CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN
FOR

Olson Brothers Storage
Puyallup, Washington

Revised July 2022
February 2021

Prepared for:
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Grimit Architecture

Prepared by:
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Approved By:

Daniel Smith, P.E., Project Manager

REPORT #20083

"I hereby state that this Drainage and Erosion/Sediment Control Plan for the Olson Brothers Storage project has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community of professional engineers. I understand that City of Puyallup does not and will not assume liability for the sufficiency, suitability or performance of drainage facilities prepared by me."

This analysis is based on data and records either supplied to, or obtained by, C.E.S. NW, Inc. These documents are referenced within the text of the analysis. The analysis has been prepared utilizing procedures and practices within the standard accepted practices of the industry.

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EROSION/SEDIMENTATION CONTROL

1. Thirteen Elements

1.1 Mark Clearing Limits

The project proposes to clear areas onsite within the clearing limits shown on the approved plans. Clearing limits are to be staked by a professional land surveyor as shown on the approved plans prior to land disturbing activities, and all clearing shall remain within these limits.

1.2 Establish Construction Access

Construction vehicle access shall be limited to one route, that being from Inter Avenue. As necessary, the access point shall be stabilized with a pad of quarry spalls or crushed rock to minimize the tracking of sediment onto public and private roads (BMP C105). The stabilized construction entrance shall be installed prior to site grading and shall be maintained per the instructions included in *Appendix 'C'*.

If sediment is tracked off site, public roads shall be cleaned thoroughly at the end of each day, or more frequently during wet weather, if necessary, to prevent sediment from entering waters of the State. 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. Runoff from the street washing shall be directed towards a sump where sediment can be collected prior to discharging to downstream water bodies.

1.3 Control Flow Rates

The project will clear approximately 1.12-acres to construct the proposed improvements. Properties and waterways downstream from development sites shall be protected from erosion due to any increase in the volume, velocity, and peak flow rate of stormwater runoff from the project site. Stormwater runoff during construction will be mitigated through the use of cover measures (BMPs C120, C121, C122, C123), and silt fencing (BMP C233). These BMPs shall be installed and maintained per the instructions included in *Appendix 'C'*.

1.4 Install Sediment Controls

Prior to discharge from the construction site, stormwater runoff shall pass through an appropriate sediment removal BMP. The project proposes silt fencing (BMP C233) around the downslope perimeter of the site to trap sediment onsite and prevent sediment-laden water from entering adjacent properties and rights-of-way. These BMPs shall be installed prior to significant grading activity.

1.5 Stabilize Soils

All exposed and unworked soils shall be stabilized by application of effective BMPs that protect the soil from the erosive forces of raindrop impact, flowing water, and wind. Construction is anticipated to be started and completed during the summer and fall of 2020. During the wet season, from October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days. Site soils shall be stabilized, mulching (BMP C121), and plastic covering (BMP C123). Stockpiles shall be stabilized with plastic covering (BMP C123). During the dry season from May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days. Site soils shall be stabilized with temporary or permanent seeding (BMP C120), mulching (BMP C121), and plastic covering (BMP C123). Stockpiles shall be stabilized with plastic covering (BMP C123).

This element applies to all soils on site, whether at final grade or not. Soils shall be stabilized at the end of the shift before a holiday or weekend, if needed, based on the weather forecast. Soil stabilization measures shall 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. Soil stockpiles must be stabilized from erosion, protected with sediment trapping measures and, when possible, be located away from storm drain inlets, waterways and drainage channels. