTICAL SCALE: 1" = 10'



A / C-08 SECTION

SCALE: 1" = 20'



B / C-08 SECTION

SCALE: 1" = 20'

0 20 40
SCALE IN FEET

LEGEND:

- - -	EXISTING GRADE
──	PROPOSED GRADE
— · ▽ · —	MEAN HIGHER HIGH WATER (+8.7' NAVD88)
▨	PROPOSED ARMOR ROCK
▨	PROPOSED FILTER LAYER
▨	PROPOSED QUARRY SPALL
▨	PROPOSED COBBLE
▨	PROPOSED TOP SOIL
✸	PROPOSED PLACED LARGE WOOD

MATERIALS NOTES:

1. FOR MATERIAL TYPES, THICKNESS, AND DETAILS, REFER TO LANDSCAPE DRAWINGS, L-01 TO L-04.1.
2. SEE L-01 FOR PLACEMENT OF TOPSOIL AMENDMENTS, COARSE SAND, AND MULCH IN RIPARIAN FILL AREAS.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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Mar 06, 2024 11:56am bluecoast

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DATE: MARCH 2024

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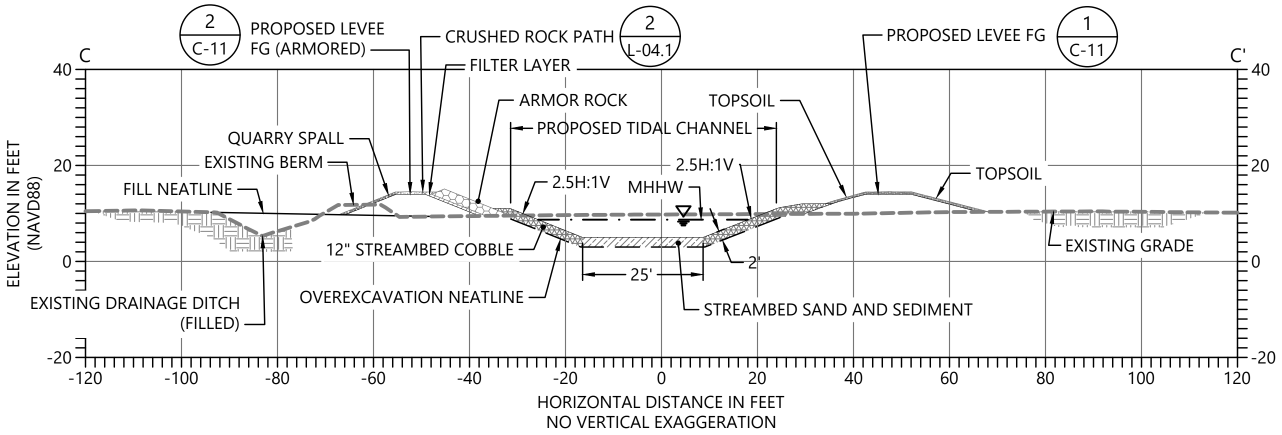
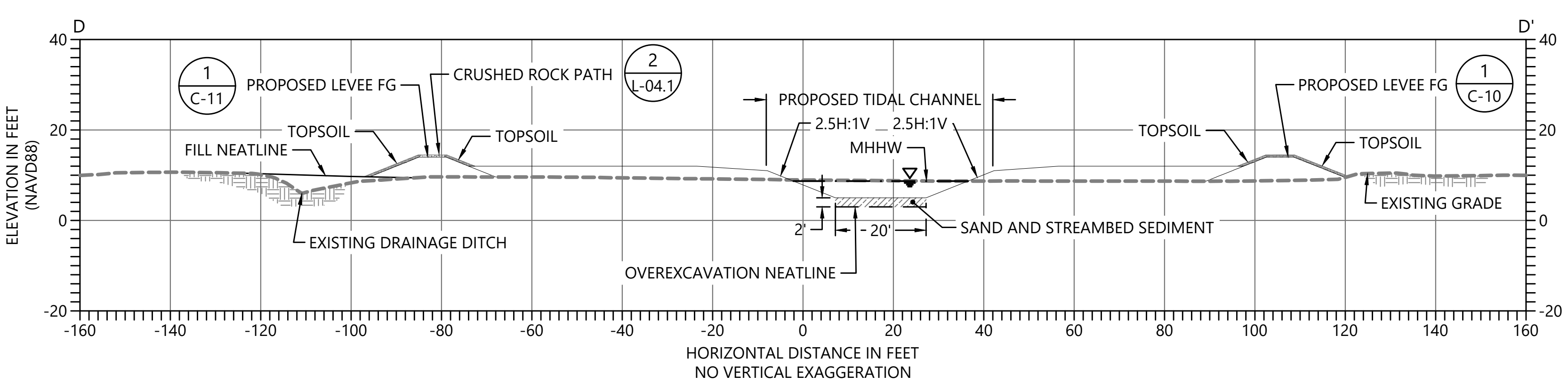
GRADING PROFILES AND CROSS-SECTIONS

C-09

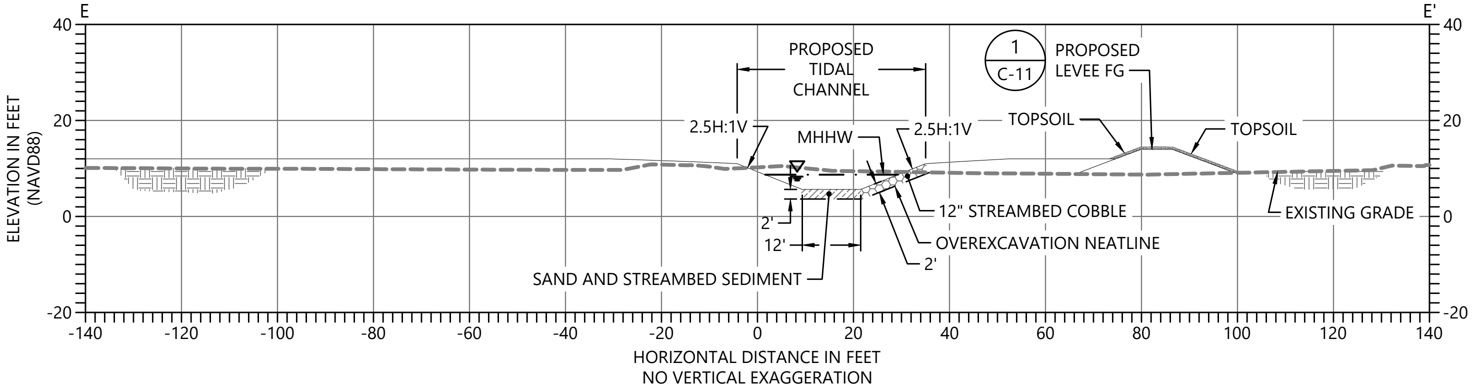
SHEET # **11** OF **32**



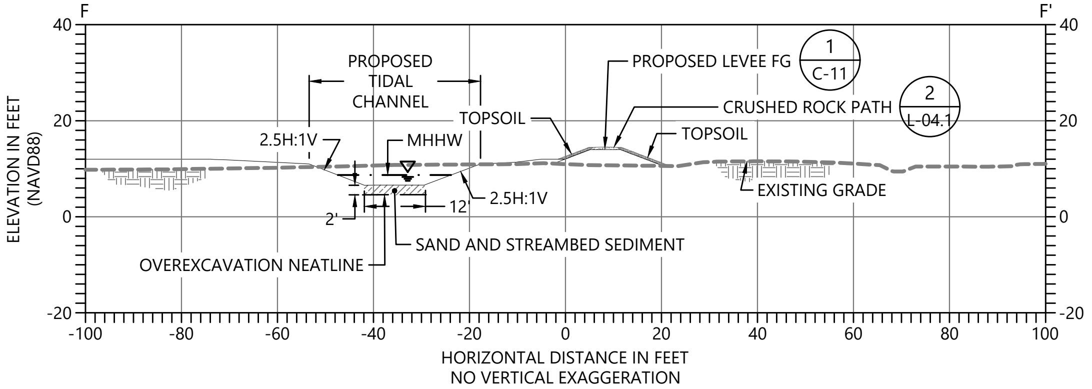
C SECTION C-08
SCALE: 1" = 20'



D SECTION C-08
SCALE: 1" = 20'



E SECTION C-08
SCALE: 1" = 20'



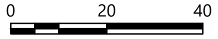
F SECTION C-08
SCALE: 1" = 20'

LEGEND:

– – –	EXISTING GRADE
───	PROPOSED GRADE
— · ▽ · —	MEAN HIGHER HIGH WATER (+8.7' NAVD88)
▨	PROPOSED SAND AND STREAMBED SEDIMENT
▨	PROPOSED ARMOR ROCK
▨	PROPOSED FILTER LAYER
▨	PROPOSED QUARRY SPALL
▨	PROPOSED COBBLE
▨	PROPOSED TOP SOIL

MATERIALS NOTES:

1. FOR MATERIAL TYPES, THICKNESS, AND DETAILS, REFER TO LANDSCAPE DRAWINGS, L-01 TO L-04.1.
2. SEE L-01 FOR PLACEMENT OF TOPSOIL AMENDMENTS, COARSE SAND, AND MULCH IN RIPARIAN FILL AREAS.



SCALE IN FEET

ONE INCH
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FINN CREEK RESTORATION
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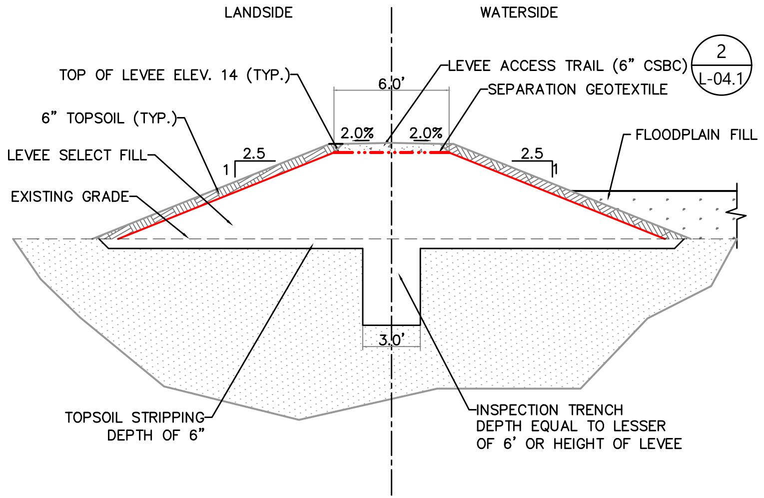
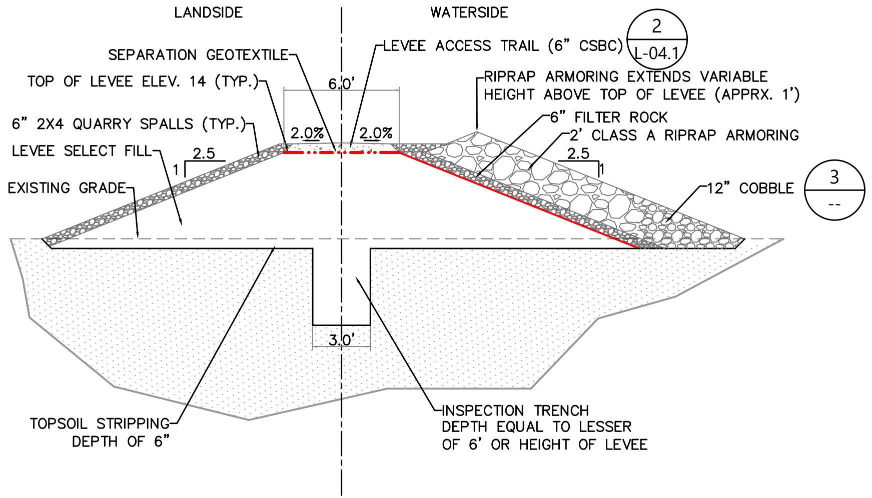
GRADING CROSS-SECTIONS

C-10

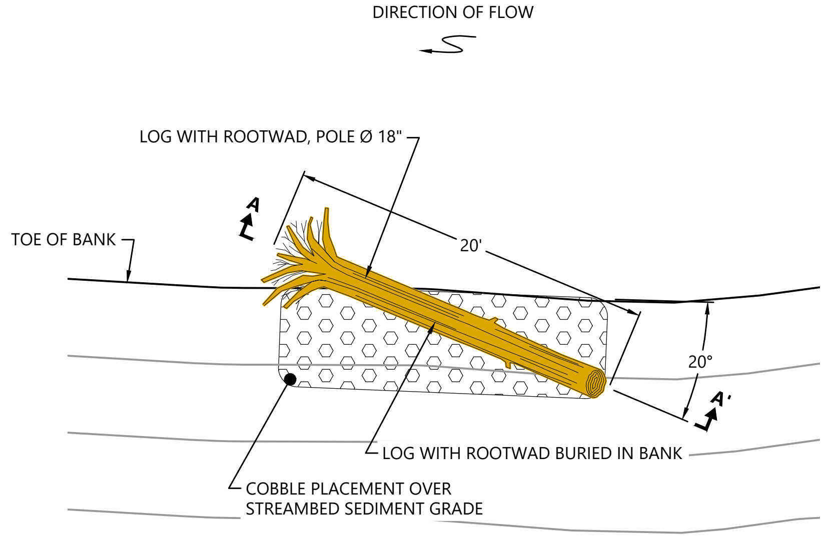
SHEET # **12** OF **32**



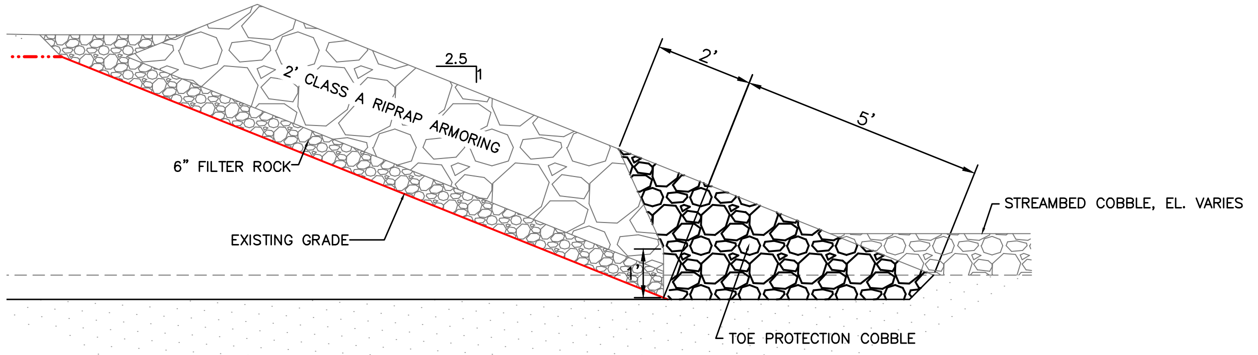
1
C-07
DETAIL: LEVEE TYPICAL SECTION
SCALE: N.T.S.



2
C-07
DETAIL: ARMORED LEVEE TYPICAL SECTION
SCALE: N.T.S.

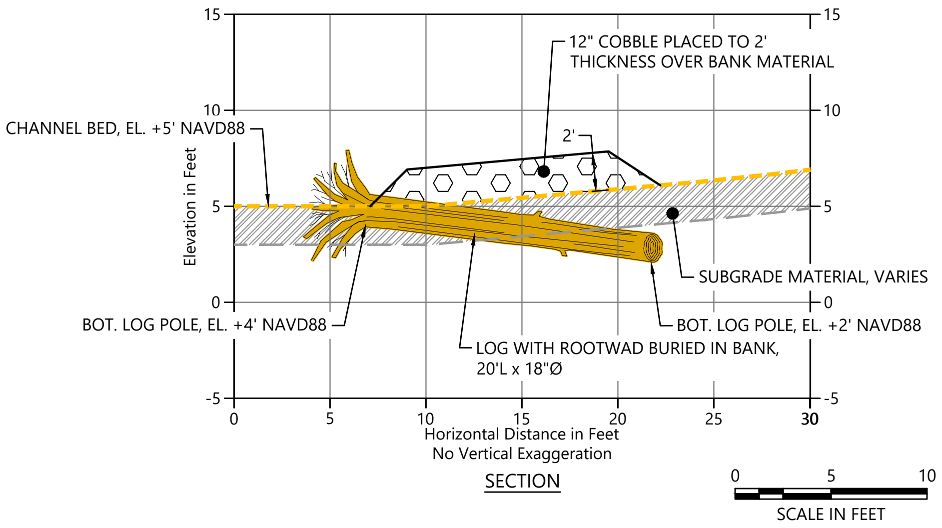


PLAN



ARMOR ROCK/COBBLE TRANSITION NOTE:
TRANSITION ARMOR ROCK TO 1' THICKNESS AT ARMOR ROCK TOE EXTENT. PLACE COBBLE OVER THE ARMOR TOE, MATCHING THE 2.5H:1V SLOPE.

3
--
DETAIL: ARMOR/COBBLE INTERFACE TRANSITION
SCALE: N.T.S.



SECTION

4
C-07
DETAIL: LARGE WOOD PLACEMENT
SCALE: 1" = 10'

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "ORANGE" 🟧

BLUE COAST
ENGINEERING

Wild Fish Conservancy
NORTHWEST

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FINN CREEK RESTORATION
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GRADING DETAILS

C-11

SHEET # 13 OF 32

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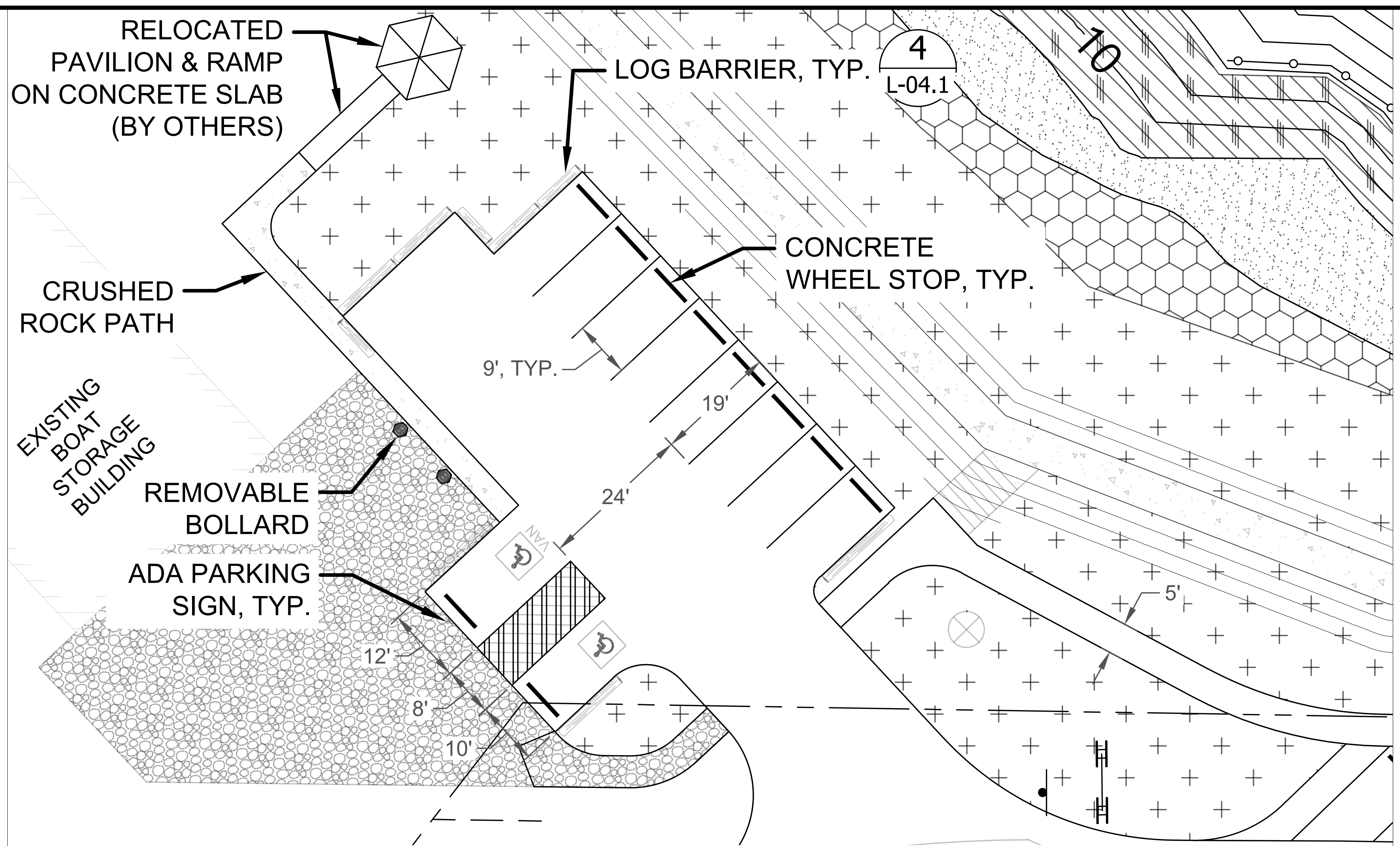
CONSTRUCTION MATERIALS

▨	EXISTING CRUSHED ROCK PAVING TO REMAIN
☐	CRUSHED ROCK PATH (1 / L-04.1)
⬡	6" TOPSOIL TYPE A
+	2" TOPSOIL TYPE B
▧	6" TOPSOIL TYPE C AND COIR FABRIC (4 / L-03.1)
░	12" COARSE SAND
—o—o—	COIR LOG
▭	TIMBER EDGING
●	REMOVABLE BOLLARD

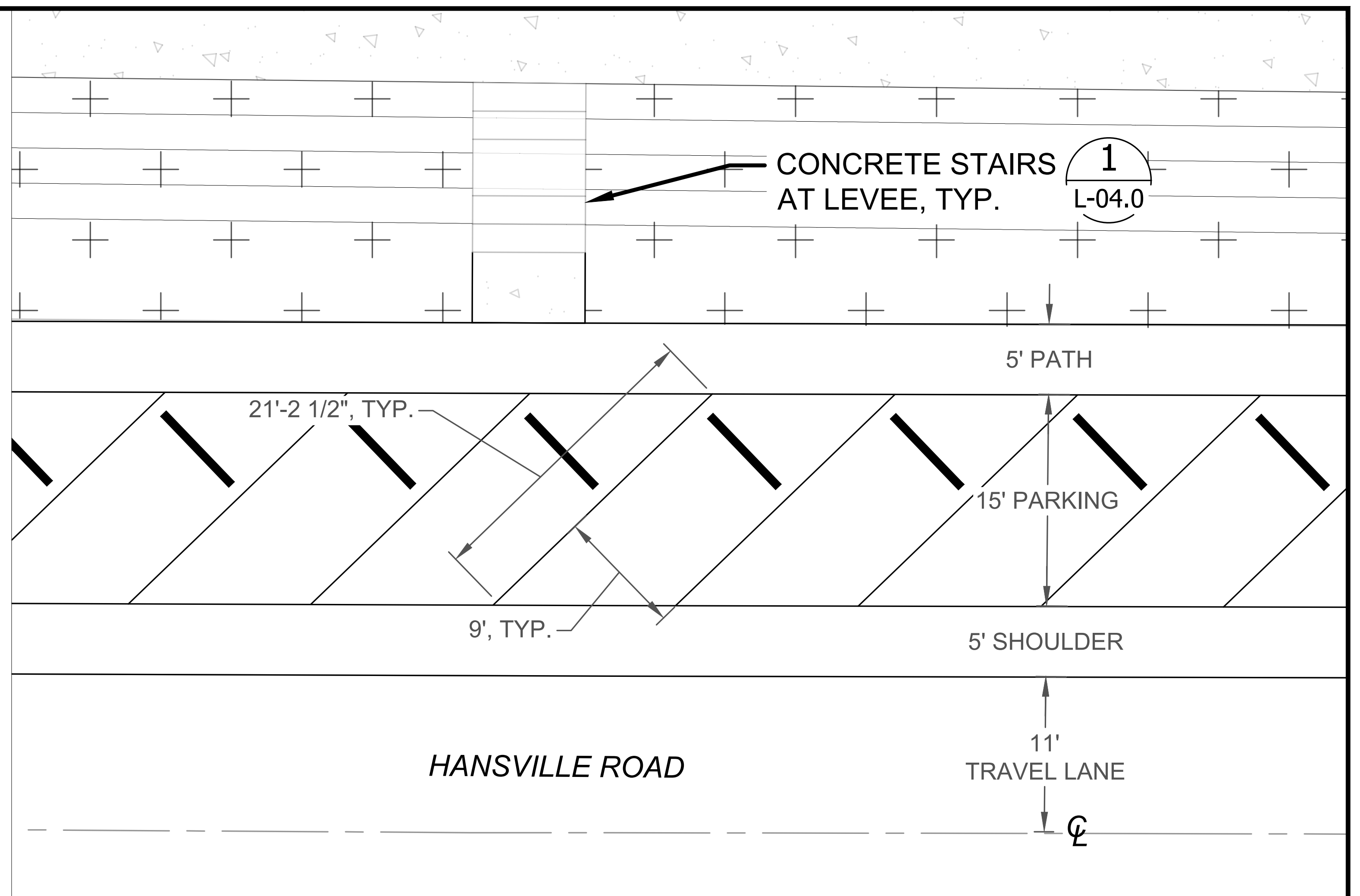
NOTES

1. FOR DRAINAGE IMPROVEMENTS, SEE SHEET SW-02.
2. FOR PLANTING PLAN, SEE SHEET L-02.2.
3. CRUSHED ROCK PAVING FOR PARKING AREAS, SEE SHEET SW-12.
4. FOR LARGE WOOD PLACEMENT, SEE SHEET C-08.
5. FOR EXTENT OF COBBLE, ARMOR AND QUARRY SPALL, SEE SHEET C-07.



ENLARGED PARKING AND PUBLIC ACCESS PLAN

0 40 80 Feet



ENLARGED LEVEE PARKING PLAN (TYP.)

0 20 40 Feet

DRAFT-NOT FOR CONSTRUCTION

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "ORANGE" 🟧

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WATERFRONT ENVIRONMENTAL

Wild Fish Conservancy
NORTHWEST

REVISIONS

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DRAWN BY: C.TAYLOR
CHECKED BY: G. SASSEN
APPROVED BY: G. SASSEN
SCALE: AS NOTED
DATE: FEBRUARY 2024

FINN CREEK RESTORATION
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LAYOUT & MATERIALS PLAN - LANDSCAPE

L-01

SHEET # **14** OF **33**

NOTES

1. FOR PLANTING SCHEDULE, SEE SHEET L-02.2.

DRAFT-NOT FOR CONSTRUCTION

0 40 80 Feet

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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PLANTING PLAN

L-02.0

SHEET # 15 OF 33

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NOTES

1. FOR PLANTING SCHEDULE, SEE SHEET L-02.2.

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PLANTING PLAN

L-02.1

SHEET # 16 OF 33

	Scientific Name	Common Name	Size	Spacing	Notes
Riparian Area (EL. 12 and above)					
Trees					
⊘	*Acer circinatum*	Vine Maple	5 gal.	As Shown	1 L-03.0 2 L-03.0 1 L-03.1
⁘	*Malus fusca*	Pacific Crabapple	5 gal.	As shown	
⦶	*Picea sitchensis*	Sitka Spruce	5 gal.	As shown	
⊛	*Pinus contorta var. contorta*	Shore Pine	5 gal.	As shown	
⊕	*Tsuga heterophylla*	Western Hemlock	5 gal.	As shown	
Low Planting					
AA	*Amelanchier alnifolia*	Serviceberry	2 gal.	10' O.C.	3 L-03.0 1 L-03.1
CC	*Corylus cornuta*	Beaked Hazelnut	2 gal.	10' O.C.	
HD	*Holodiscus discolor*	Oceanspray	2 gal.	10' O.C.	
LI	*Lonicera involucrata*	Twinberry	2 gal.	10' O.C.	
PC	*Physiocarpus capitatus*	Pacific Ninebark	2 gal.	10' O.C.	
RN	*Rosa nutkana*	Nootka Rose	2 gal.	5' O.C.	
RP	*Rosa pisocarpa*	Peafruit Rose	2 gal.	5' O.C.	
RS	*Ribes sanguineum*	Red-flowering Currant	2 gal.	5' O.C.	
SA	*Symphoricarpos albus*	Snowberry	2 gal.	5' O.C.	
Livestakes					
▨	*Salix hookeriana*	Hooker's Willow	Livestakes	3' O.C.	6 L-03.0 1 L-03.1
Transition Area A (EL. 11 – 12)					
▩	*Elymus mollis*	Dune Grass	1 gal.	2' O.C.	4 L-03.0 5 L-03.0 1 L-03.1
	Fragaria chiloensis	Beach Strawberry	4" pot	2' O.C.	
	Grindelia integrifolia	Puget Sound Gumweed	1 gal.	2' O.C.	
Transition Area B (EL. 11 – 12)					
▩	Prairie Seed Mix			lb/ac	
Beach Backshore (EL. 9 – 11)					
░	*Abronia latifolia*	Coastal Sand Verbena	10-in plug	2' O.C.	4 L-03.0 5 L-03.0 1 L-03.1
	Carex macrocephala	Largehead Sedge	10-in plug	2' O.C.	
	Deschampsia cespitosa	Pacific Silverweed	10-in plug	2' O.C.	
	Honkenya peploides	Sea Sandwort	10-in plug	2' O.C.	
	Lupinus litteralis	Seashore Lupine	10-in plug	2' O.C.	
	Ambrosia chammissonis	Silver Burweed	10-in plug	2' O.C.	
High Marsh (EL. 10 – 11)					
▨	*Symphiotrichon subspicatum*	Douglas Aster	10-in plug	2' O.C.	5 L-03.0 2 L-03.1 3 L-03.1 4 L-03.1
	Carex lyngbyi	Lyngby Sedge	10-in plug	2' O.C.	
	Deschampsia cespitosa	Tufted Hairgrass	10-in plug	2' O.C.	
	Grindelia integrifolia	Puget Sound Gumweed	10-in plug	2' O.C.	
Low Marsh (EL. 9 – 10)					
⊥ ⊥ ⊥	*Jaumea carnosa*	Fleshy Jaumea	10-in plug	2' O.C.	5 L-03.0 2 L-03.1 3 L-03.1 4 L-03.1
	Triglochin maritima	Seaside Arrowgrass	10-in plug	2' O.C.	
	Potentilla anserina sp pacifica	Pacific Silverweed	10-in plug	2' O.C.	
	Salicornia pacifica	Pickleweed	10-in plug	2' O.C.	
	Scirpus americanus	American Three-square	10-in plug	2' O.C.	
Levee (incl. setback areas)					
× × ×	Erosion Control Seed Mix			lb/ac	

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INCH SCALE ACCORDINGLY

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WATERFRONT ENVIRONMENTAL

Wild Fish Conservancy
NORTHWEST

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FINN CREEK RESTORATION
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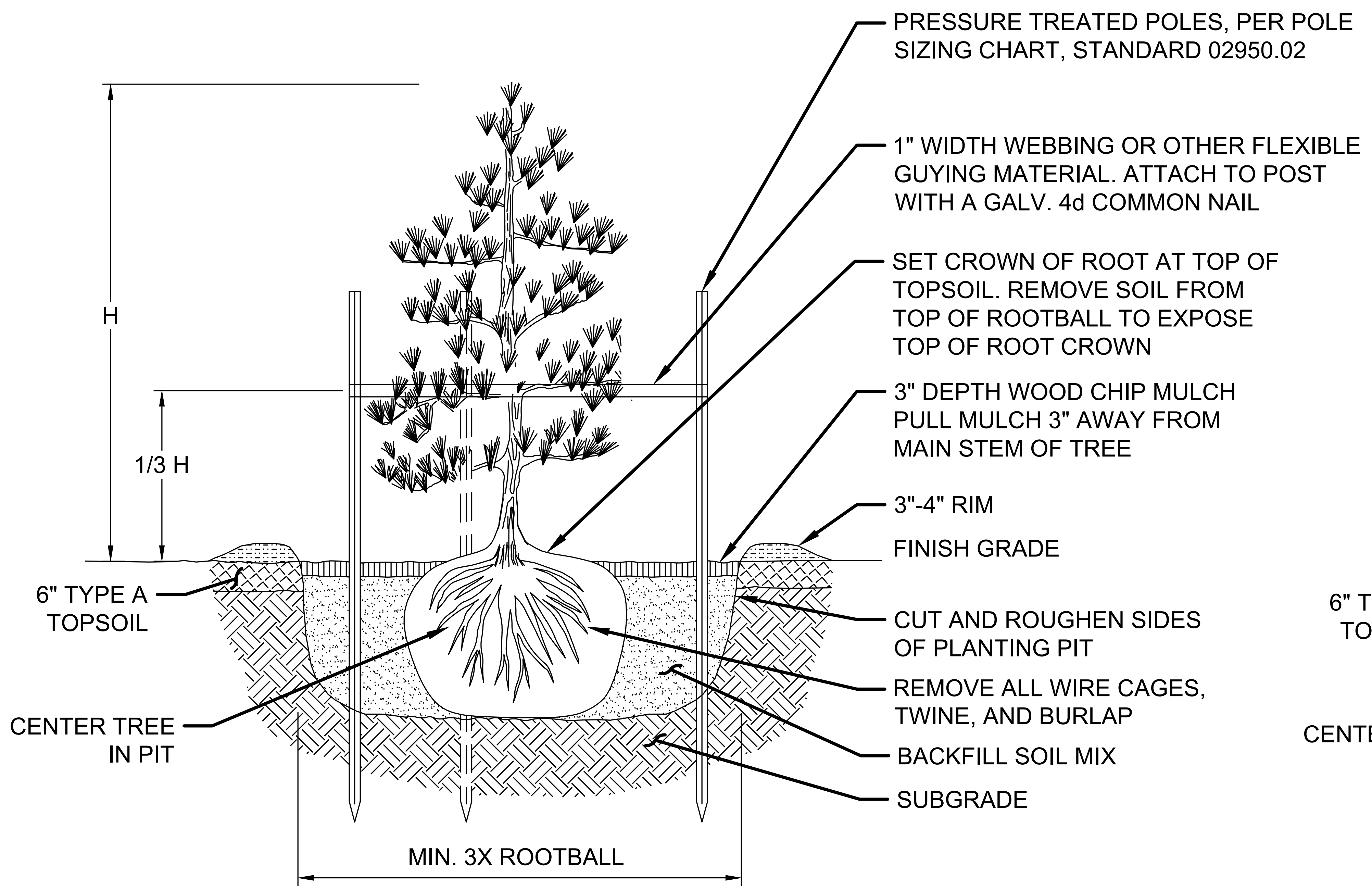
PLANTING SCHEDULE

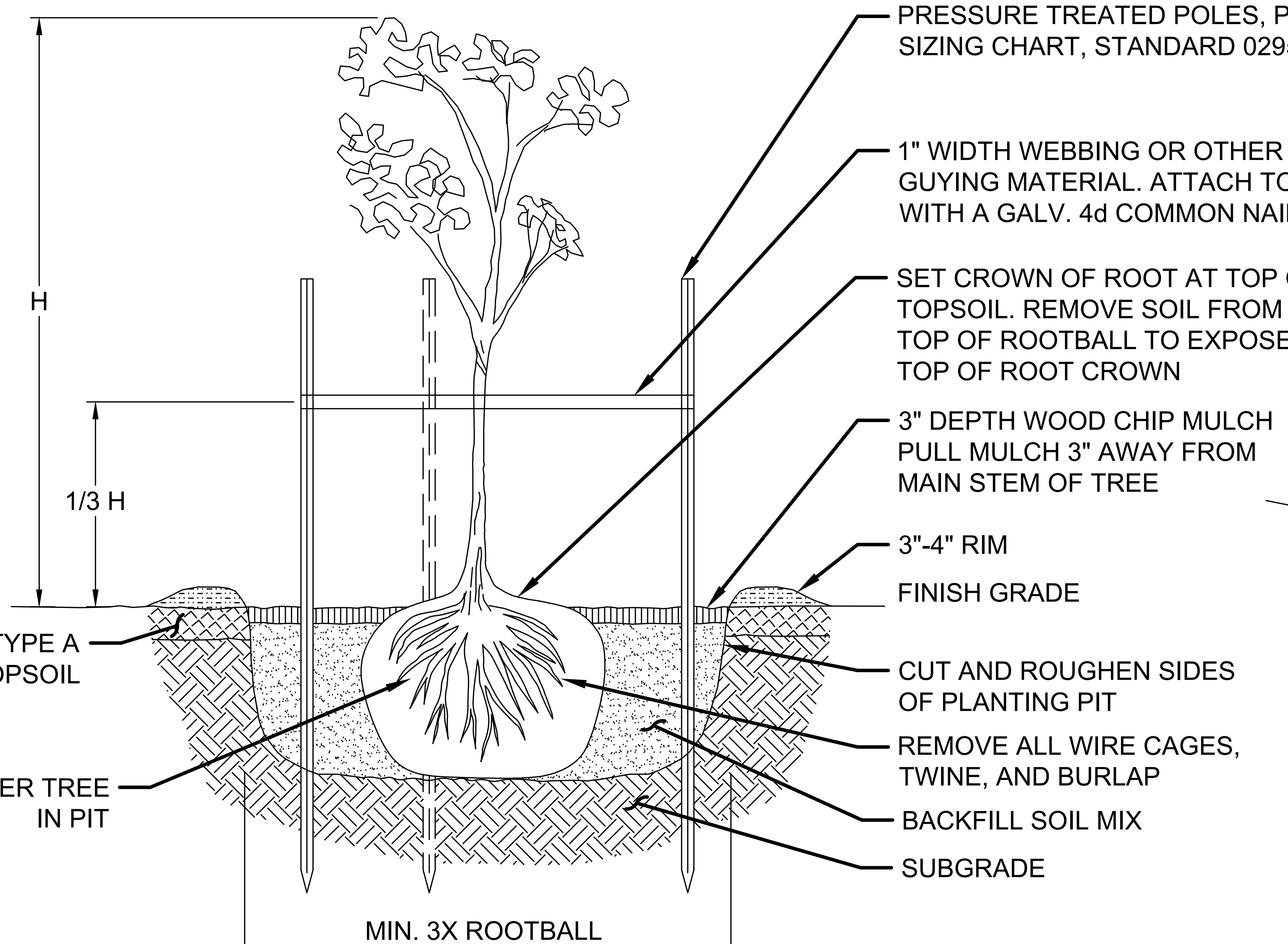
L-02.2

SHEET # 17 OF 33



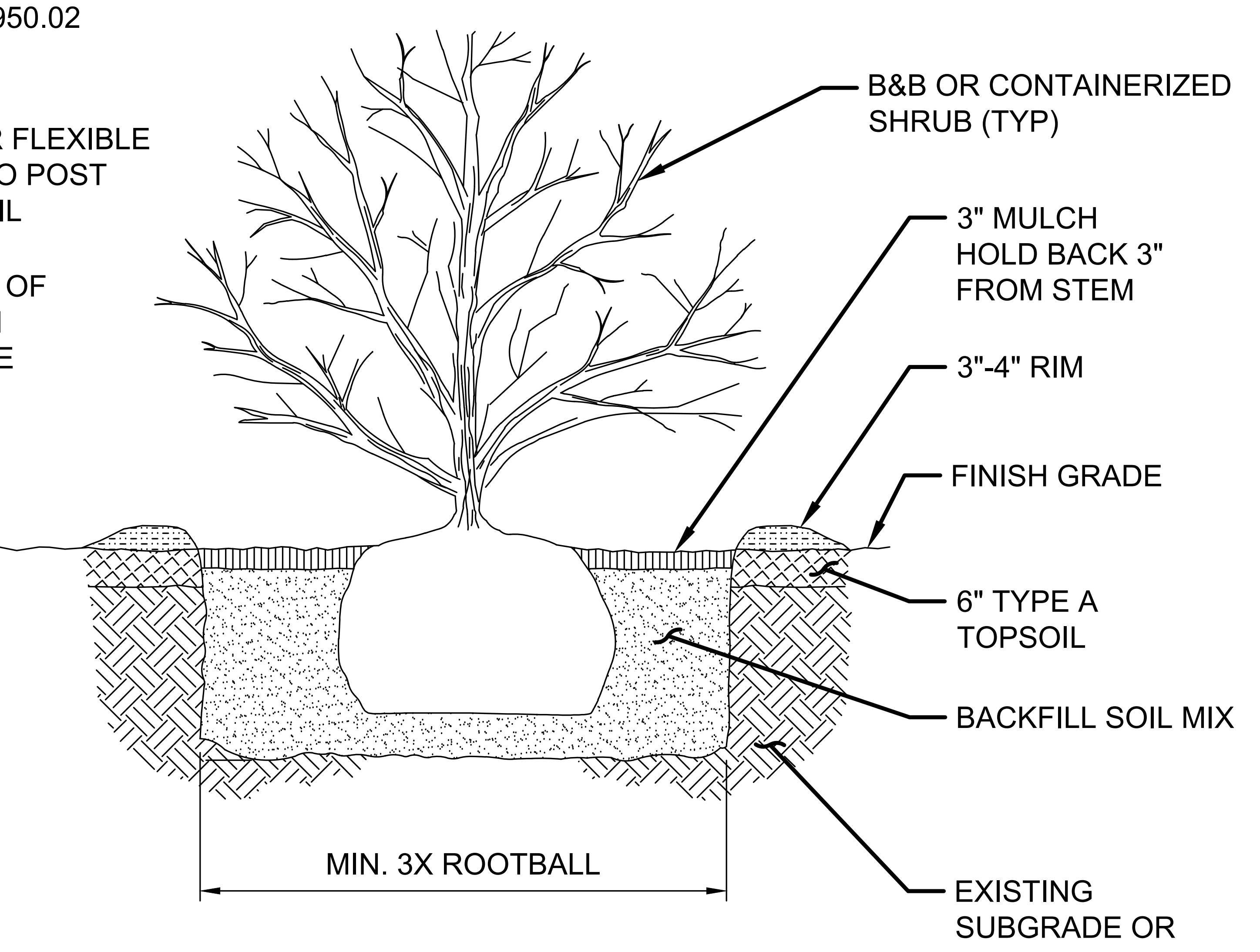
1 - CONIFEROUS TREE PLANTING

Scale: NTS



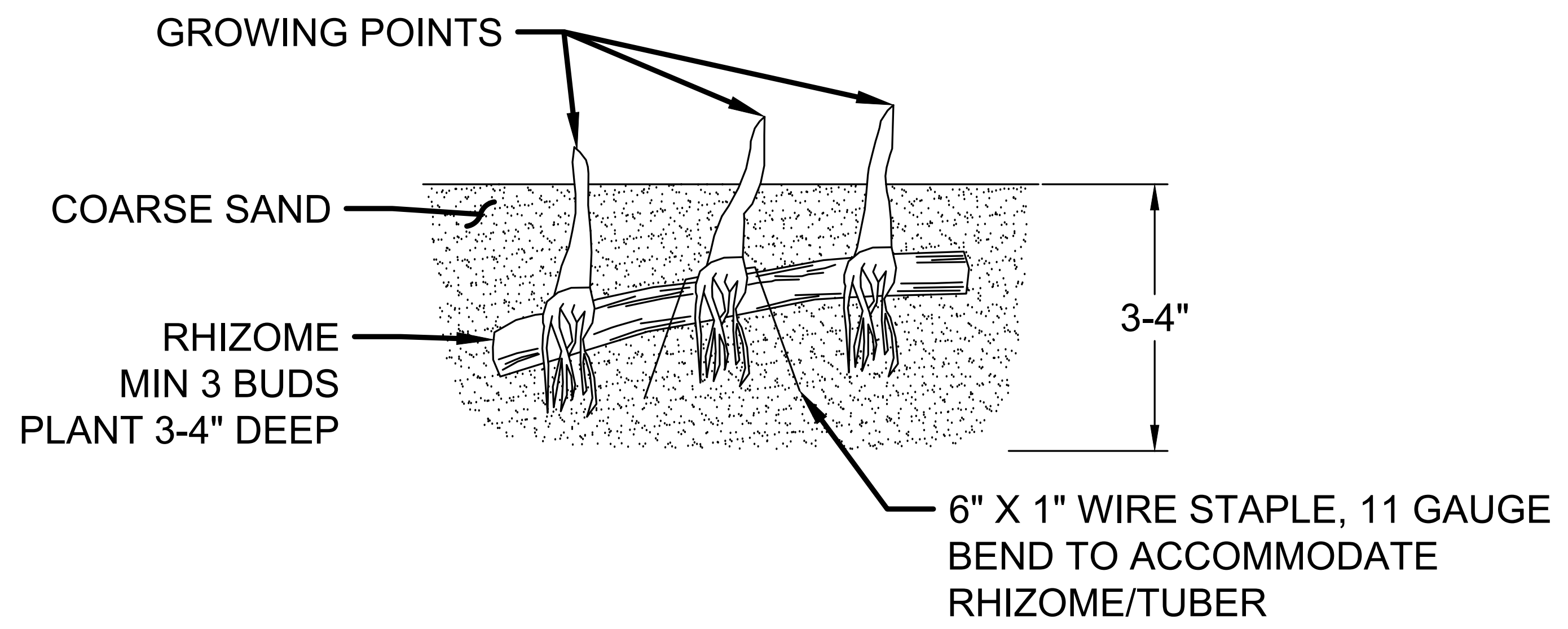
2 - DECIDUOUS TREE PLANTING

Scale: NTS



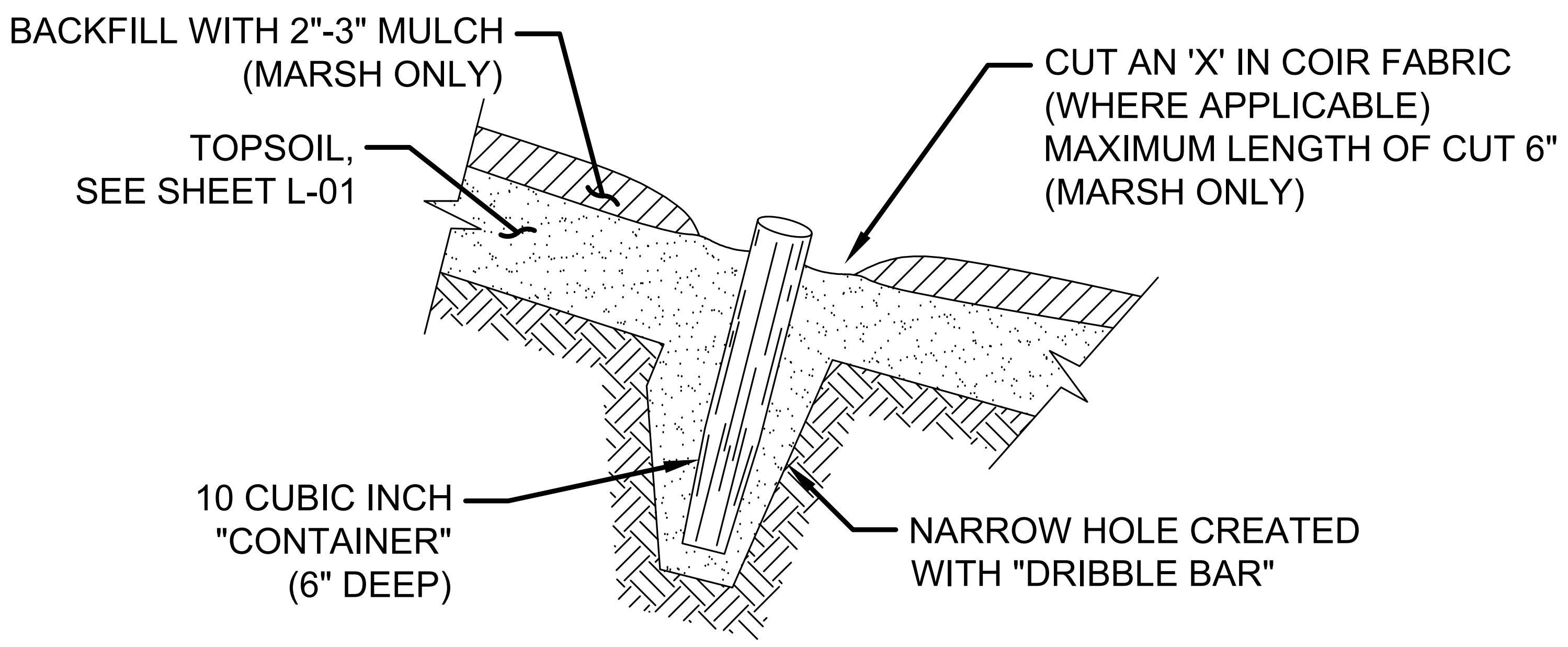
3 - SHRUB PLANTING

Scale: NTS



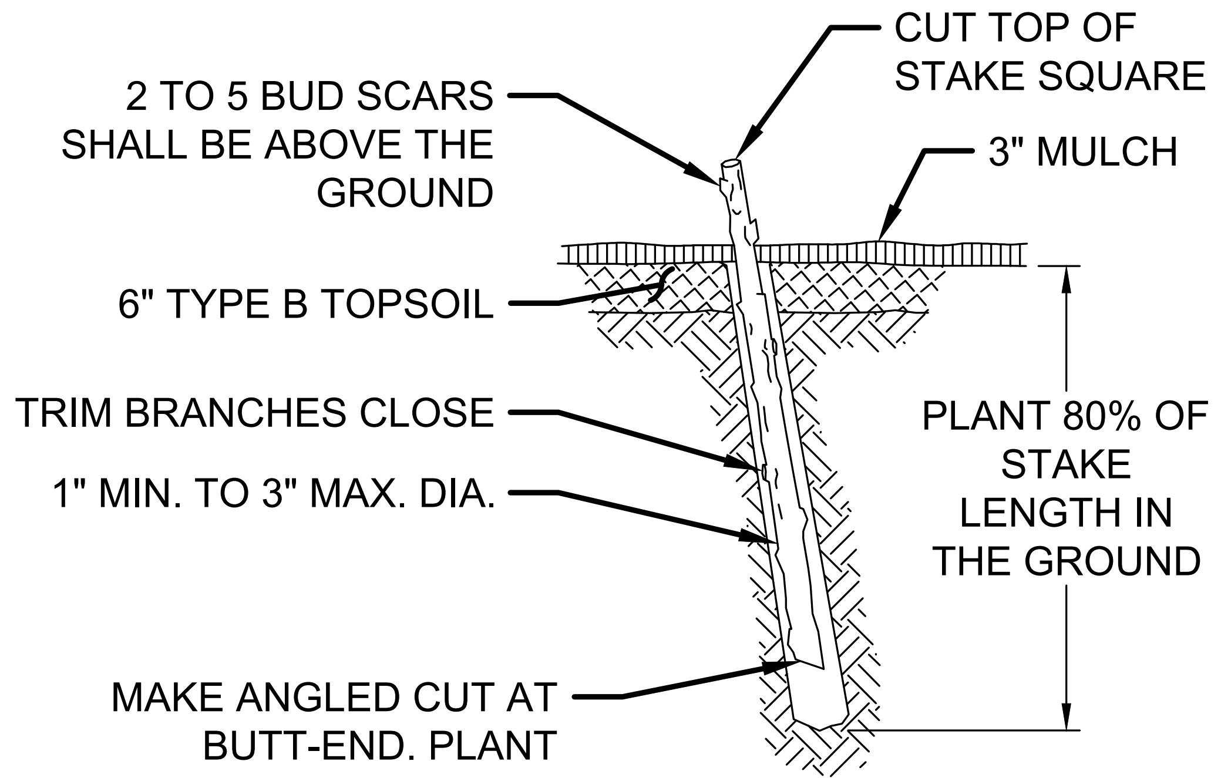
4 - BEACH GRASS PLANTING

Scale: NTS



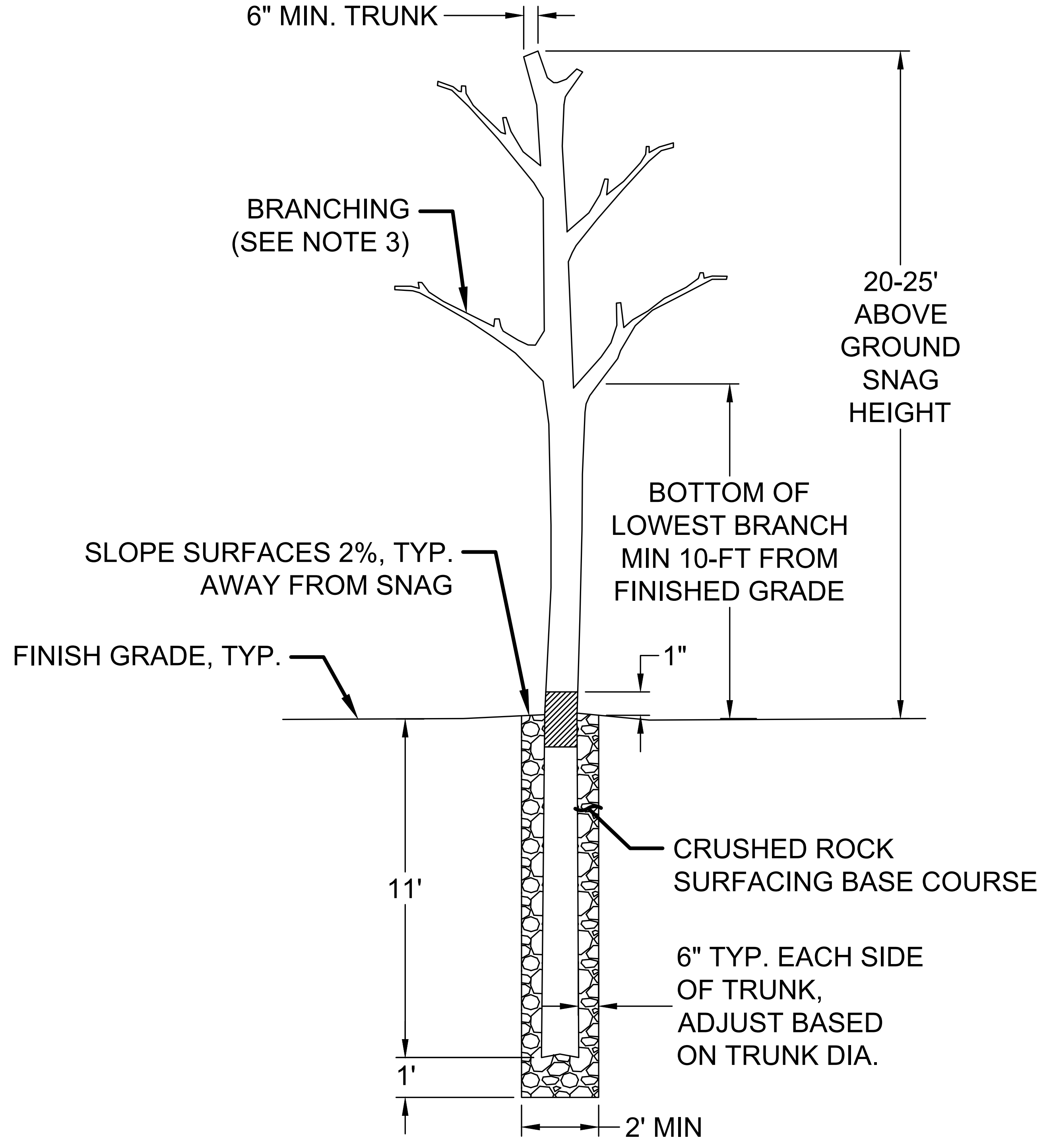
5 - EMERGENT & HERBACEOUS PERENNIAL PLANTING

Scale: NTS



6 - LIVE STAKE PLANTING

Scale: NTS



7 - WILDLIFE TREE SNAG

Scale: NTS

NOTES

1. USE ON-SITE SALVAGED CONIFER TREES AS SNAGS. SELECTED TREES SHALL BE FIELD APPROVED BY ENGINEER.
2. 12"-14" DIAMETER SNAG (AT FG)
3. BRANCHING SHALL BE FIELD APPROVED BY ENGINEER. 3"-5" MIN. BRANCH DIAMETER. 4 BRANCHES MIN. TO REMAIN.
4. REMOVE BARK PRIOR TO INSTALLATION.

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ONE INCH

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WATERFRONT ENVIRONMENTAL

Wild Fish Conservancy
NORTHWEST

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FINN CREEK RESTORATION
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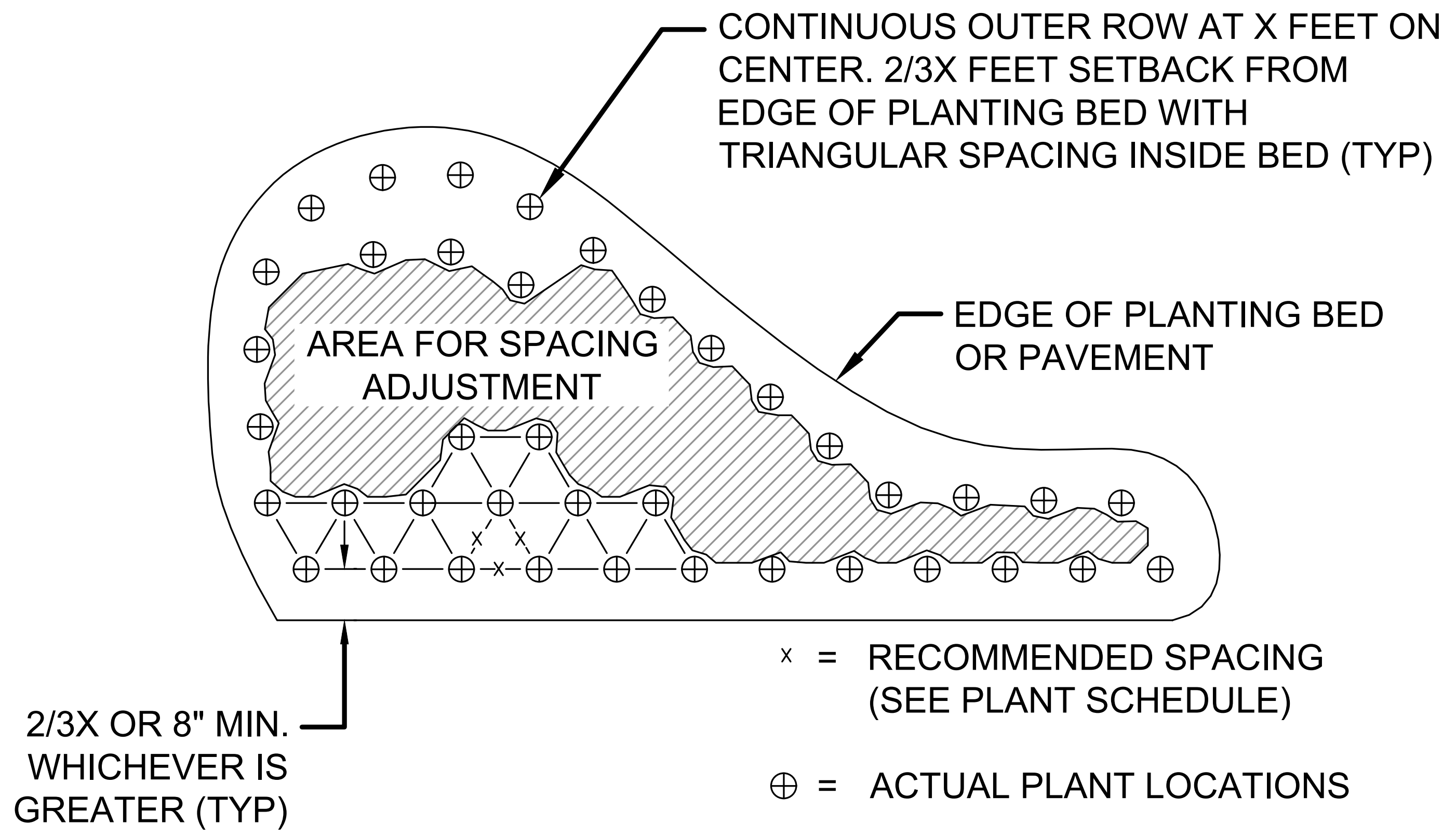
PLANTING DETAILS

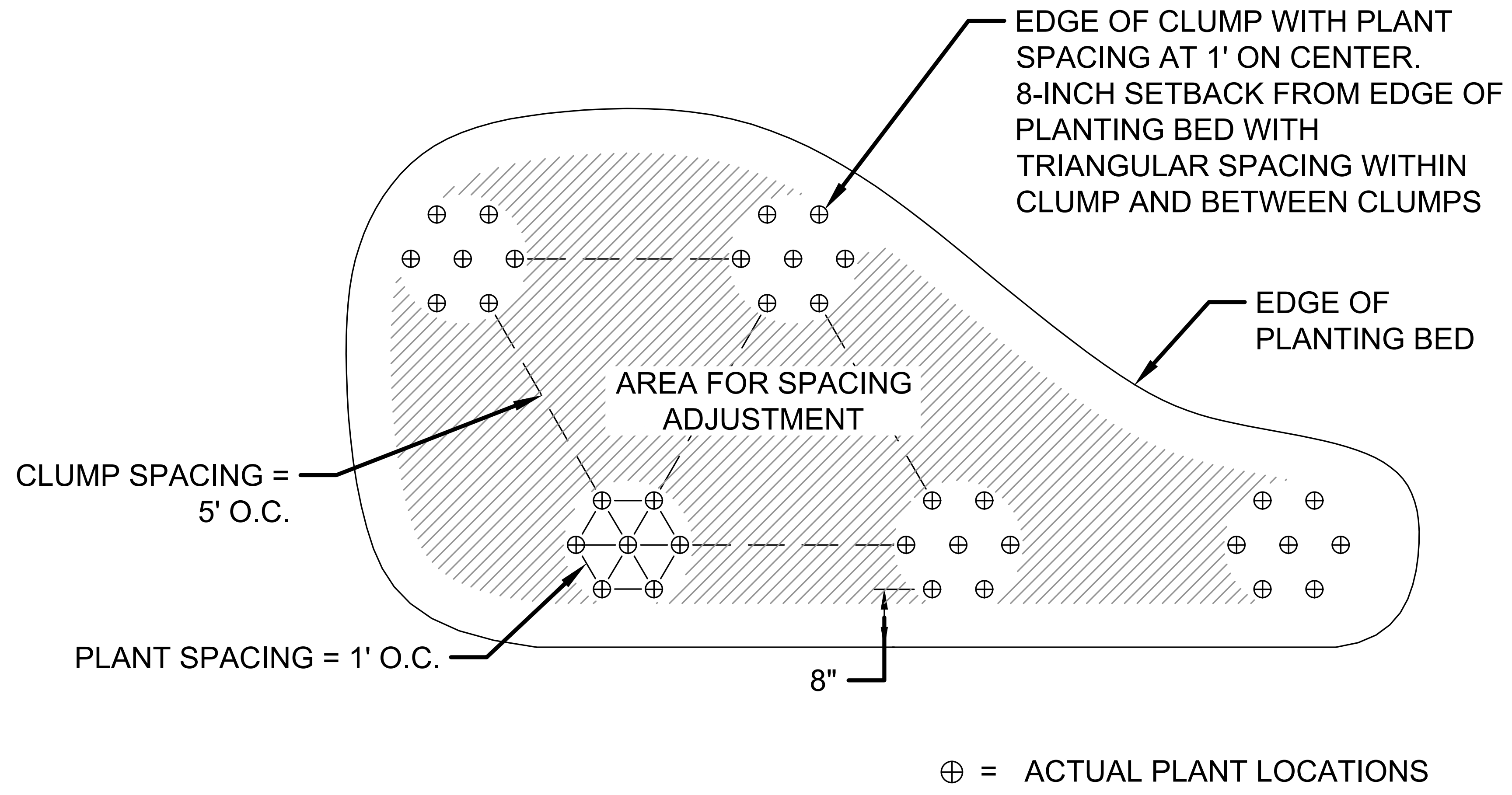
L-03.0

SHEET # 18 OF 33



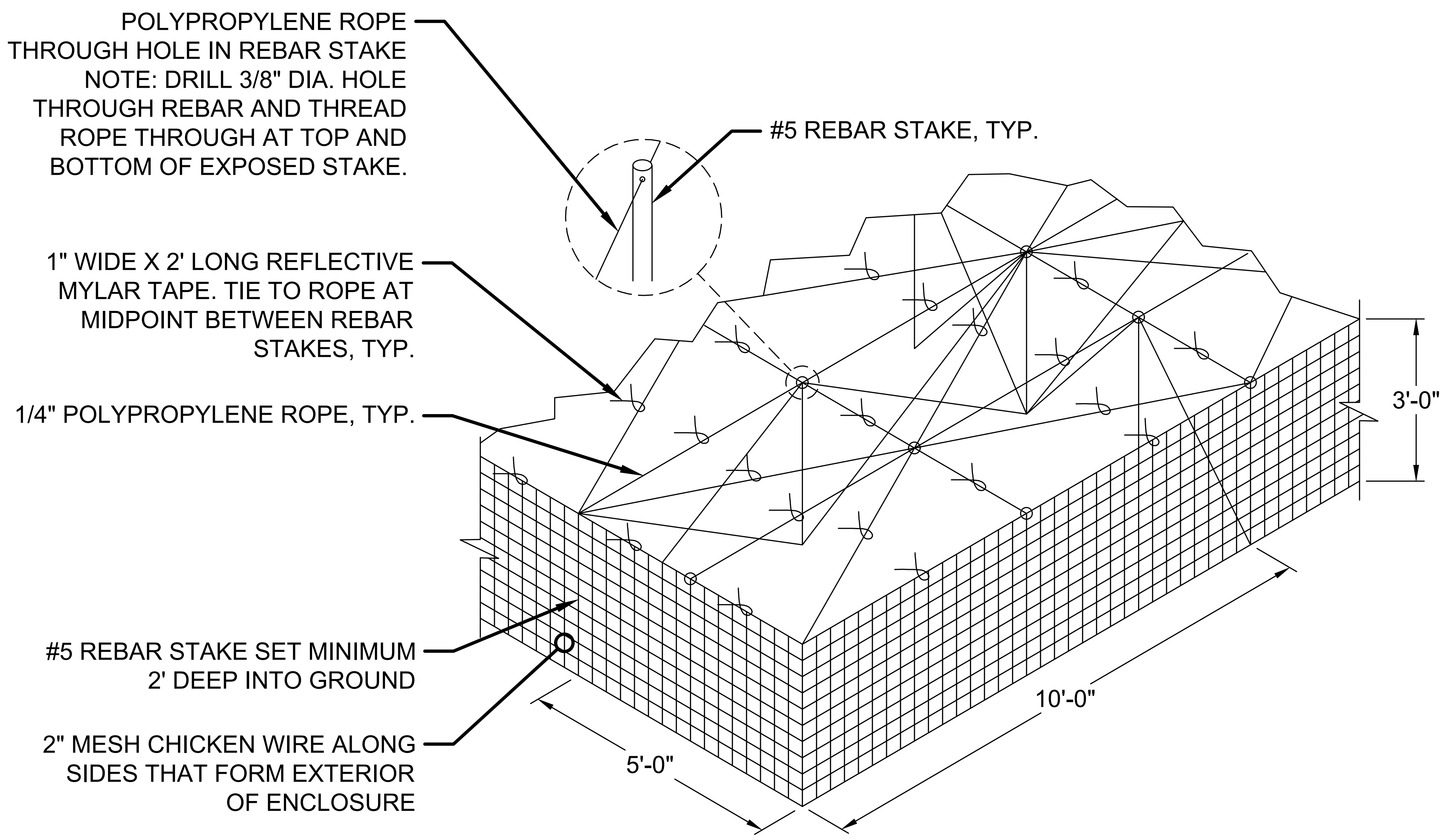
1 - PLANTING PATTERN

Scale: NTS



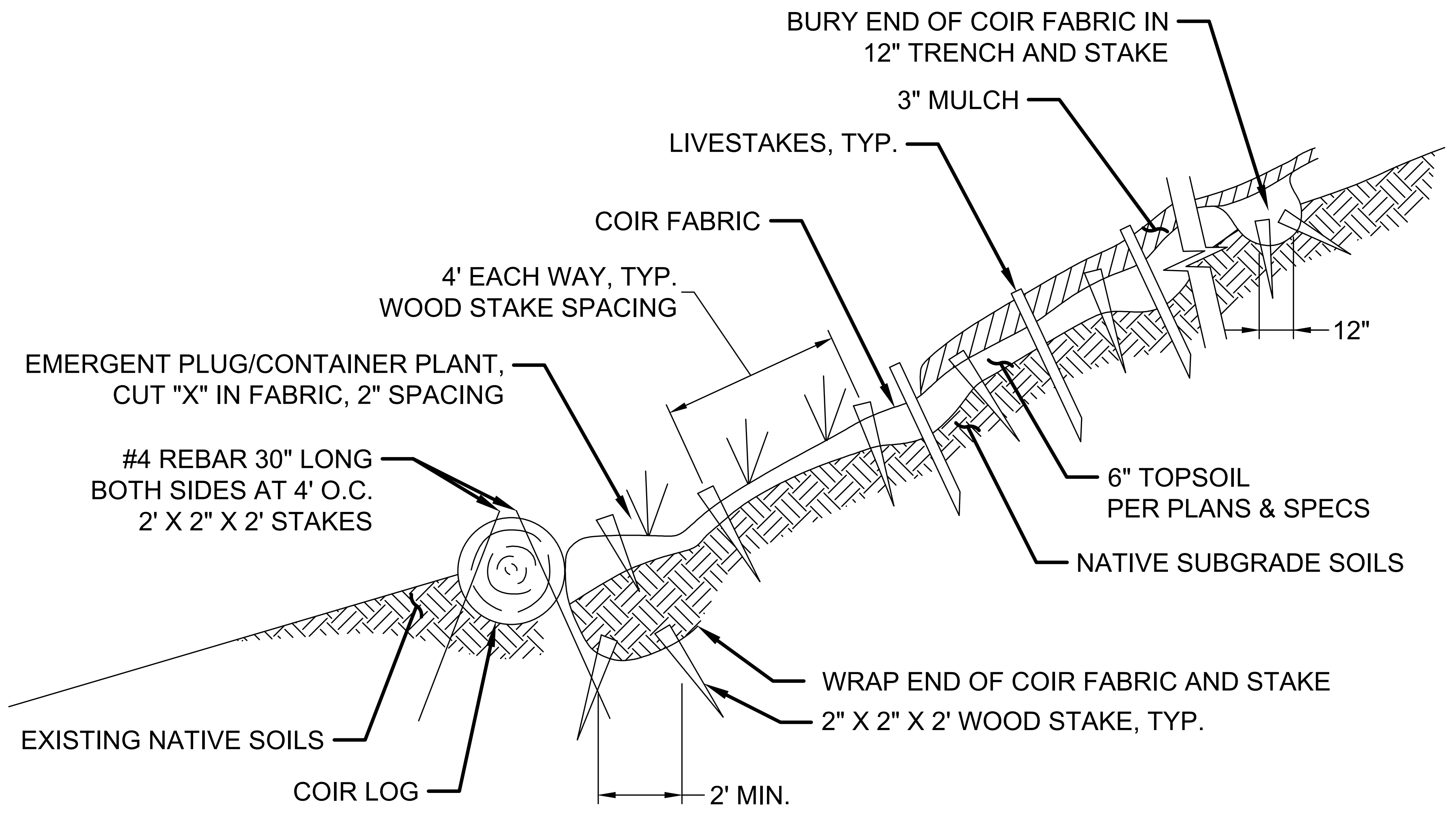
2 - MARSH PLANTING PATTERN

Scale: NTS



3 - TEMPORARY WATERFOWL EXCLOSURE DETAIL

Scale: NTS



4 - COIR LOG AND COIR FABRIC INSTALLATION

Scale: NTS

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ONE INCH
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NORTHWEST

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FINN CREEK RESTORATION
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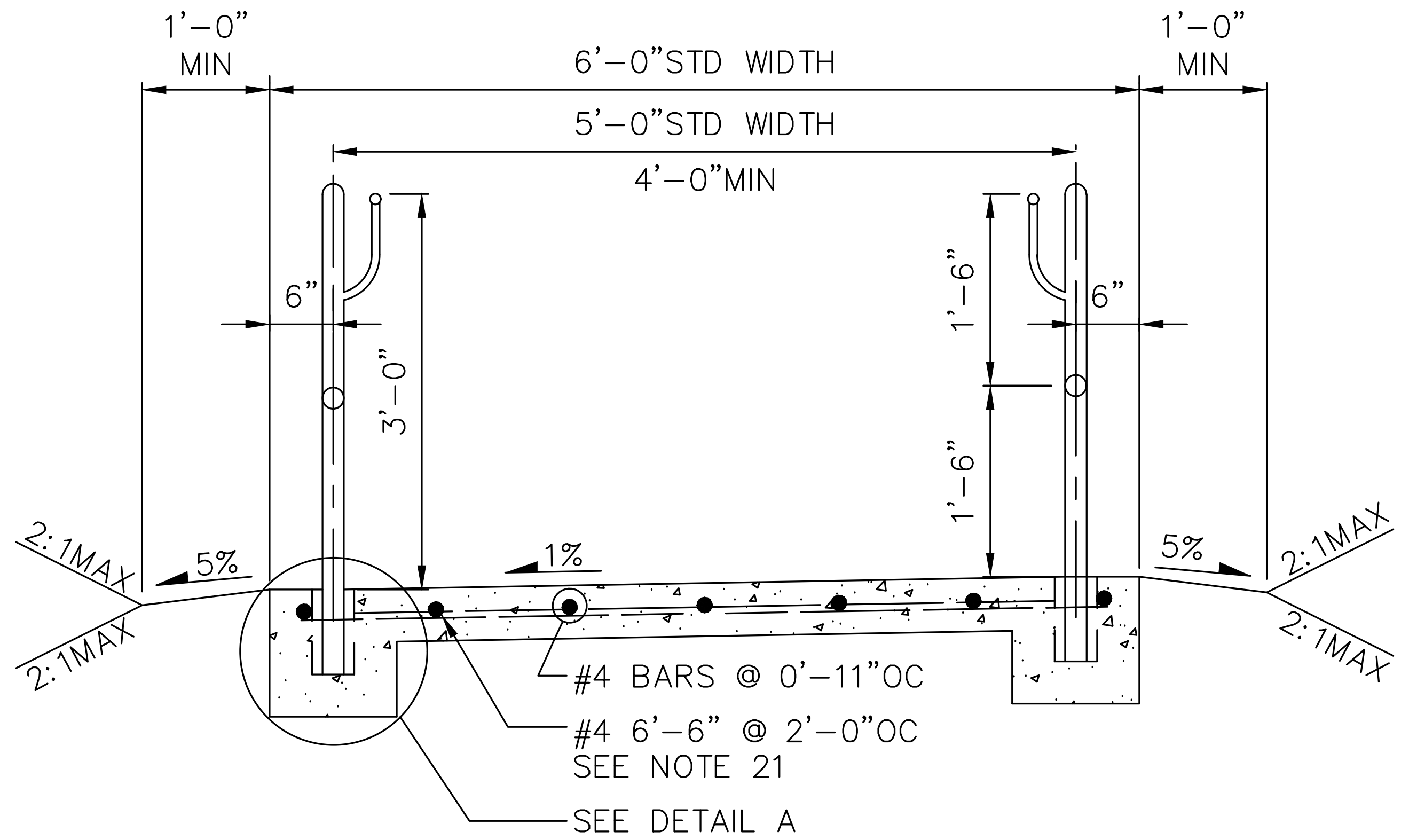
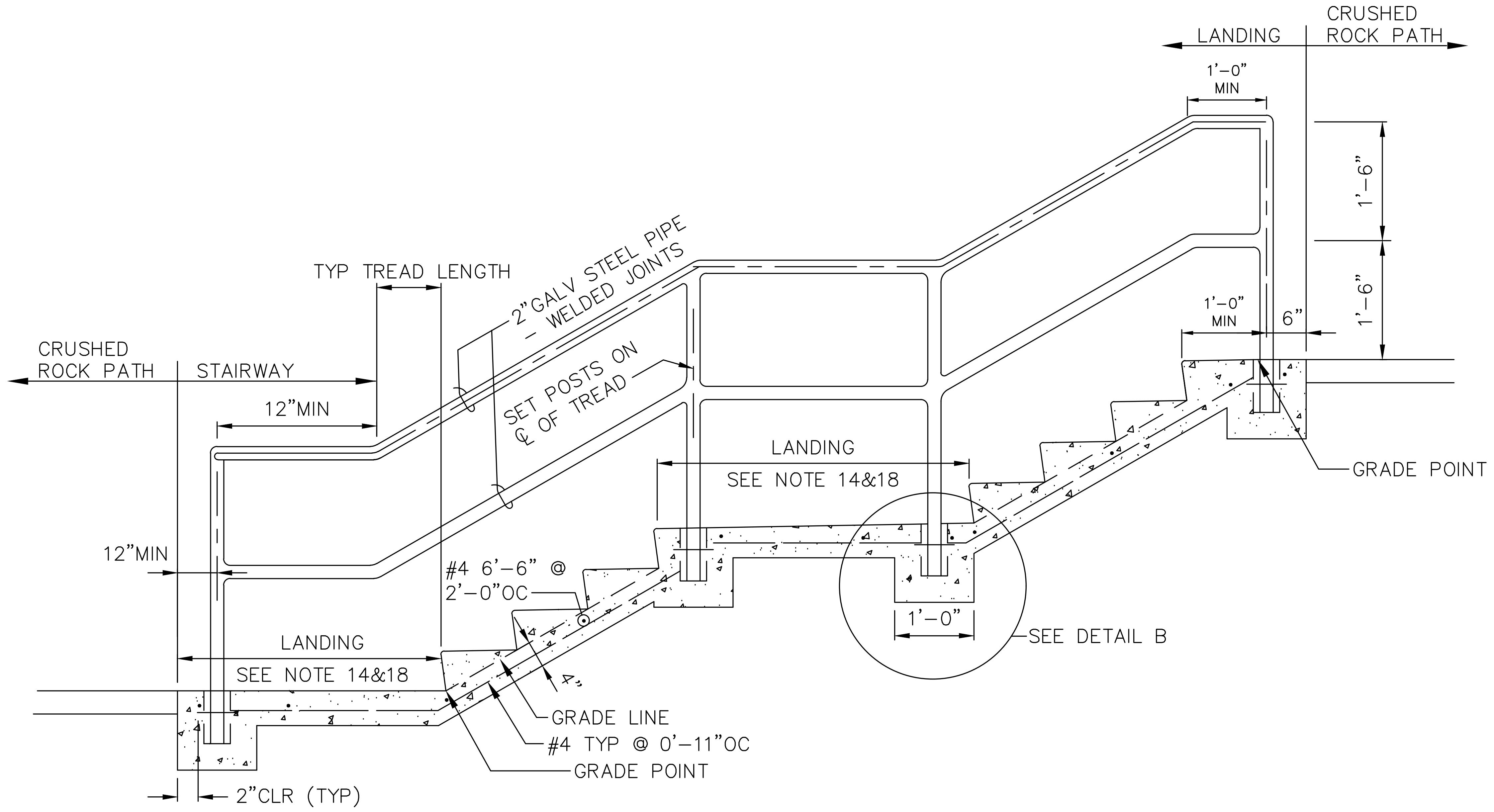
PLANTING DETAILS

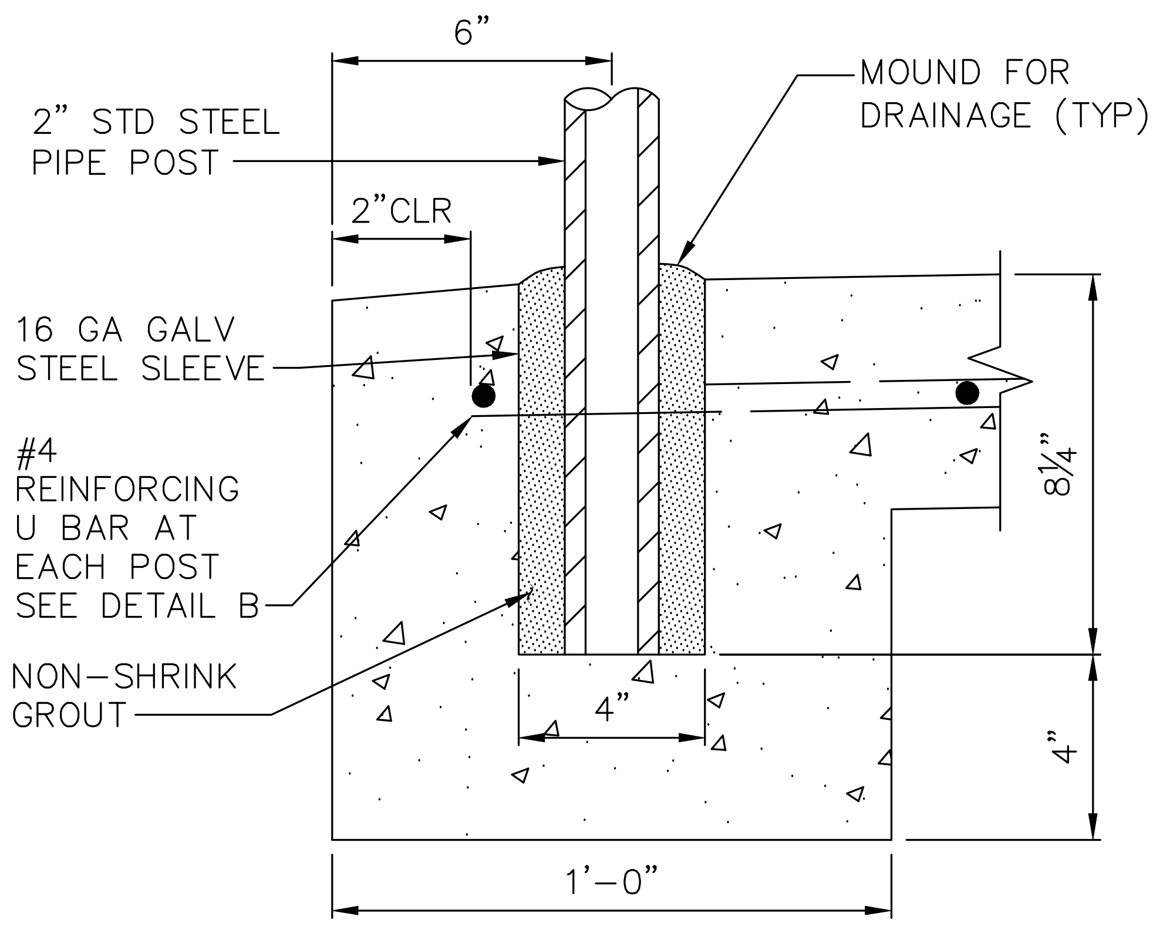
L-03.1

SHEET # **19** OF **33**

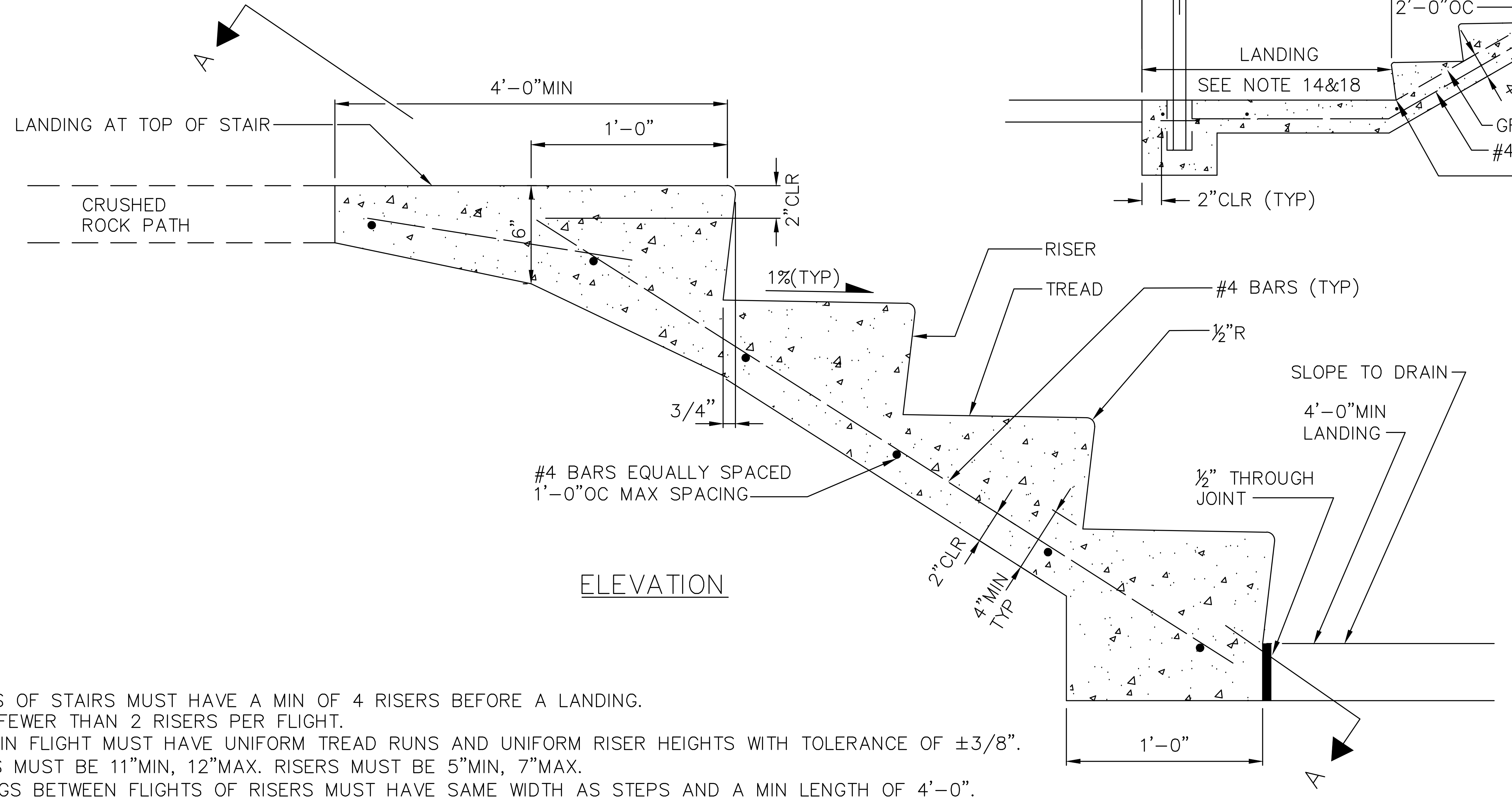


SIDE VIEW

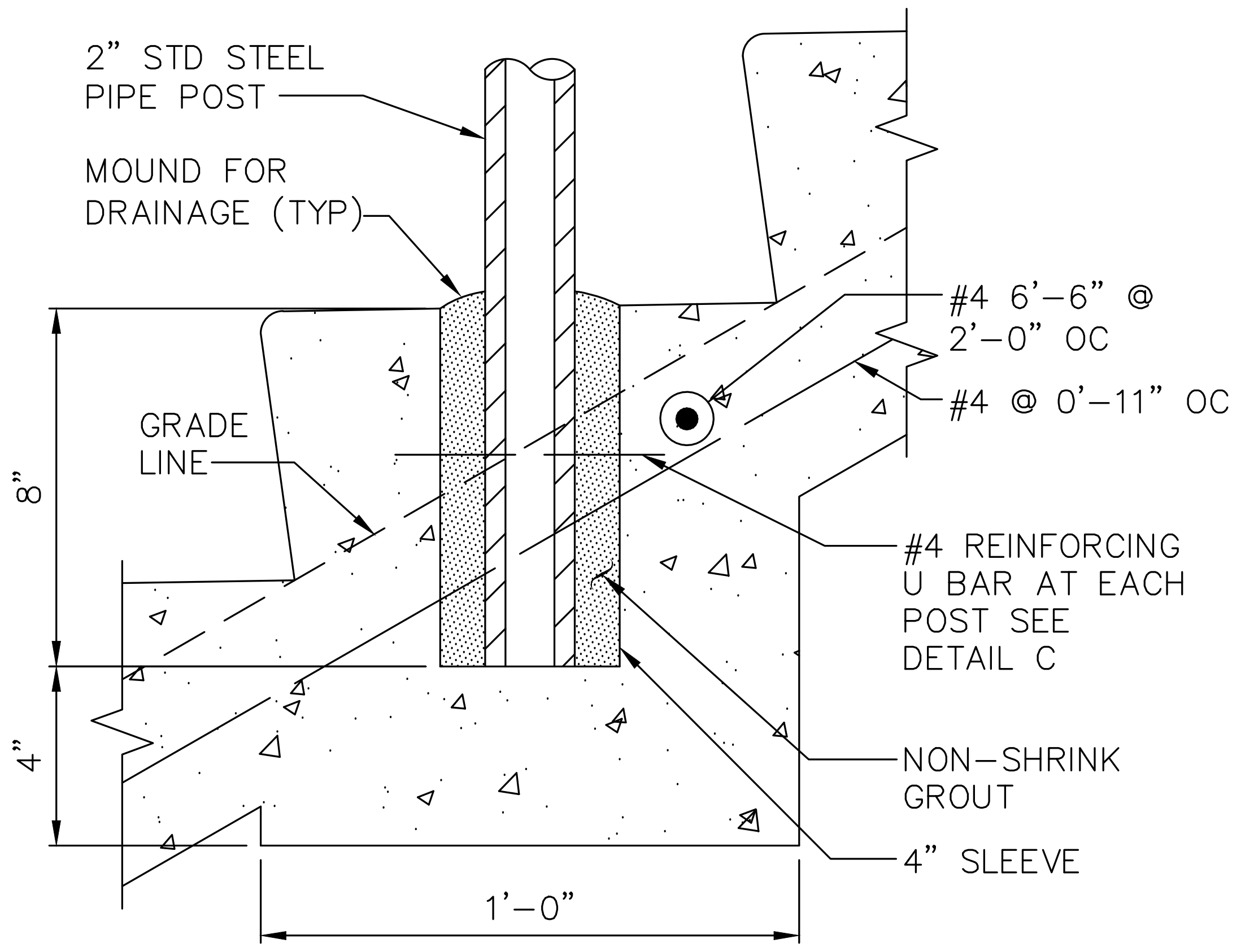




DETAIL A



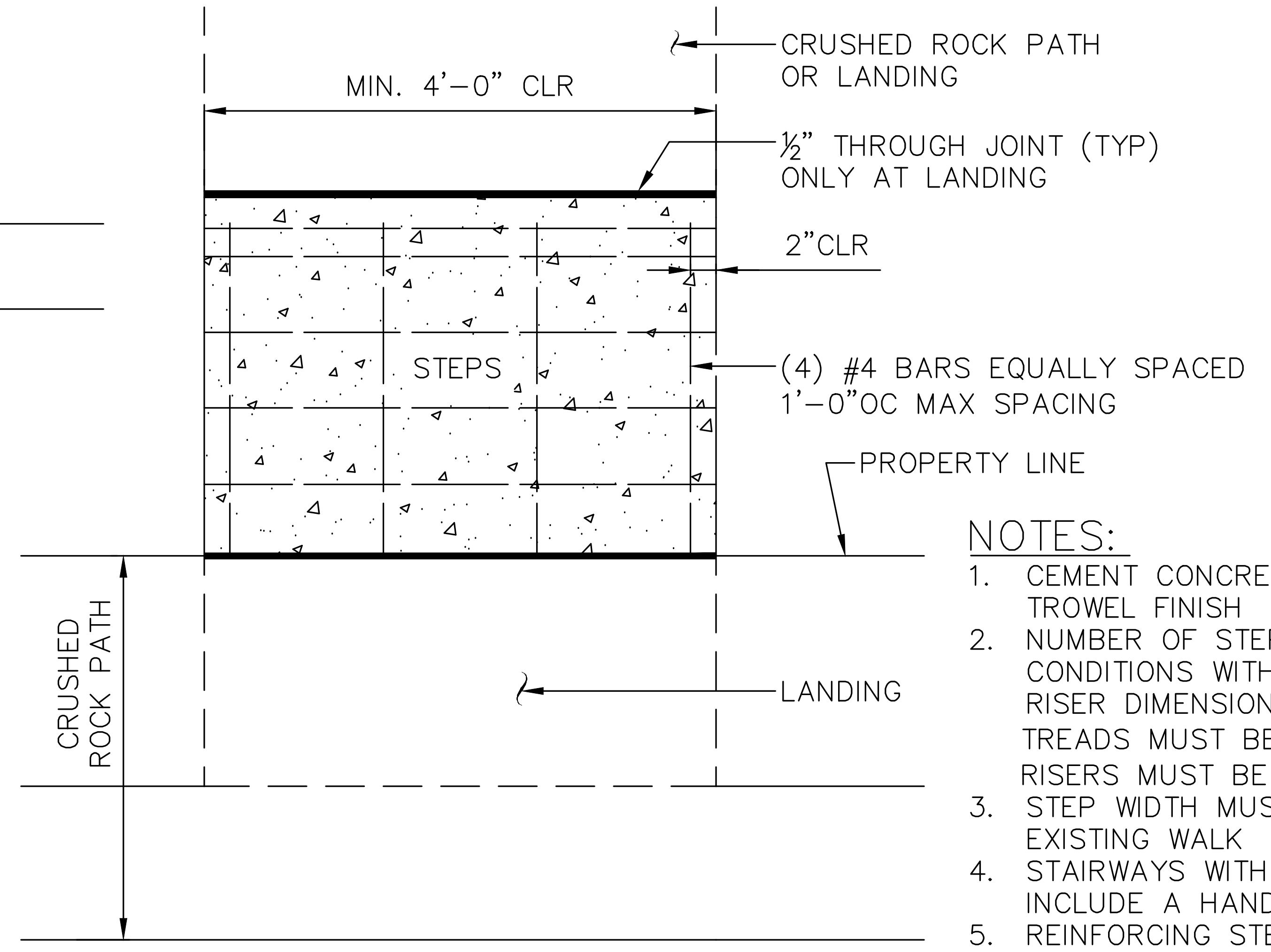
ELEVATION



DETAIL B

NOTES:

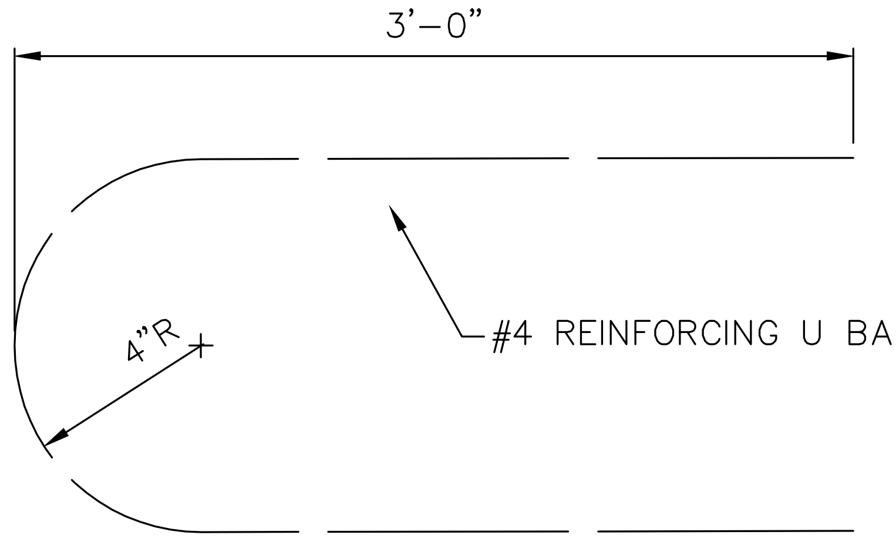
1. FLIGHTS OF STAIRS MUST HAVE A MIN OF 4 RISERS BEFORE A LANDING.
2. AVOID FEWER THAN 2 RISERS PER FLIGHT.
3. STEPS IN FLIGHT MUST HAVE UNIFORM TREAD RUNS AND UNIFORM RISER HEIGHTS WITH TOLERANCE OF ±3/8".
4. TREADS MUST BE 11"MIN, 12"MAX. RISERS MUST BE 5"MIN, 7"MAX.
5. LANDINGS BETWEEN FLIGHTS OF RISERS MUST HAVE SAME WIDTH AS STEPS AND A MIN LENGTH OF 4'-0".
6. STAIRWAYS WITH 1 OR MORE RISERS MUST HAVE HANDRAILS ON BOTH SIDES.
7. HANDRAILS MUST BE CONTINUOUS ACROSS LANDINGS BETWEEN FLIGHTS OF STEPS.
8. ALL STEEL MUST BE HOT DIPPED GALVANIZED.
9. PIPE MATERIAL MUST BE ASTM A53 AND ROUND BAR ASTM A36.
10. REINFORCING STEEL MUST BE ASTM A615 GR 60.
11. (NOT USED)
12. PIPE DIAMETERS SHOWN CORRESPOND TO PIPE "SHAPE" AS DEFINED IN AMERICAN INSTITUTE OF STEEL CONSTRUCTION MANUAL.
13. CONCRETE CLASS CL3000.
14. LANDINGS MUST BE 0.5%MIN FOR A MIN LENGTH OF 4.
15. TREAD SURFACE MUST HAVE GROOVES AT THE NOSE FOR TRACTION.
16. (NOT USED)
17. (NOT USED)
18. DIMENSION FROM THE BOTTOM LANDING RAILING TO THE NOSE OF THE TREAD MUST BE 12"MIN + 1 TREAD LENGTH.
19. HANDRAIL GRIPPING SURFACE AND ADJACENT SURFACES MUST BE FREE FROM SHARP OR ABRASIVE ELEMENTS AND MUST HAVE ROUNDED EDGES.
20. BOTTOM HANDRAIL EXTENSION MUST EXTEND ONE TREAD LENGTH MINIMUM PARALLEL TO THE SLOPE OF THE STAIR BEYOND BOTTOM STAIR NOSING.
21. TOP HANDRAIL EXTENSION MUST EXTEND HORIZONTALLY ABOVE LANDING 12" MINIMUM BEYOND TOP STAIR NOSING.
22. (NOT USED)
23. EXTERNAL VENT HOLES MUST BE AS CLOSE TO THE WELD AS POSSIBLE AND MUST BE 25% THE SIZE OF THE I.D. OF THE PIPE, BUT NOT LESS THAN ⅜" IN DIA.
24. VENT HOLES IN END SECTIONS OR IN SIMILAR SECTIONS MUST BE ½" IN DIA.
25. ENDS MUST BE LEFT COMPLETELY OPEN. ANY DEVICE USED FOR FIELD-ERECTION THAT PREVENTS FULL OPENINGS ON ENDS OF HORIZONTAL RAILS AND VERTICAL LEGS MUST BE GALVANIZED SEPARATELY AND ATTACHED AFTER GALVANIZING.



SECTION A-A

NOTES:

1. CEMENT CONCRETE MUST BE CL 3000 TROWEL FINISH
2. NUMBER OF STEPS MUST SUIT INDIVIDUAL CONDITIONS WITH UNIFORM TREAD AND RISER DIMENSIONS AS FOLLOWS:
   TREADS MUST BE 11"MIN – 1'-0"MAX
   RISERS MUST BE 5"MIN – 7"MAX
3. STEP WIDTH MUST MATCH WIDTH OF EXISTING WALK
4. STAIRWAYS WITH 1 OR MORE RISERS MUST INCLUDE A HANDRAIL ON BOTH SIDES.
5. REINFORCING STEEL ASTM A 615 GR60
6. TREAD SLOPES OUTWARD @1%



DETAIL C

1 TYPICAL STAIRS AT LEVEE
-
Scale: NTS

DRAFT-NOT FOR CONSTRUCTION

ONE INCH
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WATERFRONT ENVIRONMENTAL

Wild Fish Conservancy
NORTHWEST

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FINN CREEK RESTORATION
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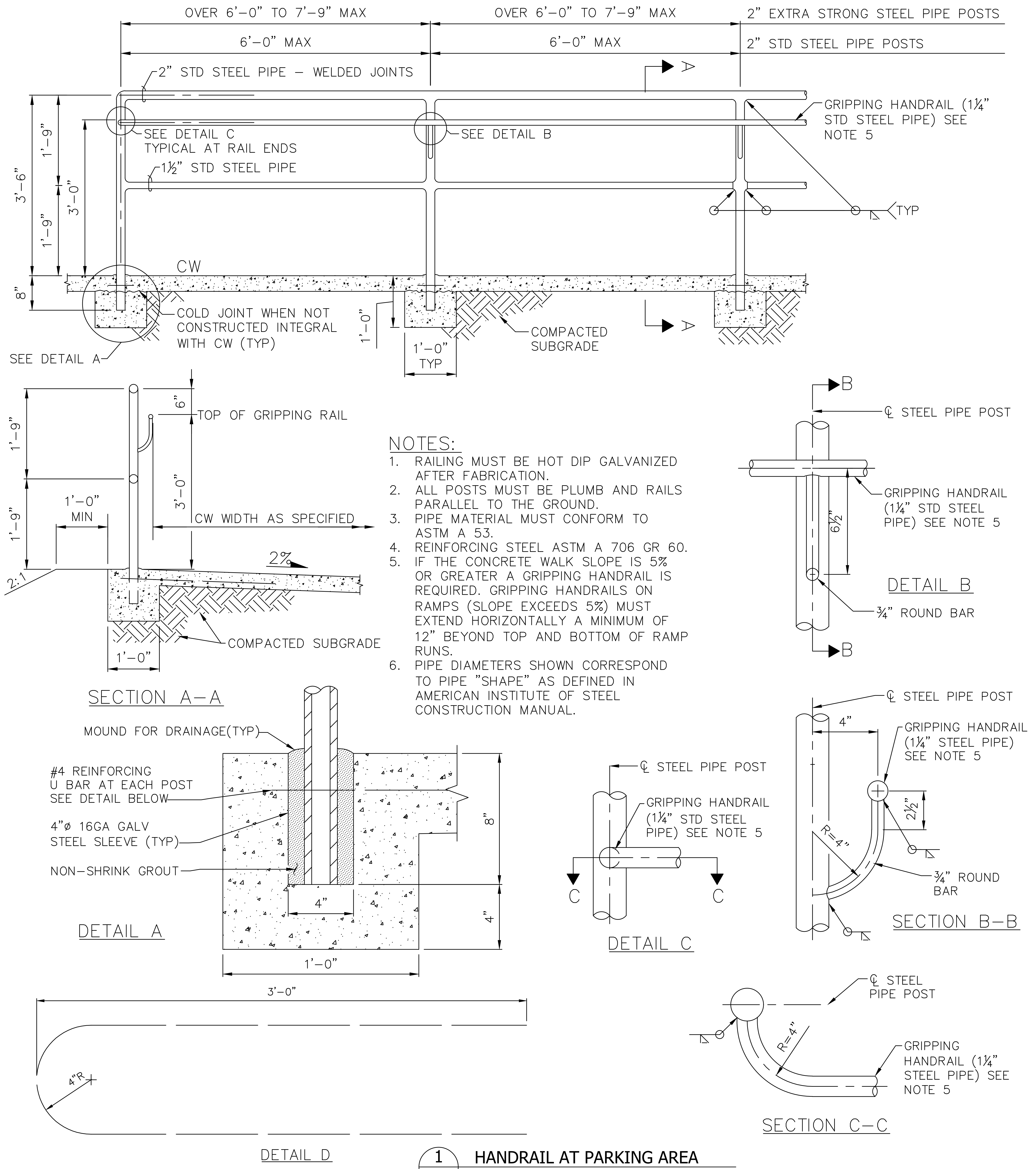
SITE DETAILS

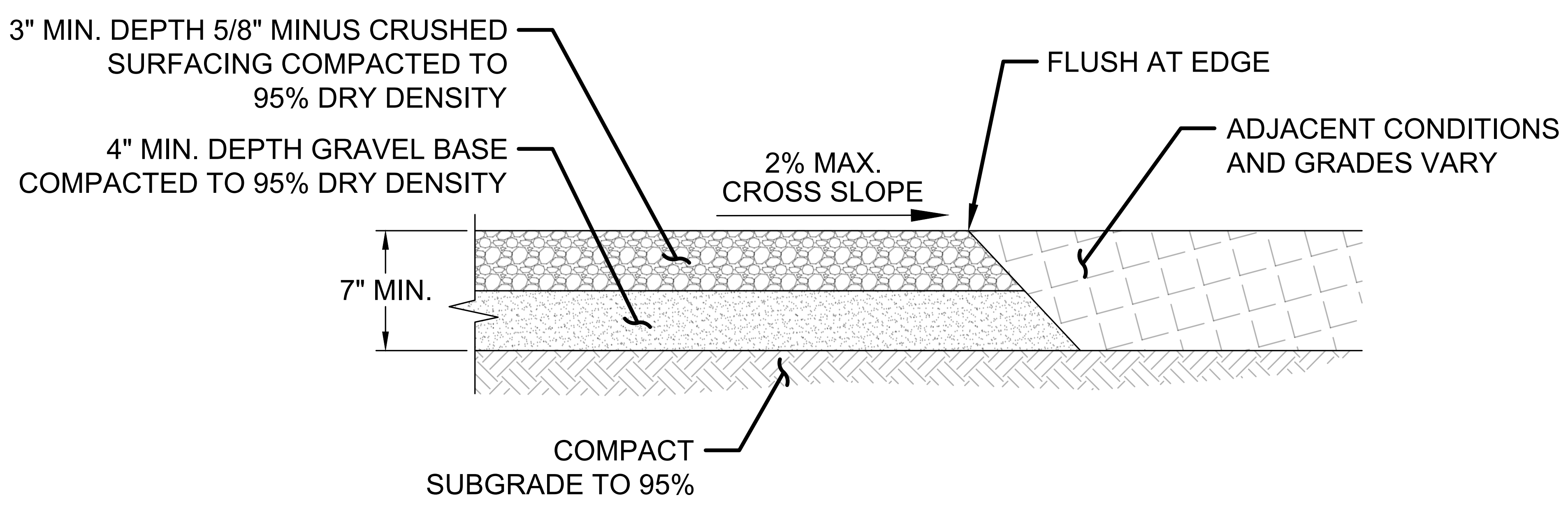
L-04.0

SHEET # 20 OF 33

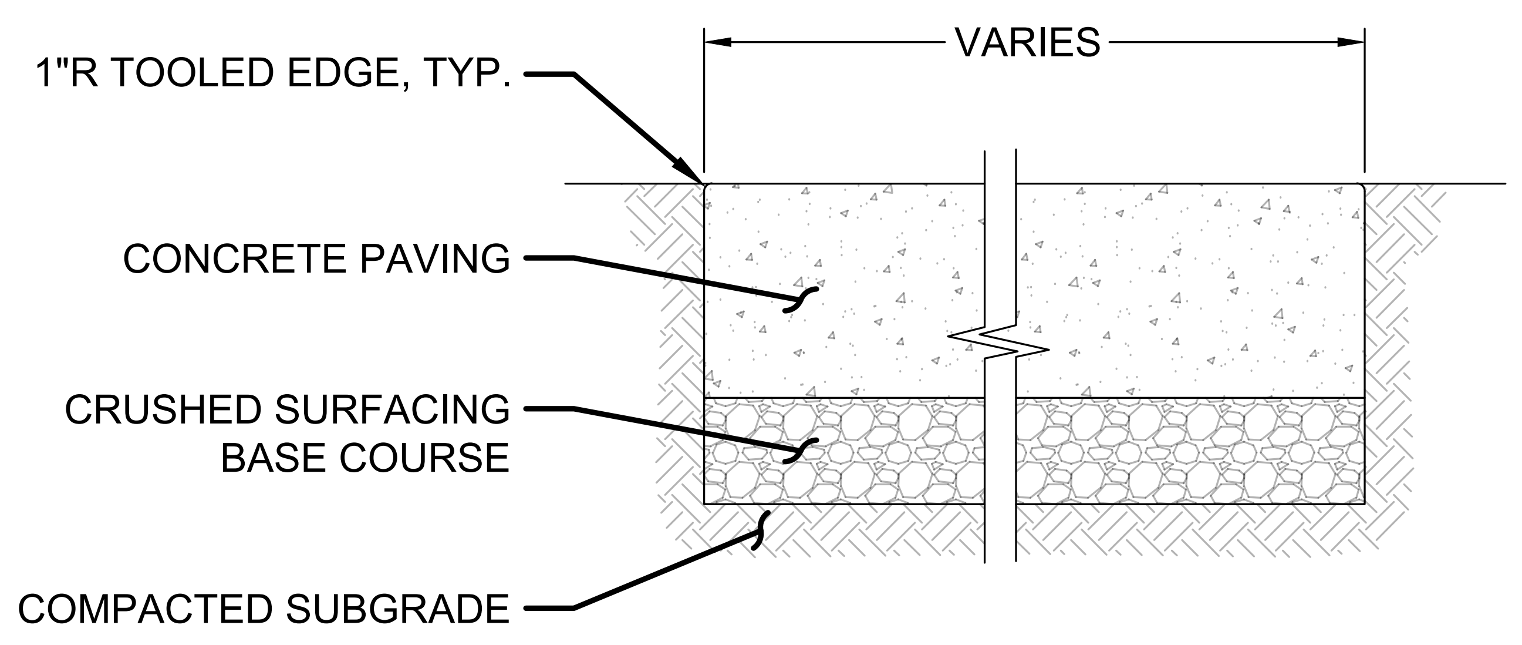


NOTES:
1. RAILING MUST BE HOT DIP GALVANIZED AFTER FABRICATION.
2. ALL POSTS MUST BE PLUMB AND RAILS PARALLEL TO THE GROUND.
3. PIPE MATERIAL MUST CONFORM TO ASTM A 53.
4. REINFORCING STEEL ASTM A 706 GR 60.
5. IF THE CONCRETE WALK SLOPE IS 5% OR GREATER A GRIPPING HANDRAIL IS REQUIRED. GRIPPING HANDRAILS ON RAMPS (SLOPE EXCEEDS 5%) MUST EXTEND HORIZONTALLY A MINIMUM OF 12" BEYOND TOP AND BOTTOM OF RAMP RUNS.
6. PIPE DIAMETERS SHOWN CORRESPOND TO PIPE "SHAPE" AS DEFINED IN AMERICAN INSTITUTE OF STEEL CONSTRUCTION MANUAL.

1
-
HANDRAIL AT PARKING AREA
Scale: NTS

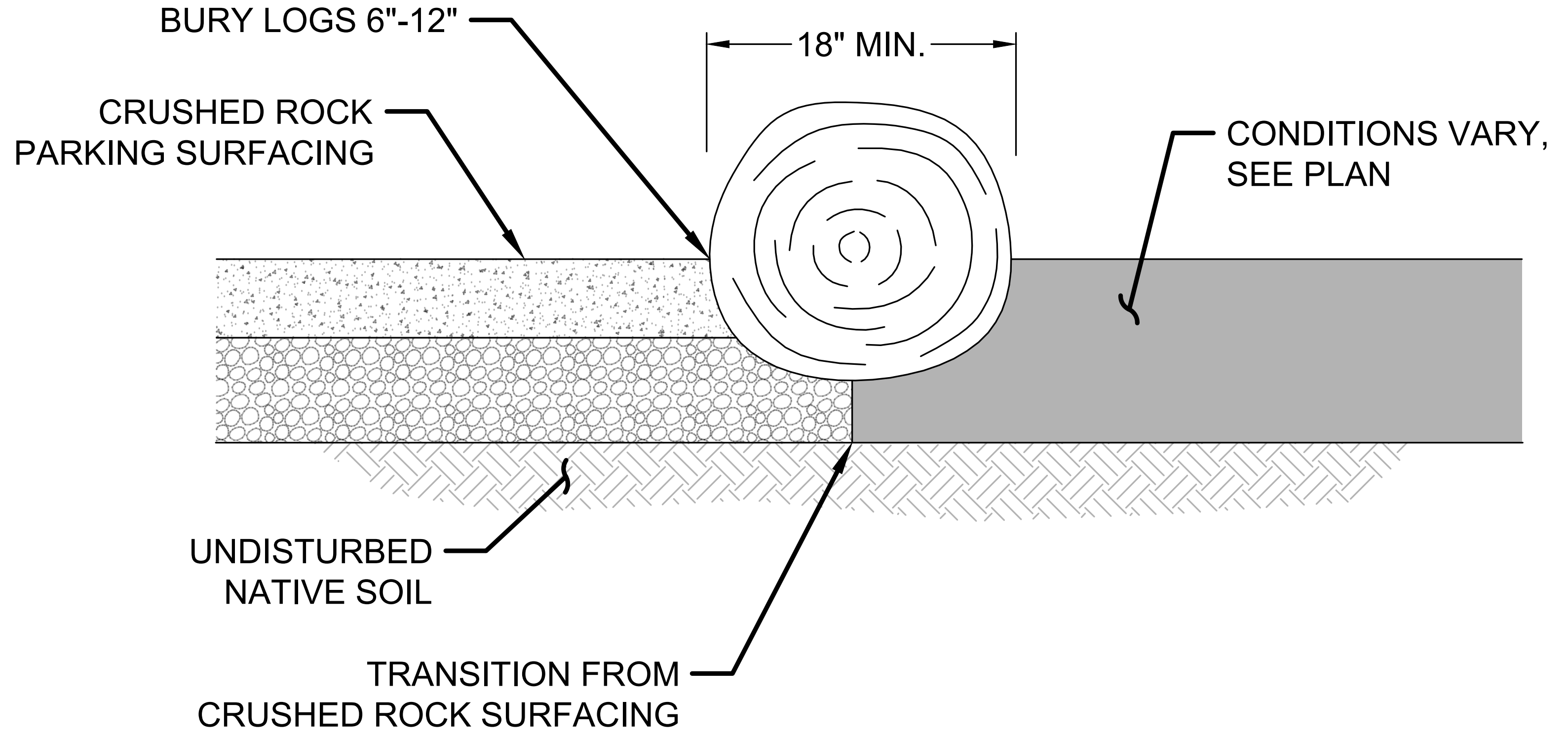


2
-
CRUSHED ROCK PATH
Scale: NTS



NOTES
1. FOR DIMENSIONS AND REQUIRED REINFORCEMENT SEE SPECIFICATIONS

3
-
CONCRETE PAD AT RELOCATED PAVILION
Scale: NTS



4
-
LOG BARRIER AT PARKING AREA
Scale: NTS

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WATERFRONT ENVIRONMENTAL

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SITE DETAILS

L-04.1

SHEET # **21** OF **33**

SECTION 16, TOWNSHIP 28 NORTH, RANGE 02 EAST, WILLAMETTE MERIDIAN, CITY OF HANSVILLE, KITSAP COUNTY, WASHINGTON

FINN CREEK RESTORATION

SITE IMPROVEMENTS PLAN

39118 HANSVILLE RD NE, HANSVILLE, WA 98340

LEGEND

EXISTING SYMBOL LEGEND

- ◎ FND IP
- FND MON (DESCRIBE IN NOTES)
- ○ FND REBAR
- ◉ SET IRON PIPE
- CATCH BASIN
- Ⓓ STORM DRAIN CLEAN OUT
- BUSH
- LARGE ROCK
- CONFIR TREE
- BOLLARD
- ∘ GATE POST
- FLAG POLE
- MB MAIL BOX
- MONITORING WELL/PIEZOMETER/BORING
- ROAD SIGN
- ♿ HANDICAP SYMBOL
- Ⓒ COMMUNICATIONS MANHOLE
- dp U/G UTILITY DROP FROM POLE
- E ELEC. BOX ON CONC./SHOTS ON PED ON PAD COR.
- ELECTRICAL METER
- → GUY ANCHOR
- GP GUY POLE
- T PHONE PEDASTAL
- UTILITY POLE
- YARD LIGHT
- H2O BLOWOFF VALVE
- FIRE HYDRANT
- hb HOSE BIB (FAUCET)
- Ⓘ IRRIGATION BOX
- W WATER METER
- WATER VALVE

EXISTING LINE LEGEND

- 200 MAJOR CONTOUR LINE
- MINOR CONTOUR LINE
- EDGE OF WATER
- >> CENTER LINE DITCH
- CULVERT
- EAVE OVERHANG
- X FENCE
- GUARD RAIL
- SINGLE YELLOW DASH STRIPE
- DOUBLE YELLOW STRIPE
- SINGLE YELLOW STRIPE W/DASH STRIPE
- WHITE STRIPE/FOG LINE
- EDGE OF CONCRETE
- EDGE OF GRAVEL
- UNDERGROUND WATER LINE
- UNDERGROUND CABLE LINE
- UNDERGROUND POWER LINE
- UNDERGROUND FIBER OPTIC LINE
- OVERHEAD POWER, TELEPHONE & CABLE LINE
- OCM OVERHEAD COMMUNICATION LINE
- OVERHEAD ELECTRIC LINE

PROPOSED SYMBOL LEGEND

- PROPOSED STREET SIGN
- ■ PROPOSED STORM DRAIN CATCH BASIN
- PROPOSED STORM DRAIN MANHOLE
- PROPOSED CAVFS

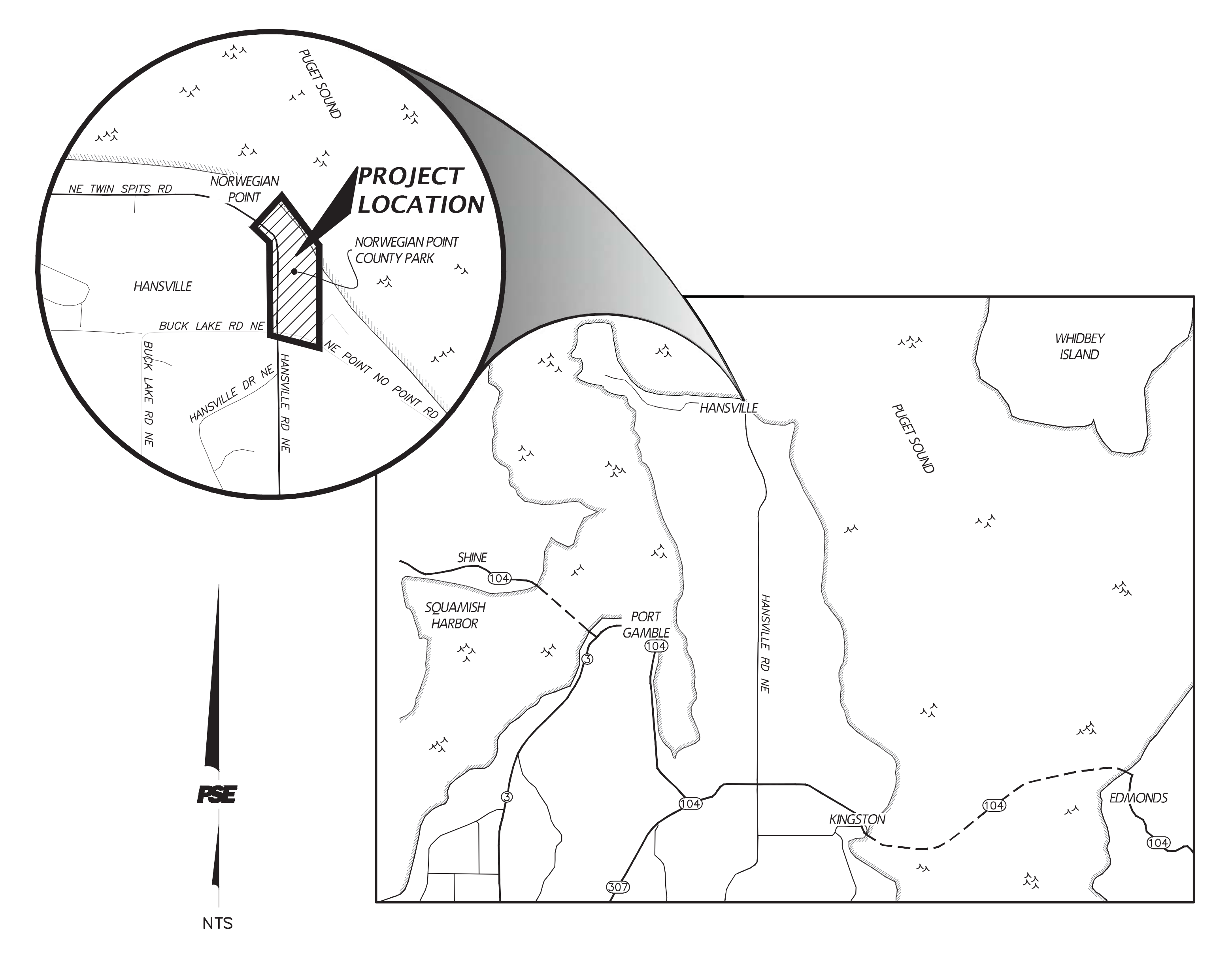
PROPOSED LINE LEGEND

- = PROPOSED EDGE OF ASPHALT
- = PROPOSED EDGE OF CONCRETE
- = PROPOSED SIDEWALK
- = PROPOSED STRIPE
- = PROPOSED SAWCUT LIMITS
- SD = PROPOSED STORM DRAIN LINE
- TOP = PROPOSED TOP OF SLOPE LINE
- = PROPOSED SLOPE DIRECTION ARROW
- TOE = PROPOSED TOE OF SLOPE LINE
- 125 = PROPOSED FINISHED GRADE INDEX CONTOUR
- 124 = PROPOSED FINISHED GRADE INTERVAL CONTOUR

SHEET INDEX

SHEET NUMBER	SHEET TITLE
SW-1	COVER
SW-2	OVERALL
SW-3	EXISTING CONDITIONS SW
SW-4	EXISTING CONDITIONS NW
SW-5	EXISTING CONDITIONS SE
SW-6	EXISTING CONDITIONS NE
SW-7	HANSVILLE SITE PLAN SW
SW-8	HANSVILLE SITE PLAN NW
SW-9	DRIVEWAY SITE PLAN SE
SW-10	DRIVEWAY SITE PLAN NE
SW-11	TEMPORARY EROSION & SEDIMENT CONTROL PLAN
SW-12	ROAD & ACCESS DETAILS

VICINITY MAP



SURVEY NOTES

BASE MAP PREPARED BY KITSAP COUNTY PUBLIC WORKS SURVEY DEPARTMENT (AUGUST, 2023), FROM FIELD SURVEY DATA COLLECTED JULY 2023. KITSAP COUNTY DID NOT VERIFY NOR EDIT ANY OF THE MAPPING DATA FROM AES CONSULTANTS, INC. BASE MAP SUPPLIED TO THE ENGINEERING DESIGN TEAM.

HORIZONTAL DATUM: NAD83(1991), WASHINGTON PLANE COORDINATE SYSTEM (NORTH ZONE), AS ESTABLISHED BY AES CONSULTANTS, INC. FOR KITSAP COUNTY PARKS DEPARTMENT.

VERTICAL DATUM: NGVD 1929 AS ESTABLISHED BY AES CONSULTANTS, INC. FOR KITSAP COUNTY PARKS DEPARTMENT.

CONTOUR INTERVAL IS ONE–FOOT AND ARE COMPUTER GENERATED FROM GROUND FIELD TOPOGRAPHY GATHERED FOR THIS SURVEY UTILIZING ELECTRONIC DATA COLLECTION. KITSAP COUNTY GENERATED SURFACE MODEL FROM OUR OWN DATA. KITSAP COUNTY MERGED COUNTY AND AES SURFACE MODELS FOR THE ENGINEERING DESIGN TEAM.

SUBSURFACE UTILITY LINES WERE MARKED AS PART OF "MT. VIEW LOCATING SERVICES LLC" LOCATE REQUEST. UTILITY SURFACE LINES AND FEATURES WERE LOCATED AND SHOWN ON THE BASE MAP AS ACCURATELY AS POSSIBLE FROM FIELD MARKINGS. PORTIONS OF THE WATERLINE IS SHOWN ON THE BASE MAP WHERE IT WAS TRACEABLE. ENGINEERING DESIGN WILL BE REQUIRED TO CONTACT WATER PROVIDER TO CONFIRM UNKNOWN LOCATIONS.

NO ADDITIONAL WETLAND FLAGS WERE LOCATED AS PART OF THE KITSAP COUNTY MAPPING. THERE MAY BE ADDITIONAL WETLANDS BEYOND THE MAPPING LIMITS OF THE AES CONSULTANTS, INC. BASE MAP.

ABBREVIATIONS

ACP	ASPHALT CONCRETE PAVING
ADA	AMERICAN DISABILITIES ACT
A.F.#	AUDITOR'S FILE NUMBER
APWA	AMERICAN PUBLIC WORKS ASSOCIATION
APPROX.	APPROXIMATE
A.D.	ALGEBRAIC DIFFERENCE
B/C	BACK OF CURB
BW	BOTTOM OF WALL
BMP	BEST MANAGEMENT PRACTICE
CB	CATCH BASIN
BVCS	BEGINNING VERTICAL CURVE STATION
BVCE	BEGINNING VERTICAL CURVE ELEVATION
C&G	CURB AND GUTTER
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CONC.	CONCRETE
DIA.	DIAMETER
CPP	CORRUGATED POLYETHYLENE PIPE
EG	EXISTING GRADE
EL.	ELEVATION
EOP	EDGE OF PAVEMENT
EVCS	ENDING VERTICAL CURVE STATION
EX.	EXISTING
EVCE	ENDING VERTICAL CURVE ELEVATION
F&G	FRAME AND GRATE
F.HYD.	FIRE HYDRANT
F/C	FACE OF CURB
FF	FINISH FLOOR
FG	FINISH GRADE
FL	FLOWLINE
FS	FINISH SURFACE
GA.	GAUGE
GALV.	GALVANIZED
H.C.	HANDICAP
I.E.	INVERT ELEVATION
INV.	INVERT
K	RATE OF VERTICAL CURVATURE
LT	LEFT
LF	LINEAL FEET
MAX.	MAXIMUM
MIN.	MINIMUM
N.I.C.	NOT IN CONTRACT
NVPA	NATIVE VEGETATION PROTECTION AREA
OHWM	ORDINARY HIGH WATER MARK
PROP.	PROPOSED
PERF.	PERFORATED
PVC	POLYVINYL CHLORIDE
PVI	POINT OF VERTICAL INFLECTION
PC	POINT OF CURVATURE
PT	POINT OF TANGENCY
R=	CURVE RADIUS
RT	RIGHT
R/W	RIGHT OF WAY
SD	STORM DRAIN
SDCB	STORM DRAIN CATCH BASIN
SDR	STANDARD DIAMETER RATIO
SDMH	STORM DRAIN MANHOLE
SVC	SERVICE
SPEC.	SPECIFICATION
SSCO	SANITARY SEWER CLEAN–OUT
SSMH	SANITARY SEWER MANHOLE
STD	STANDARD
STA	STATION
S/W	SIDEWALK
SF	SQUARE FOOT
T/W	TOP OF WALL
TBOC	TOP BACK OF CURB
TC	TOP OF CURB
TF	TOP OF FOOTING
TP	TOP OF PIPE
TYP.	TYPICAL
VC	VERTICAL CURVE LENGTH
WM	WATER METER
WSDOE	WASHINGTON STATE DEPT. OF ECOLOGY
WSDOT	WASHINGTON STATE DEPT. OF TRANSPORTATION

CALL BEFORE YOU DIG 1-800-424-5555

REVISION	DATE	DESCRIPTION	ISSUE	DATE	DESCRIPTION
			1	01/29/2024	30% DESIGN

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1504 24TH ST
BELLINGHAM, WA 98225
(360)319-8069

FINN CREEK RESTORATION
HANSVILLE, WA
SITE IMPROVEMENTS

COVER

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VERT. SCALE:	XXX		VERT.:	XXX

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SHEET SW-1 OF SW-12

DAVID P. GALBRAITH JR.
44679
01-29-2024

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VERT. SCALE:	XXX		VERT.:	XXX

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SHEET SW-2 OF SW-12

DAVID P. GALBRAITH JR.
44679
07-29-2024

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FINN CREEK RESTORATION
HANSVILLE, WA
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EXISTING CONDITIONS SW

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VERT. SCALE:	XXX		VERT.:	XXX

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SHEET SW-3 OF SW-12

DAVID P. GALBRAITH JR.
44679
01-29-2024

CULVERT
30" CONC IE=4.46'

4"X3" METAL TRASH RACK

CULVERT
30" CONC IE=4.49'

CONCRETE STRUCTURE
FOR OUTLET CONC. INTO CB

CB#3635 TYPE 2
RIM=11.05'
30" CONC (NE) IE=4.02'
PIPE w/ FLOOD GATE (W)
IE=±4.15'
SUMP=3.58'

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HANSVILLE, WA
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VERT. SCALE:	XXX		VERT.:	XXX

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SHEET SW-4 OF SW-12

DAVID P. GALBRAITH Jr.
44679
01-29-2024

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FINN CREEK RESTORATION
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VERT. SCALE:	XXX		VERT.:	XXX

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SHEET SW-5 OF SW-12

DAVID P. GALBRAITH JR.
44679
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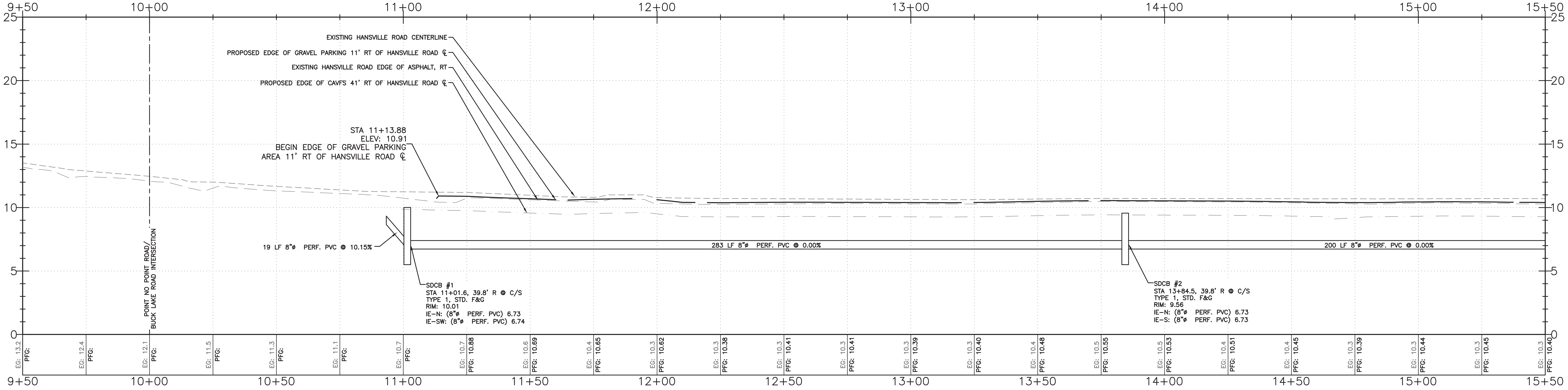
SHEET SW-6 OF SW-12

DAVID P. GALBRAITH Jr.
44679
01-29-2024



HANSVILLE ROAD PROFILE

H. SCALE: 1"=20' V. SCALE: 1"=4'

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FINN CREEK RESTORATION
HANSVILLE, WA
SITE IMPROVEMENTS

HANSVILLE SITE PLAN SW

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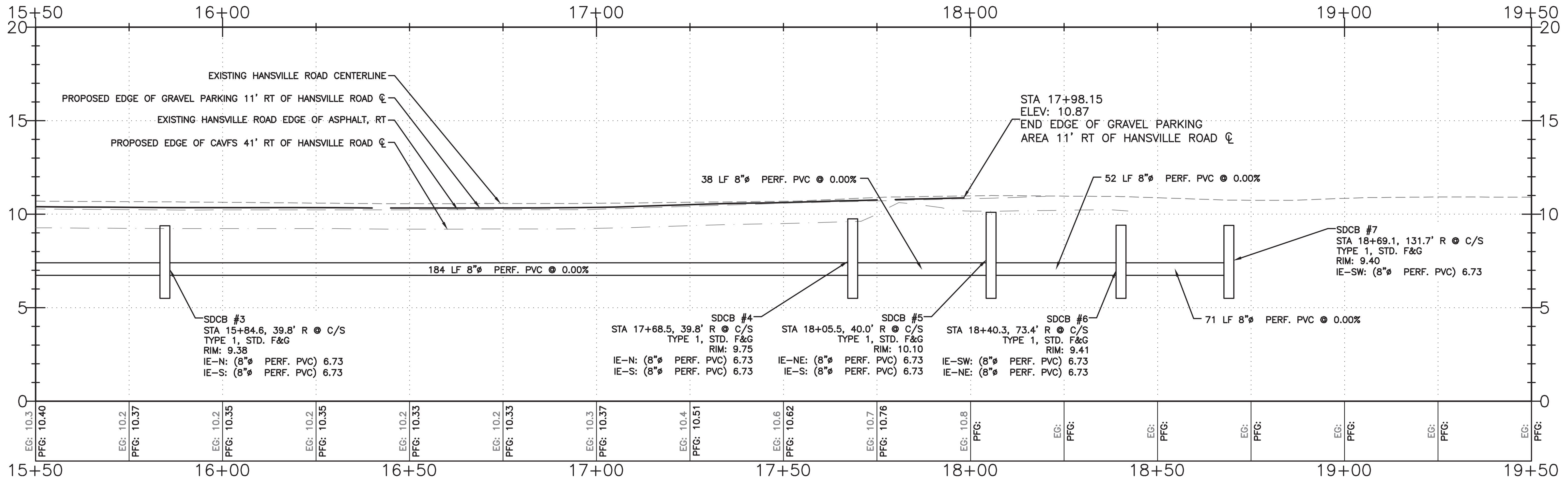
SHEET SW-7 OF SW-12

DAVID P. GALBRAITH JR.
44679
01-29-2024



HANSVILLE ROAD PROFILE

H. SCALE: 1"=20' V. SCALE: 1"=4'

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FINN CREEK RESTORATION
HANSVILLE, WA
SITE IMPROVEMENTS

HANSVILLE SITE PLAN NW

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SHEET SW-8 OF SW-12

DAVID P. GALBRAITH JR.
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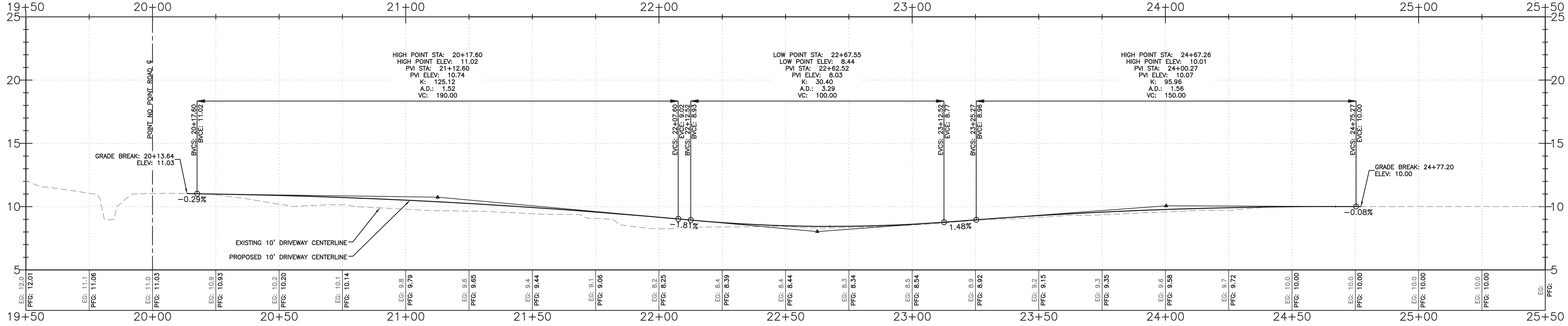

PROPOSED DRIVEWAY PROFILE

H. SCALE: 1"=20'   V. SCALE: 1"=4'

CALL BEFORE YOU DIG 1-800-424-5555

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FINN CREEK RESTORATION
HANSVILLE, WA
SITE IMPROVEMENTS

DRIVEWAY SITE PLAN SE

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SHEET SW-9 OF SW-12

DAVID P. GALBRAITH JR.
44679
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FINN CREEK RESTORATION
HANSVILLE, WA
SITE IMPROVEMENTS

DRIVEWAY SITE PLAN NE

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VERT. SCALE:	XXX		VERT.:	XXX

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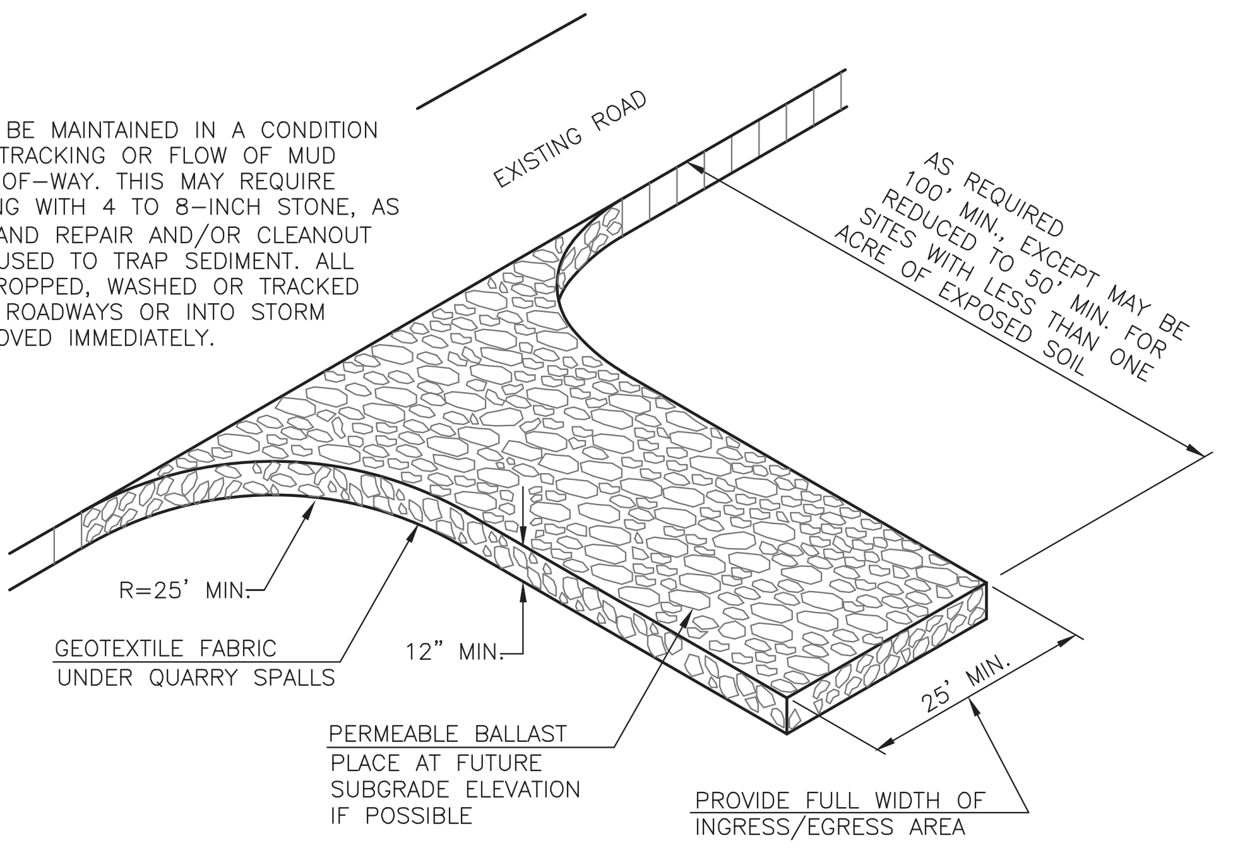
SHEET SW-10 OF SW-12

DAVID P. GALBRAITH JR.
44679
01-29-2024

MAINTENANCE:

THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOW OF MUD ONTO PUBLIC RIGHTS-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH 4 TO 8-INCH STONE, AS CONDITIONS DEMAND, AND REPAIR AND/OR CLEANOUT OF ANY STRUCTURES USED TO TRAP SEDIMENT. ALL MATERIALS SPILLED, DROPPED, WASHED OR TRACKED FROM VEHICLES ONTO ROADWAYS OR INTO STORM DRAINS MUST BE REMOVED IMMEDIATELY.

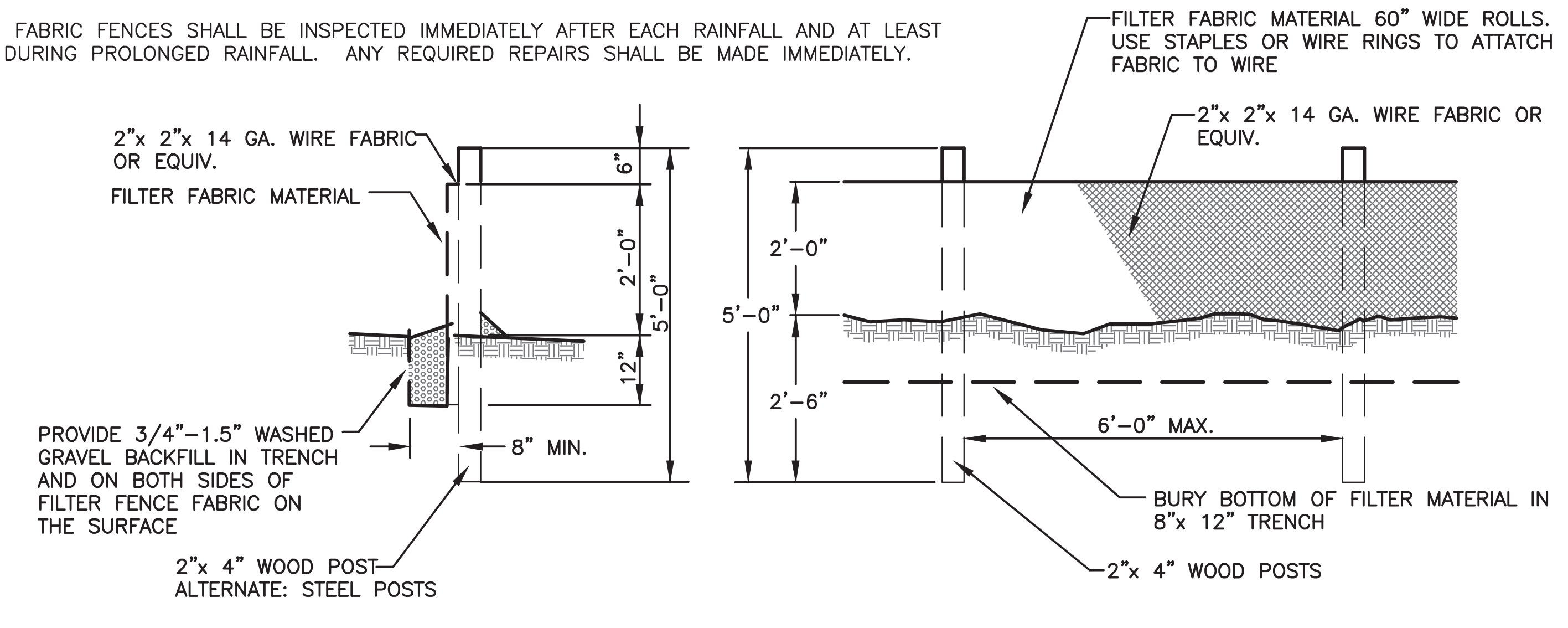


ROCK STABILIZATION CONSTRUCTION ROAD ENTRANCE

NOT TO SCALE

FILTER FENCE NOTES

1. THE FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID USE OF JOINTS. WHEN JOINTS ARE NECESSARY, FILTER CLOTH SHALL BE SPLICED TOGETHER ONLY AT A SUPPORT POST WITH A MINIMUM 6-INCH OVERLAP AND BOTH ENDS SECURELY FASTENED TO THE POST.
2. THE FILTER FABRIC FENCE SHALL BE INSTALLED TO FOLLOW THE CONTOURS (WHERE FEASIBLE). THE FENCE POSTS SHALL BE SPACED AT A MAXIMUM OF 6 FEET APART AND DRIVEN SECURELY INTO THE GROUND (MINIMUM OF 30 INCHES).
3. A TRENCH SHALL BE EXCAVATED, ROUGHLY 8 INCHES WIDE AND 12 INCHES DEEP, UPSLOPE AND ADJACENT TO THE WOOD POST TO ALLOW THE FILTER FABRIC TO BE BURIED.
4. WHEN STANDARD STRENGTH FILTER FABRIC IS USED, A WIRE MESH SUPPORT FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY-DUTY WIRE STAPLES AT LEAST 1 INCH LONG, TIE WIRES OR HOG RINGS. THE WIRE SHALL EXTEND INTO THE TRENCH A MINIMUM OF 4 INCHES AND SHALL NOT EXTEND MORE THAN 36 INCHES ABOVE THE ORIGINAL GROUND SURFACE.
5. THE STANDARD STRENGTH FILTER FABRIC SHALL BE STAPLED OR WIRED TO THE FENCE AND 20 INCHES OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. THE FABRIC SHALL NOT EXTEND MORE THAN 36 INCHES ABOVE THE ORIGINAL GROUND SURFACE. FILTER FABRIC SHALL NOT BE STAPLED TO EXISTING TREES.
6. WHEN EXTRA STRENGTH FILTER FABRIC AND CLOSER POST SPACING ARE USED, THE WIRE MESH SUPPORT FENCE MAY BE ELIMINATED. IN SUCH A CASE, THE FILTER FABRIC IS STAPLED OR WIRED DIRECTLY TO THE POSTS WITH ALL OTHER PROVISIONS OF STANDARD NOTE 5 APPLYING.
7. THE TRENCH SHALL BE BACKFILLED WITH 3/4-INCH MINIMUM DIAMETER WASHED GRAVEL.
8. FILTER FABRIC FENCES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFUL PURPOSE BUT NOT BEFORE THE UPSLOPE AREA HAS BEEN PERMANENTLY STABILIZED.
9. FILTER FABRIC FENCES SHALL BE INSPECTED IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST DAILY DURING PROLONGED RAINFALL. ANY REQUIRED REPAIRS SHALL BE MADE IMMEDIATELY.



CROSS SECTION VIEW

ELEVATION VIEW

SILT FENCE DETAILS

NOT TO SCALE

TEMPORARY EROSION/SEDIMENTATION CONTROL

1. A COPY OF THESE APPROVED PLANS MUST BE ON THE JOB SITE WHENEVER CONSTRUCTION IS IN PROGRESS.
2. APPROVAL OF THESE TEMPORARY EROSION/SEDIMENTATION CONTROL (TESC) PLANS DOES NOT CONSTITUTE AN APPROVAL OF PERMANENT ROAD OR DRAINAGE DESIGN (E.G., SIZE AND LOCATION OF ROADS, PIPES, RESTRICTORS, CHANNELS, RETENTION FACILITIES, UTILITIES, ETC.).
3. THE IMPLEMENTATION OF THESE TESC PLANS AND THE CONSTRUCTION, MAINTENANCE, REPLACEMENT AND UPGRADING OF THESE TESC FACILITIES IS THE RESPONSIBILITY OF THE CONTRACTOR UNTIL ALL CONSTRUCTION IS APPROVED.
4. THE BOUNDARIES OF THE CLEARING LIMITS SHOWN ON THIS PLAN SHALL BE CLEARLY FLAGGED IN THE FIELD PRIOR TO CONSTRUCTION. DURING THE CONSTRUCTION PERIOD, NO DISTURBANCE BEYOND THE FLAGGED CLEARING LIMITS SHALL BE PERMITTED. THE FLAGGING SHALL BE MAINTAINED BY THE CONTRACTOR FOR THE DURATION OF CONSTRUCTION.
5. THE TESC FACILITIES SHOWN ON THE PLANS MUST BE CONSTRUCTED PRIOR TO ALL, AS FEASIBLE, CLEARING AND GRADING ACTIVITIES, AND IN SUCH A MANNER AS TO INSURE THAT SEDIMENT LADEN WATER DOES NOT ENTER THE DRAINAGE SYSTEM OR VIOLATE APPLICABLE WATER STANDARDS.
6. THE TESC FACILITIES SHOWN ON THE PLANS ARE THE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE CONDITIONS. DURING THE CONSTRUCTION PERIOD, THESE TESC FACILITIES SHALL BE UPGRADED (E.G., ADDITIONAL SUMPS, RELOCATION OF DITCHES AND SILT FENCES, ETC.) AS NEEDED FOR UNEXPECTED STORM EVENTS.
7. THE TESC FACILITIES SHALL BE INSPECTED DAILY BY THE CONTRACTOR AND MAINTAINED AS NECESSARY TO ENSURE THEIR CONTINUED FUNCTIONING. A RECORD OF EACH INSPECTION AND ANY CORRECTIVE ACTION TAKEN MUST BE RETAINED WITH THE SWPPP.
8. ANY AREA STRIPPED OF VEGETATION, INCLUDING ROADWAY EMBANKMENTS, WHERE NO FURTHER WORK IS ANTICIPATED FOR A PERIOD OF 7 DAYS, SHALL BE IMMEDIATELY STABILIZED WITH THE APPROVED TESC METHODS (E.G., SEEDING, MULCHING, NETTING, EROSION BLANKETS, ETC.).
9. ANY AREA NEEDING TESC MEASURES, NOT REQUIRING IMMEDIATE ATTENTION, SHALL BE ADDRESSED WITHIN FIFTEEN (15) DAYS.
10. THE TESC FACILITIES ON INACTIVE SITES SHALL BE INSPECTED AND MAINTAINED A MINIMUM OF ONCE A MONTH OR WITHIN THE 24 HOURS FOLLOWING A STORM EVENT WITH THE APPROVAL OF ENGINEER.
11. AT NO TIME SHALL MORE THAN ONE FOOT OF SEDIMENT BE ALLOWED TO ACCUMULATE WITHIN A CATCH BASIN. ALL CATCH BASINS AND CONVEYANCE LINES SHALL BE CLEANED PRIOR TO PAVING. THE CLEANING OPERATION SHALL NOT FLUSH SEDIMENT LADEN WATER INTO THE DOWNSTREAM SYSTEM.
12. STABILIZED CONSTRUCTION ENTRANCES AND WASH PADS SHALL BE INSTALLED AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES MAY BE REQUIRED TO INSURE THAT ALL PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.
13. DURING THE TIME PERIOD OF OCTOBER 1 THROUGH APRIL 30, ALL PROJECT DISTURBED AREAS GREATER THAN 5,000 SQUARE FEET, THAT ARE TO BE LEFT UNWORKED FOR MORE THAN 12 HOURS, SHALL BE COVERED BY ONE OF THE FOLLOWING COVER MEASURES: MULCH, SODDING, OR PLASTIC COVERING.
14. ANY PERMANENT RETENTION/DETENTION FACILITY USED AS A TEMPORARY SETTLING BASIN SHALL BE MODIFIED WITH THE NECESSARY EROSION CONTROL MEASURES AND SHALL PROVIDE ADEQUATE STORAGE CAPACITY. IF THE PERMANENT FACILITY IS TO FUNCTION ULTIMATELY AS AN INFILTRATION OR DISPERSION SYSTEM, THE FACILITY SHALL NOT BE USED AS A TEMPORARY SETTLING BASIN. NO UNDERGROUND DETENTION TANK, DETENTION VAULT, OR SYSTEM WHICH BACKS UNDER OR INTO A POND SHALL BE USED AS A TEMPORARY SETTLING BASIN.
15. WHERE SEEDING FOR TEMPORARY EROSION CONTROL IS REQUIRED, FAST GERMINATING GRASSES SHALL BE APPLIED AT AN APPROPRIATE RATE (E.G. ANNUAL OR PERENNIAL RYE APPLIED AT APPROXIMATELY 120 POUNDS PER ACRE).
16. WHERE STRAW MULCH FOR TEMPORARY EROSION CONTROL IS REQUIRED, IT SHALL BE APPLIED AT A MINIMUM THICKNESS OF TWO INCHES.
17. ALL EROSION/SEDIMENTATION CONTROL PONDS WITH A DEAD STORAGE DEPTH EXCEEDING 6 INCHES MUST HAVE SLOPES NOT STEEPER THAN 3H:1V.
18. ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH WASHINGTON STATE DEPARTMENT OF TRANSPORTATION STANDARDS AND SPECIFICATIONS.
19. EROSION/SEDIMENTATION CONTROL FACILITIES SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE DETAILS IN THESE PLANS LOCATIONS MAY BE MOVED TO SUIT FIELD CONDITIONS, SUBJECT TO APPROVAL BY THE ENGINEER AND LOCAL JURISDICTIONAL AUTHORITY.

NPDES NOTES

1. THE CONTRACTOR SHALL KEEP A RECORD OF THE DATES WHEN MAJOR GRADING ACTIVITIES OCCUR, WHEN CONSTRUCTION ACTIVITIES TEMPORARILY OR PERMANENTLY CEASE ON A PORTION OF THE SITE, AND WHEN STABILIZATION MEASURES ARE IMPLEMENTED.
2. ALL EROSION CONTROL FACILITIES SHALL BE INSPECTED, MAINTAINED AND REPAIRED BY THE CONTRACTOR AS NEEDED TO ASSURE CONTINUED PERFORMANCE OF THEIR INTENDED FUNCTION. ALL ON SITE EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE INSPECTED AT LEAST ONCE EVERY SEVEN DAYS AND WITHIN 24 HOURS AFTER ANY STORM EVENT OF GREATER THAN 0.5 INCHES PER 24 HOUR PERIOD. AN INSPECTION REPORT FILE SHALL BE MAINTAINED BY THE CONTRACTOR FOR EACH INSPECTION.
3. THIS PROJECT REQUIRES A NPDES PERMIT AND ON-SITE CESCL FOR THE PROJECT DURATION. THE CONTRACTOR SHALL NAME THE CESCL PRIOR TO BEGINNING WORK.

SEEDING NOTES

1. SEEDBED PREPARATION MAY INCLUDE THE FOLLOWING:
    A. IF INFERTILE OR COURSE TEXTURED SUBSOIL WILL BE EXPOSED DURING GRADING, STOCKPILE TOPSOIL AND RE-SPREAD IT OVER THE FINISHED SLOPE AND ROLL IT TO PROVIDE A FIRM BASE.
    B. IF CONSTRUCTION FILLS HAVE LEFT SOIL EXPOSED WITH A LOOSE, ROUGH OR IRREGULAR SURFACE, TRACK WALK UP SLOPE.
    C. IF CUTS OR CONSTRUCTION EQUIPMENT HAVE LEFT A TIGHTLY COMPACTED SURFACE, BREAK WITH CHISEL PLOW OR OTHER SUITABLE EQUIPMENT.
    D. PERFORM ALL CULTURAL OPERATIONS ACROSS OR AT RIGHT ANGLES TO THE SLOPES (CONTOURED). THE SEEDBED SHOULD BE FIRM WITH A FAIRLY FINE SURFACE AFTER ROUGHENING.
2. FERTILIZATION – AS PER SUPPLIER'S RECOMMENDATIONS. DEVELOPMENTS ADJACENT TO WATER BODIES MUST USE NON-PHOSPHOROUS FERTILIZER.
3. HYDROSEEDING APPLICATIONS WITH APPROVED SEED-MULCH-FERTILIZER MIXTURES MAY ALSO BE USED.
4. SEEDING – APPLY APPROPRIATE MIXTURE TO THE PREPARED SEEDBED AT A RATE OF 120 LBS/ACRE. COVER THE SEED WITH TOPSOIL OR MULCH NO DEEPER THAN ONE-HALF INCH.

SEED MIX	VEGETATION TYPE (COMMON NAME)	PROPORTIONS BY WEIGHT	PERCENT PURITY	PERCENT GERMINATION
TEMPORARY EROSION CONTROL*	CHEWINGS OR RED FESCUE	40%	98	90
	PERENNIAL RYE	50%	98	90
	REDTOP OR COLONIAL BENTGRASS	5%	92	85
	WHITE DUTCH CLOVER	5%	98	90
LOW GROW*	DWARF TALL FESCUE VAR.	45%	98	90
	DWARF PERENNIAL RYE (BARCLAY)	30%	98	90
	RED FESCUE	20%	98	90
	COLONIAL BENTGRASS	5%	98	90

*(ADOPTED FROM WSDOE 2005 STORMWATER MANAGEMENT MANUAL WESTERN WASHINGTON, VOLUME. II, BMP C120)

CALL BEFORE YOU DIG 1-800-424-5555

REVISION	DATE	DESCRIPTION	ISSUE	DATE	DESCRIPTION
			1	01/29/2024	30% DESIGN

BLUE COAST ENGINEERING
1504 24TH ST
BELLINGHAM, WA 98225
(360)319-8069

FINN CREEK RESTORATION

HANSVILLE, WA
SITE IMPROVEMENTS

TEMPORARY EROSION & SEDIMENT CONTROL PLAN

PACIFIC SURVEYING
& ENGINEERING, INC.
909 Squalicum Way, Suite 111 | BELLINGHAM, WA 98225
T: 360.671.7387 | F: 360.671.4685
WWW.PSESURVEY.COM | INFO@PSESURVEY.COM

DATA	DRAWN BY	CHECKED BY	FIELD BOOKS	
BASE	XXX	XXX	DESIGN:	XXX
DESIGN	XXX	XXX	STAKING:	XXX
XREF:	XXX		ASBUILT:	XXX
JOB#:	XXX		DATUM	
HORIZ. SCALE:	XXX		HORIZ.:	XXX
VERT. SCALE:	XXX		VERT.:	XXX

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SHEET SW-11 OF SW-12

DAVID P. GALBRAITH Jr.
44679
01-29-2024

GENERAL NOTES

1. ALL WORKMANSHIP AND MATERIALS SHALL CONFORM TO THE MOST CURRENT STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION PREPARED BY WSDOT AND APWA AS ADOPTED BY THE KCPW.
2. ANY REVISIONS TO THE ACCEPTED CONSTRUCTION PLANS SHALL BE REVIEWED AND APPROVED BY KITSAP COUNTY PRIOR TO IMPLEMENTATION IN THE FIELD.
3. THE CONTRACTOR SHALL MAINTAIN A SET OF THE ACCEPTED CONSTRUCTION DRAWINGS ONSITE AT ALL TIMES WHILE CONSTRUCTION IS IN PROGRESS.
4. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO OBTAIN ALL NECESSARY PERMITS FROM THE KCPW PRIOR TO COMMENCING ANY WORK WITHIN COUNTY RIGHT OF WAY.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING ADEQUATE TRAFFIC CONTROL AT ALL TIMES DURING CONSTRUCTION ALONGSIDE OR WITHIN ALL PUBLIC ROADWAYS. TRAFFIC FLOW ON EXISTING PUBLIC ROADWAYS SHALL BE MAINTAINED AT ALL TIMES, UNLESS PERMISSION IS OBTAINED FROM THE KCPW FOR ROAD CLOSURE AND/OR DETOURS.
6. THE LOCATION OF EXISTING UTILITIES ON THIS PLAN IS APPROXIMATE ONLY. THE CONTRACTOR SHALL CONTACT THE "UNDERGROUND LOCATE" CENTER AT 811, AND NON_SUBSCRIBING INDIVIDUAL UTILITY COMPANIES 48 HOURS IN ADVANCE OF THE COMMENCEMENT OF ANY CONSTRUCTION ACTIVITY. THE CONTRACTOR SHALL PROVIDE FOR PROTECTION OF EXISTING UTILITIES FROM DAMAGE CAUSED BY THE CONTRACTOR'S OPERATIONS.
7. ROCKERIES OR OTHER RETAINING FACILITIES THAT SUSTAIN A SURCHARGE OR EXCEED 4 FEET IN HEIGHT AS MEASURED FROM THE FOUNDATION REQUIRE A SEPARATE PERMIT PRIOR TO CONSTRUCTION.
8. A TIMBER HARVEST PERMIT MAY BE REQUIRED PRIOR TO CLEARING OF THE SITE.

CONSTRUCTION SEQUENCE

1. APPLY FOR AND PICK UP ANY RIGHT OF WAY PERMITS FROM KITSAP COUNTY DEPARTMENT OF PUBLIC WORKS (KCPW).
2. CONSTRUCT STABILIZED CONSTRUCTION ENTRANCE(S).
3. CONSTRUCT SILT FENCE BARRIERS.
4. CONSTRUCT SEDIMENTATION BASINS.
5. CONSTRUCT RUNOFF INTERCEPTION AND DIVERSION DITCHES.
6. CLEAR AND GRADE THE MINIMUM SITE AREA REQUIRED FOR CONSTRUCTION OF THE VARIOUS PHASES OF WORK.
7. PROVIDE TEMPORARY HYDROSEEDING OR OTHER SOURCE CONTROL STABILIZATION MEASURES ON ALL DISTURBED SOILS.
8. MAINTAIN ALL EROSION AND SEDIMENTATION CONTROL BEST MANAGEMENT PRACTICES (BMPS) TO PROVIDE THE REQUIRED PROTECTION OF DOWNSTREAM WATER QUALITY.
9. ALL CATCH BASINS AND CONVEYANCE LINES SHALL BE CLEANED PRIOR TO PAVING. THE CLEANING OPERATION SHALL NOT FLUSH SEDIMENT LADEN WATER INTO THE DOWNSTREAM SYSTEM.
10. PROVIDE PERMANENT SITE STABILIZATION.
11. EROSION AND SEDIMENTATION CONTROL BMPS SHALL NOT BE REMOVED UNTIL CONSTRUCTION IS COMPLETE AND ACCEPTED BY KITSAP COUNTY.

DRAINAGE NOTES

1. THE CONTRACTOR SHALL ENSURE THAT THE DRAINAGE IS INSTALLED AND OPERATIONAL PRIOR TO COMMENCEMENT OF PAVING WORK.
2. ALL STEEL PIPE AND PARTS SHALL BE GALVANIZED. ALL SUBMERGED STEEL PIPES AND PARTS SHALL BE GALVANIZED AND HAVE ASPHALT TREATMENT #1 OR BETTER.
3. DRAINAGE STUB-OUTS ON INDIVIDUAL LOTS SHALL BE LOCATED WITH A 5_FOOT_HIGH 2" X 4" STAKE MARKED "STORM." THE STUB OUT SHALL EXTEND ABOVE SURFACE LEVEL AND BE SECURED TO THE STAKE.
4. VIDEO DOCUMENTATION OF PIPE INTERIOR FOR ALIGNMENT AND JOINT CONNECTION ADEQUACY SHALL BE PROVIDED IF NOT INSPECTED PRIOR TO COVER.

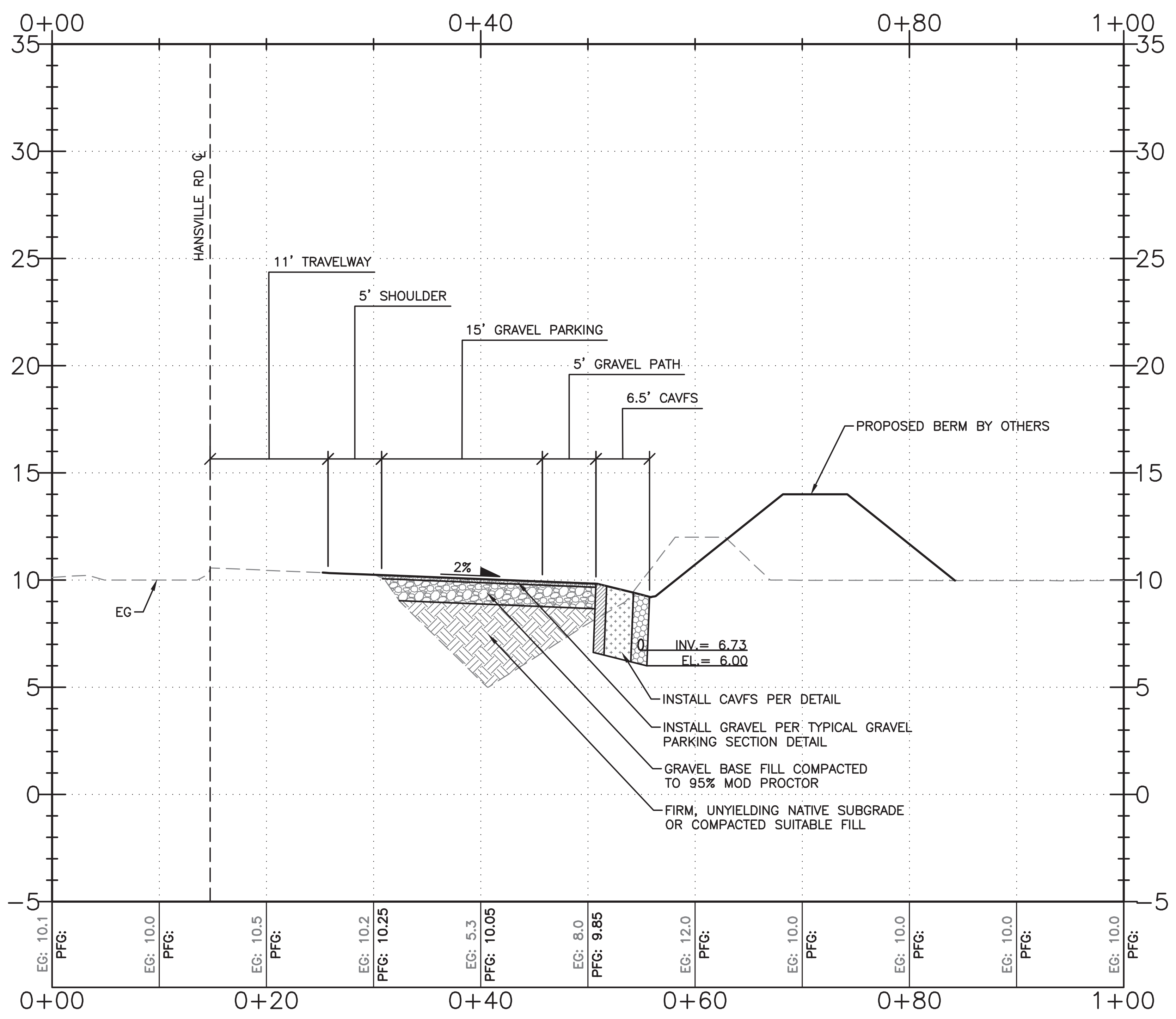
GRADING NOTES

THE CONTRACTOR SHALL NOTIFY THE ENGINEER IN THE EVENT OR DISCOVERY OF POOR SOILS, GROUNDWATER OR DISCREPANCIES IN THE EXISTING CONDITIONS AS NOTED ON THE PLANS.

1. MAXIMUM SLOPE STEEPNESS SHALL BE 2:1 (HORIZONTAL TO VERTICAL) FOR CUT AND FILL SLOPES.
2. UNLESS OTHERWISE SPECIFIED, ALL EMBANKMENTS IN THE PLAN SET SHALL BE CONSTRUCTED IN ACCORDANCE WITH SECTION 2_03.3(14)B OF THE WSDOT STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION (WSDOT 2020). EMBANKMENT COMPACTIONS SHALL CONFORM TO SECTION 2_03.3(14)C, METHOD B OF SAID STANDARD SPECIFICATIONS.
3. EMBANKMENTS DESIGNED TO IMPOUND WATER SHALL BE COMPACTED TO 95 PERCENT MAXIMUM DENSITY PER SECTION 2_03.3(14)C, METHOD C OF WSDOT STANDARD SPECIFICATIONS.
4. ALL AREAS RECEIVING FILL MATERIAL SHALL BE PREPARED BY REMOVING VEGETATION, NON_COMPLYING FILL, TOPSOIL AND OTHER UNSUITABLE MATERIAL, BY SCARIFYING THE SURFACE TO PROVIDE A BOND WITH THE NEW FILL, AND WHERE SLOPES ARE STEEPER THAN 3 HORIZONTAL TO 1 VERTICAL AND THE HEIGHT IS GREATER THAN 5 FEET., BY BENCHING INTO SOUND COMPETENT MATERIAL AS DETERMINED BY A GEOTECHNICAL ENGINEER.

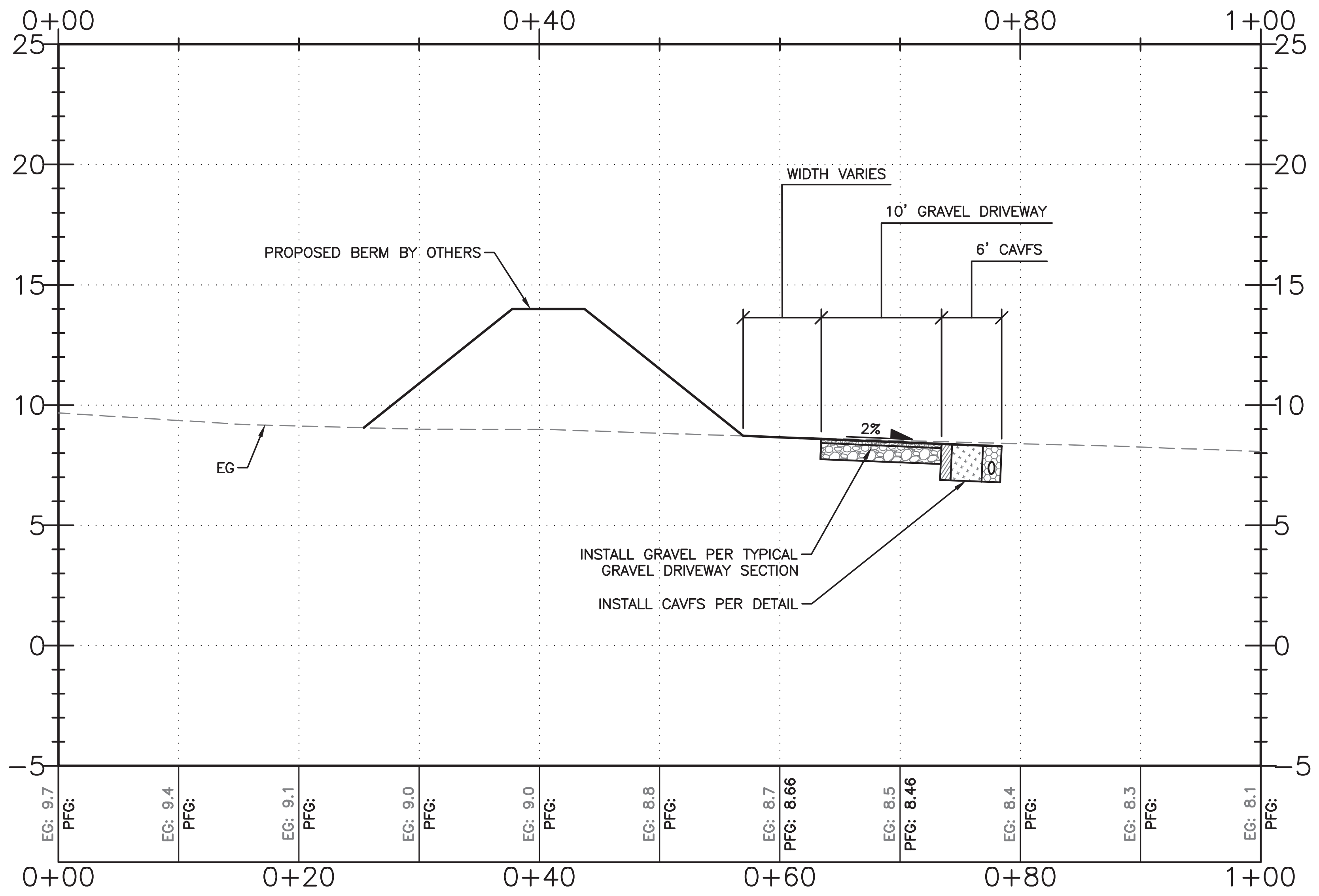
INSPECTION SCHEDULE

1. THE CONTRACTOR SHALL NOTIFY THE DEPARTMENT OF COMMUNITY DEVELOPMENT TO ARRANGE FOR INSPECTION OF THE VARIOUS WORK ACTIVITIES LISTED BELOW. ALL INSPECTIONS SHALL BE COMPLETED PRIOR TO PROCEEDING WITH THE NEXT PHASE OF WORK.
   - a. ESTABLISHMENT OF CLEARING LIMITS.
   - b. IMPLEMENTATION OF THE VARIOUS PHASES OF THE EROSION AND SEDIMENTATION CONTROL PLAN.
   - c. INSTALLATION OF CONVEYANCE, ON-SITE STORMWATER MANAGEMENT BMPS, FLOW CONTROL BMPS, AND WATER QUALITY BMPS, PRIOR TO BACKFILL.
   - d. PROTECTION OF ON-SITE STORMWATER MANAGEMENT BMPS.
   - e. PRIOR TO PLACEMENT OF THE OUTLET CONTROL STRUCTURES (ORIFICE SIZE VERIFIED PRIOR TO INSTALLATION).
   - f. FOR PUBLIC ROAD PROJECTS:
   - i. INSPECTION OF PREPARED SUB-GRADE.
   - ii. INSPECTION OF GRAVEL BASE PLACEMENT.
   - iii. INSPECTION OF FINE GRADING PRIOR TO PAVING.
   - iv. INSPECTION OF PAVING OPERATIONS.
   - v. FINAL INSPECTION.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL WORK PERFORMED AND SHALL ENSURE THAT CONSTRUCTION IS ACCEPTABLE TO KITSAP COUNTY.
3. IF INSPECTION IS NOT CALLED FOR PRIOR TO COMPLETION OF ANY ITEM OF WORK SO DESIGNATED, SPECIAL DESTRUCTIVE AND/OR NON-DESTRUCTIVE TESTING PROCEDURES MAY BE REQUIRED TO ENSURE THE ACCEPTABILITY OF THE WORK. IF SUCH PROCEDURES ARE REQUIRED, THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL COSTS ASSOCIATED WITH THE TESTING AND/OR RESTORATION OF THE WORK.



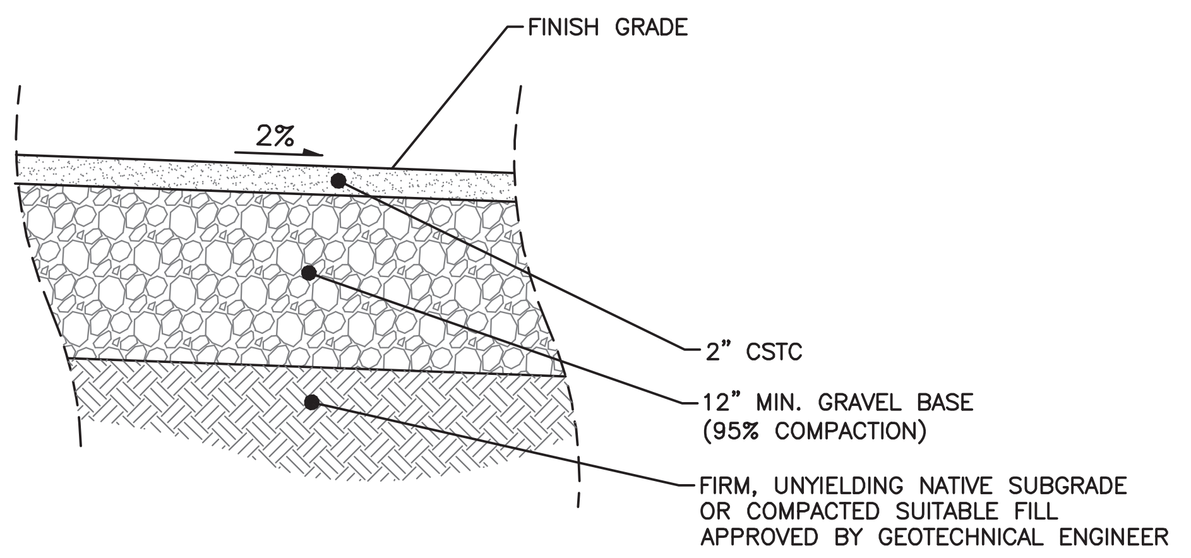
TYPICAL CROSS SECTION A-A

H. SCALE: 1"=10' V. SCALE: 1"=5'



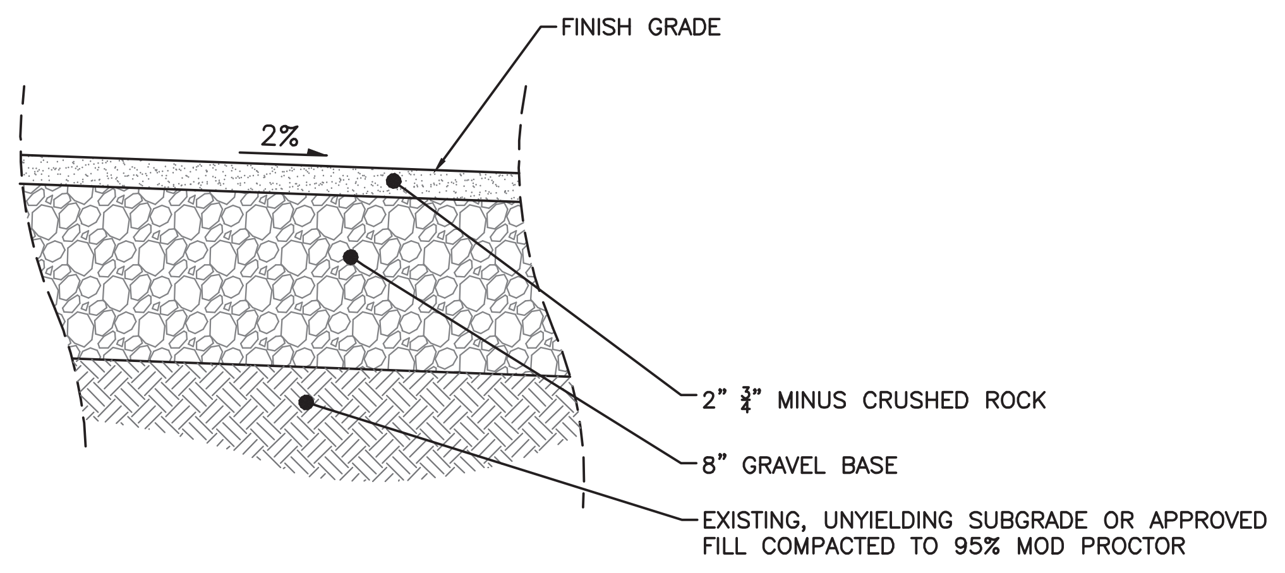
TYPICAL CROSS SECTION B-B

H. SCALE: 1"=10' V. SCALE: 1"=5'



TYPICAL GRAVEL PARKING SECTION

NTS



TYPICAL GRAVEL DRIVEWAY SECTION

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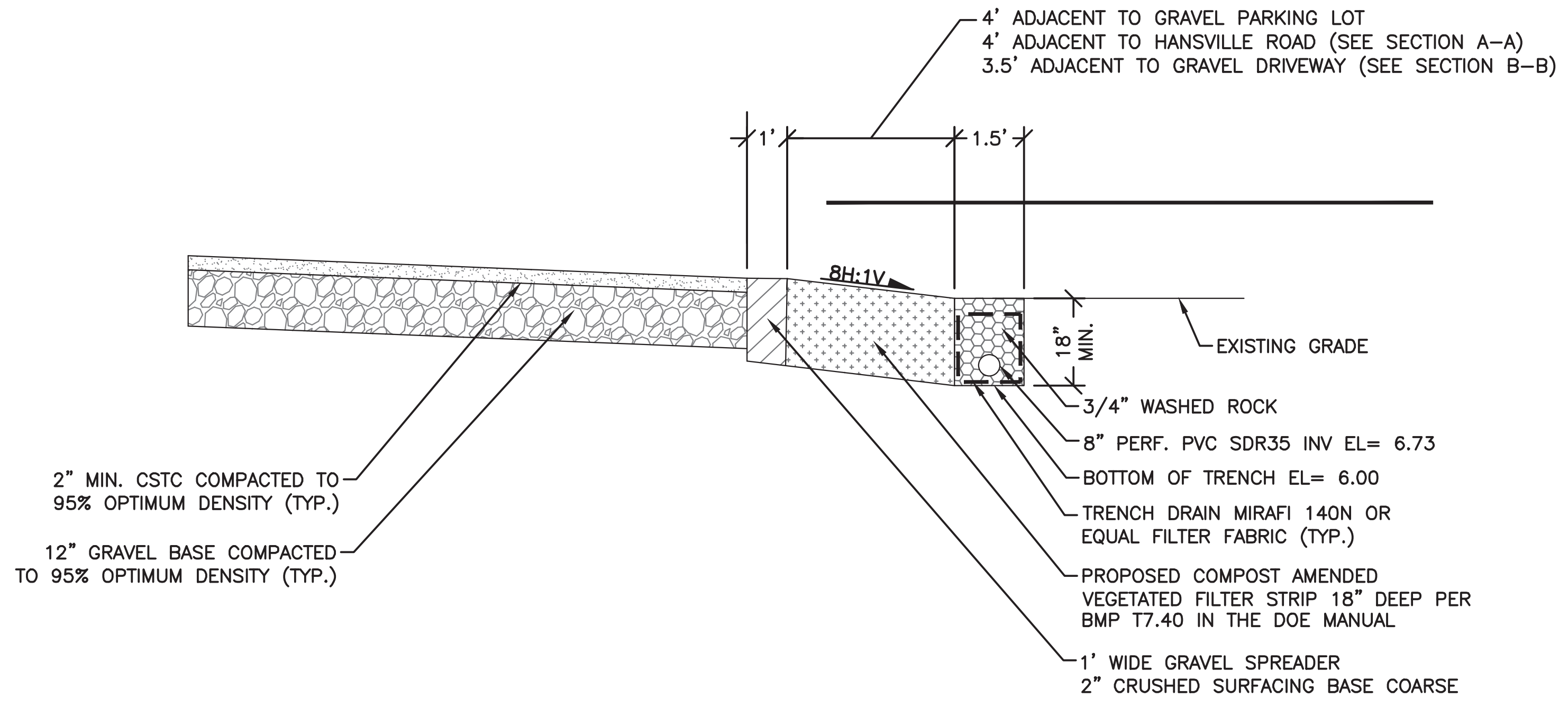
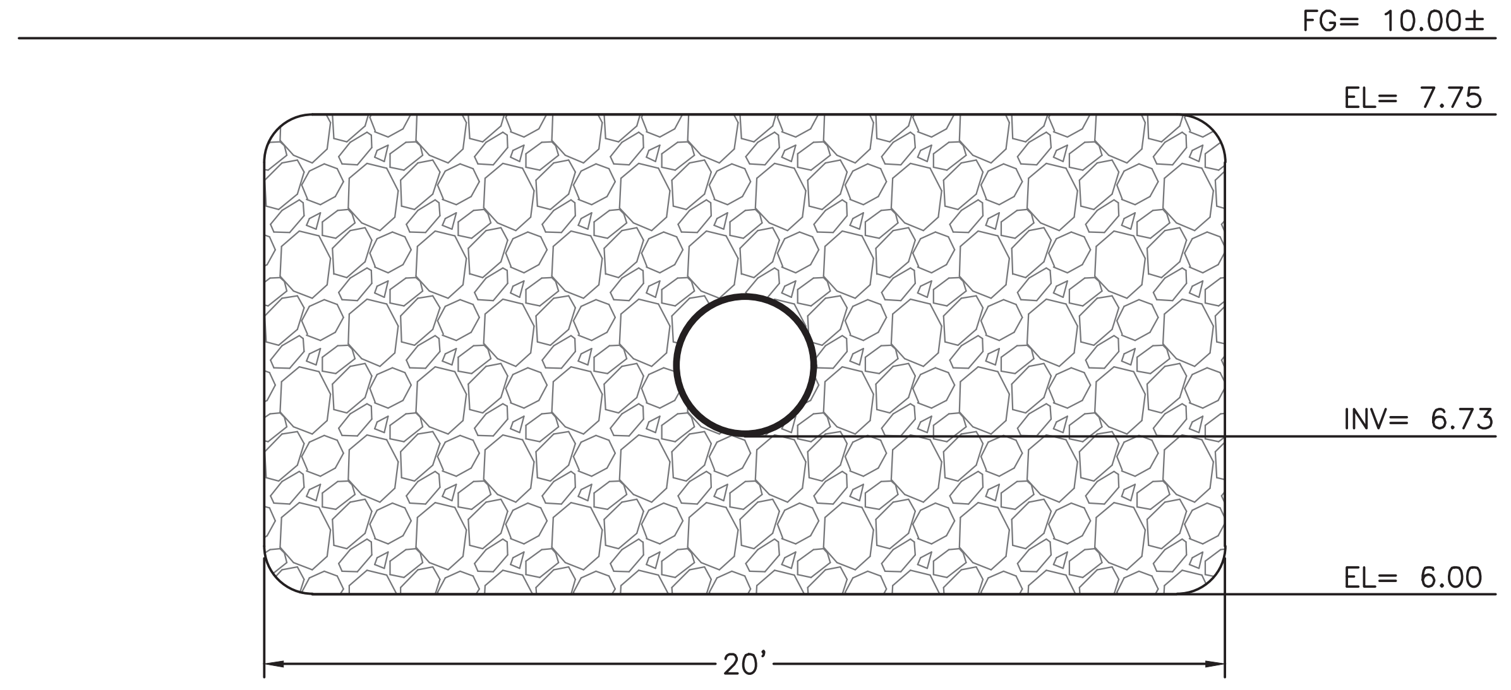


TYPICAL CAVFS DETAIL

NTS



INFILTRATION GALLERY CROSS SECTION

NTS

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BLUE COAST ENGINEERING
1504 24TH ST
BELLINGHAM, WA 98225
(360)319-8069

FINN CREEK RESTORATION
HANSVILLE, WA
SITE IMPROVEMENTS

ROAD & ACCESS DETAILS

PACIFIC SURVEYING
& ENGINEERING, INC.
909 Squalicum Way, Suite 111 | BELLINGHAM, WA 98225
T: 360.671.7387 | F: 360.671.4685
WWW.PSESURVEY.COM | INFO@PSESURVEY.COM

DATA	DRAWN BY	CHECKED BY	FIELD BOOKS	
BASE	XXX	XXX	DESIGN:	XXX
DESIGN	XXX	XXX	STAKING:	XXX
XREF:	XXX		ASBUILT:	XXX
JOB#:	XXX		DATUM	
HORIZ. SCALE:	XXX		HORIZ.:	XXX
VERT. SCALE:	XXX		VERT.:	XXX

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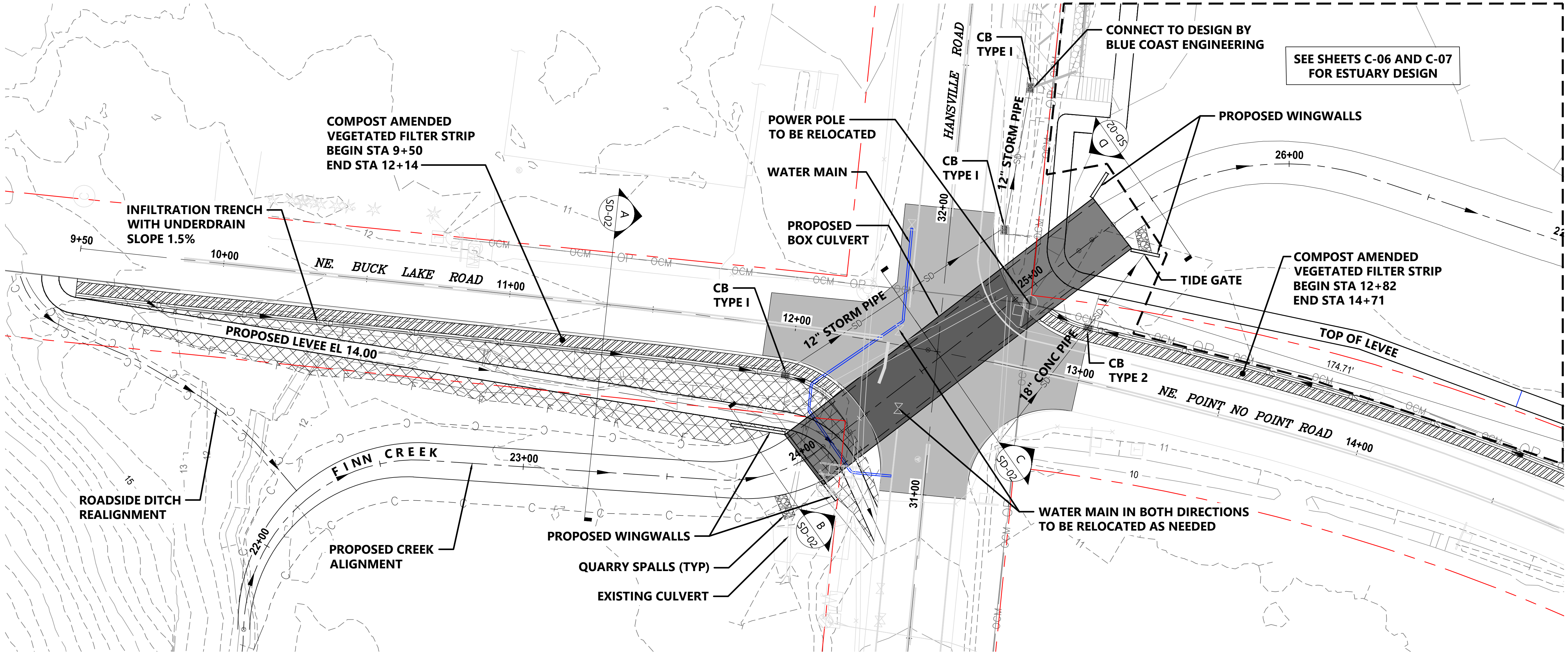
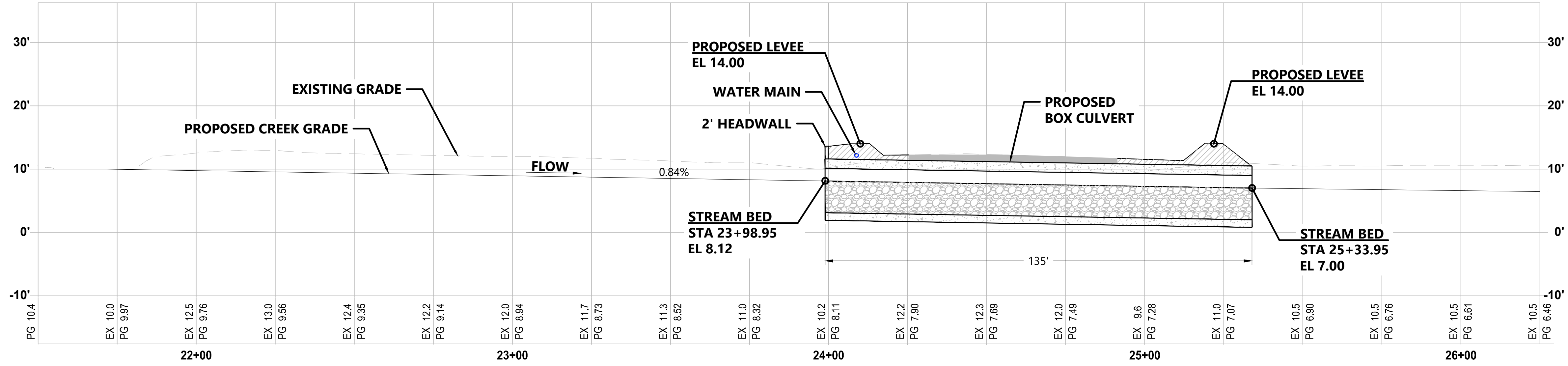
SHEET SW-12 OF SW-12

DAVID P. GALBRAITH JR.
44679
01-29-2024





PROPOSED:

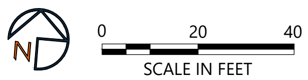
▬	CULVERT
▭	ROAD RESTORATION
▭	STREAMBED MATERIAL LANDSCAPING
▩	LEVEE FOOTPRINT
▨	COMPOST AMENDED VEGETATED FILTER STRIP
━	WATERLINE
– – – C – – –	CUT LINE
– – – F – – –	FILL LINE
——SD——	STORM DRAIN
▨	CATCH BASIN

EXISTING:

—— 15 ——	MAJOR CONTOUR (5' INTERVAL)
– – 11 – –	MINOR CONTOUR (1' INTERVAL)
— – – —	RIGHT-A- WAY
═══════	STORM DRAIN CULVERT
—— x ——	FENCE
—— □ ——	GUARD RAIL
— — — —	EDGE OF GRAVEL
—— OP ——	OVERHEAD POWER
—— OCM ——	OVERHEAD COMMUNICATIONS
MB	MAIL BOX
UP	UTILITY POLE
GP	GUY POLE
⟋	GUY ANCHOR
T	PHONE PEDESTAL
E	ELEC. BOX
⊘	ELEC. METER
Ⓒ	COMMUNICATIONS MANHOLE
drp	U/G UTIL. DROP FROM POLE
┬	ROAD SIGN
B	BOLLARD
⋈	WATER VALVE
W	WATER METER

NOTES:

1. CONTOURS ARE DEVELOPED FROM FEBRUARY 14, 2008 SURVEY PERFORMED BY AES CONSULTANTS, INC, PUBLICLY AVAILABLE 2018 LIDAR DATASET, 2022 WFS SURVEY, JANUARY 2022 BCE SURVEY, AND JULY 2023 KITSAP COUNTY SURVEY.
2. ELEVATIONS SHOWN ARE IN U.S. FEET, NAVD88 VERTICAL DATUM.



DRAFT-NOT FOR CONSTRUCTION

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "ORANGE" 🟧

Parametrix

KITSAP COUNTY
18 57
WASHINGTON

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: D. Suslikov
DRAWN BY: D. Suslikov
CHECKED BY: J. Dvorak, C. Buitrago
APPROVED BY: B. Bunker
SCALE: As Noted
DATE: 5/23/2024

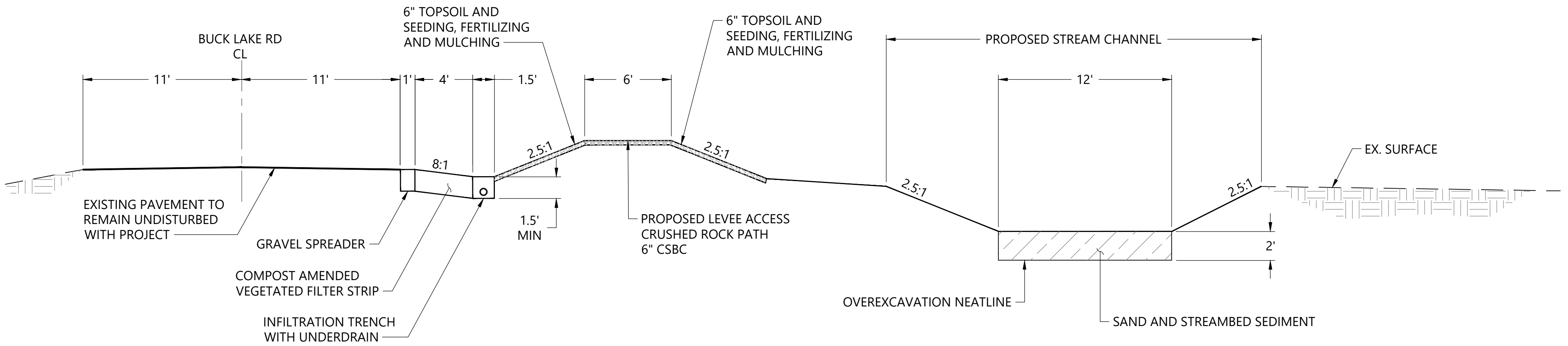
FINN CREEK RESTORATION PRELIMINARY DESIGN

STREAM AND CULVERT PLAN AND PROFILE

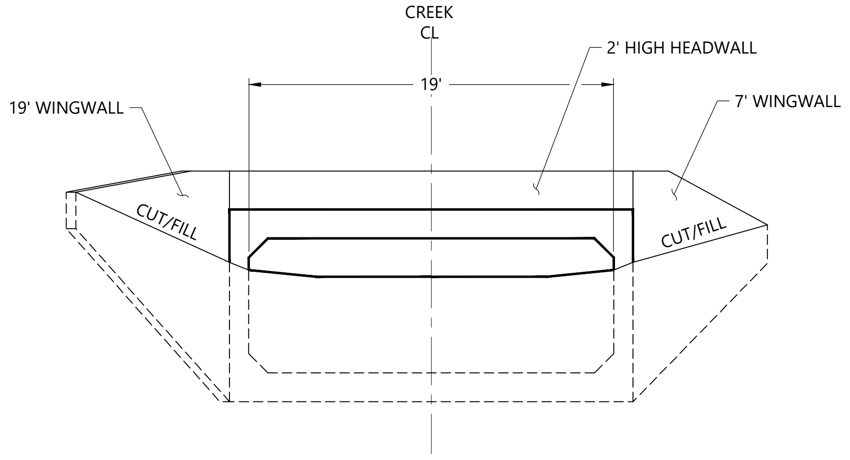
SD-01

SHEET # 1 OF 2

May 23, 2024 12:48pm OliveSta U:\PSO\Projects\Clients\9123-Blue Coast Engineering\216-9123-001 Finn Creek FishPassage\99Svcs\CADD\DWG\SD-01, SD-02.dwg SD-01



A SECTION
SD-01 SCALE: 1" = 5'



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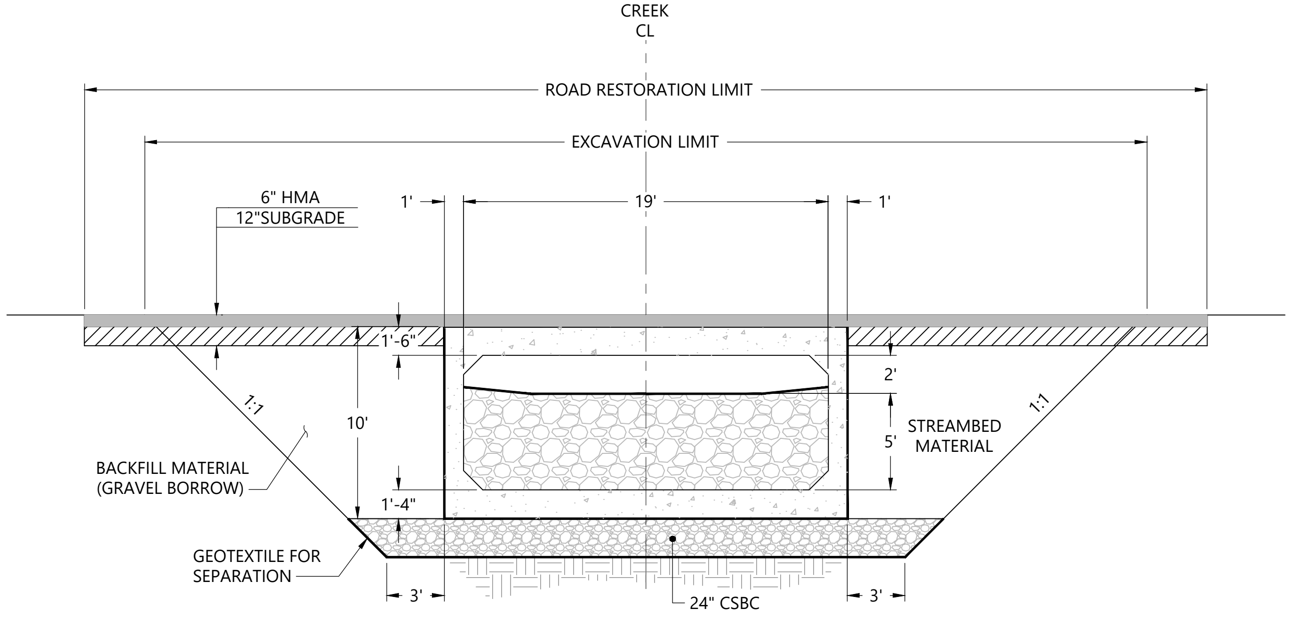

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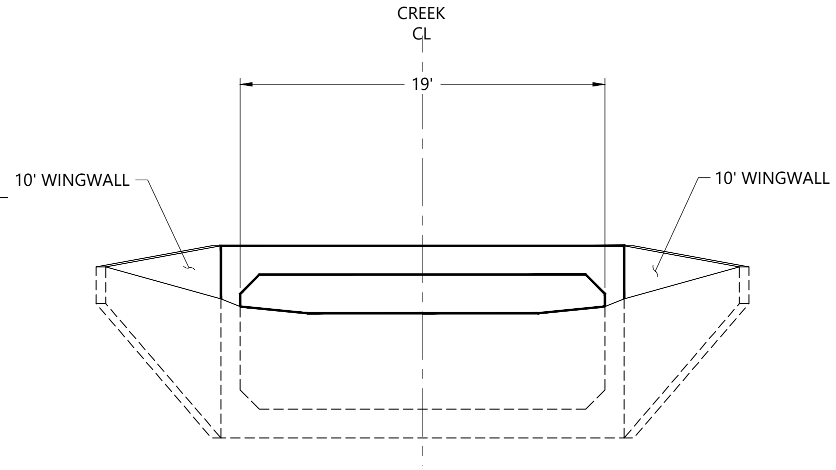

D SECTION
SD-01 SCALE: 1" = 5'

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May 23, 2024 12:49pm OliveSta

DRAFT-NOT FOR CONSTRUCTION

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "ORANGE" 🟧

Parametrix

KITSAP COUNTY 18 57 WASHINGTON

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: D. Suslikov
DRAWN BY: D. Suslikov
CHECKED BY: J. Dvorak, C. Buitrago
APPROVED BY: B. Bunker
SCALE: As Noted
DATE: 5/23/2024

FINN CREEK RESTORATION
PRELIMINARY DESIGN

STREAM AND CULVERT
DETAILS

SD-02

SHEET # 2 OF 2

Attachment E

Estimate of Probable Construction Cost

Engineer's Estimate of Probable Construction Cost

Finn Creek Restoration Project

Costs Associated with 100% Preliminary Design

	Project Element	Qty	Unit	Unit Cost		Subtotal
1. Site Preparation						
a.	Mobilization/Demobilization	1	LS	10%	$	230,700
b.	Utility Locate	1	LS	$2,000.00	$	2,000
c	Clearing and Grubbing	7	ACRE	$20,000.00	$	140,000
d.	Surveying and Record Drawings	1	LS	$15,000.00	$	15,000
e.	Creek Diversion	1	LS	$30,000.00	$	30,000
f.	TESC and Water Pollution Control	1	LS	$25,000.00	$	25,000
Subtotal Site Preparation					**$**	**442,700**
2. Estuary Excavation and Construction						
a.	General Excavation	11,771	CY	$35.00	$	412,000
b.	Excavation for Channel Construction	1,400	CY	$35.00	$	49,000
c.	Furnish and Place Streambed Cobble	1,025	CY	$117.07	$	120,000
d.	Furnish and Place Sand	2,047	CY	$60.04	$	122,900
e.	Furnish and Install Large Wood in Channel	18	EA	$2,100.00	$	37,800
f.	Furnish and Place Armor Rock	220	CY	$126.36	$	27,800
g.	Furnish and Place Filter Rock	52	CY	$80.77	$	4,200
h.	Furnish and Place Quarry Spalls	44	CY	$81.82	$	3,600
i.	Place Large Wood in the Beach Wood Placement Areas	20	EA	$500.00	$	10,000
j.	Vegetation Restoration and Planting	1	LS	$229,847.00	$	229,900
Subtotal Estuary Excavation and Construction					**$**	**1,017,200**
3. Demolition						
a.	Relocate Pavillion, Concrete Sructure	1	LS	$10,000.00	$	10,000
c.	Removal and Disposal of Structures and Obstructions	300	TON	$78.00	$	23,400
e.	Remove 2-inch Potable Water line (included as part of structures and obstruct	435	LF	$28.00	$	12,200
f.	Relocate Utility Poles	2	EA	$20,000.00	$	40,000
Subtotal Demolition					**$**	**85,600**
4. Culvert Replacement and Upgrades[2]						
a.	36" Culvert Replacement to Box Culvert - Placeholder		LS		$	-
Subtotal Culvert Replacement					**$**	**-**
5. Upland Infrastructure						
a.	Pavillion Concrete Sructure	125	SF	$55.00	$	6,900
b.	Construct Flood-protection Berm	11,040	CY	$20.00	$	220,800
c.	Import Fill for Flood Protection Berm (ADD-1)	1,982	CY	$60.00	$	119,000
d.	Furnish and Place Geotextile Material For Berm	1,450	SY	$5.00	$	7,300
e.	Furnish and Construct Rock Pedestrian Path	168	CY	$114.29	$	19,200
f.	Install Gravel Base for Parking Lot, Driveway, Spreader	885	CY	$92.29	$	81,700
g.	Install Crushed Surfacing Top Course for Parking Lot	147	CY	$262.19	$	38,600
h.	Crushed Rock Transition Infiltration Trench	151	CY	$115.38	$	17,400
i.	Infiltration Trench Geotextile	627	SY	$4.00	$	2,600
j.	Underdrain Pipe 8 In. Diam.	850	LF	$30.00	$	25,500
k.	Compost Amended Vegetated Filter Strip	4,082	SY	$90.00	$	367,400
l.	Type 1 catch basin	7	EA	$2,600.00	$	18,200
m.	Replace 2-inch Potable Water line	435	LF	$78.16	$	34,000
n.	Procure and Install Concrete Wheelstops	65	EA	$250.00	$	16,300
o.	Stall Markings	1,360	LF	$1.00	$	1,400
p.	Procure and Install Parking Signs	5	EA	$180.00	$	900
q.	Procure and Install Removable Bollard	2	EA	$700.00	$	1,400
r.	Furnish and Install Log Edging	1	EA	$5,000.00	$	5,000
s.	Concrete Stairs	320	SF	$55.00	$	17,600
t.	Galvanized Metal Hand Railing	128	LF	$165.00	$	21,200
u.	Procure and Install Log Barrier in Parking Area	128	LF	$165.00	$	21,200
Subtotal Upland Infrastructure					**$**	**1,043,600**
Subtotal for All Work Elements #1, #2, #3, #4					**$**	**2,589,100**
				Part Time Construction Oversight	$	157,000
				Final Permitting, Puget Sound Energy Coordination	$	20,000
				Sales Tax (9.0%)	$	233,100
				Subtotal Const. + Construction Oversight + Permitting + Tax	**$**	**2,999,200**
				Total Cost[2]	**$**	**3,000,000**

1. All costs are in 2024 dollars.
2. Culvert replacement costs were provided as an estimate based on other culvert replacements completed by the project team.
3. In providing opinions of probable construction cost, the client understands that Blue Coast has no control over the cost or availability of labor, equipment or materials, or over market condition or the Contractor's method of pricing, and the consultant's opinions of probable construction costs are made on the basis of the Consultant's professional judgment and experience. The Consultant makes no warranty, expressed or implied, that the bids or the negotiated cost of the work will not vary from the Consultant's opinion of probable construction cost.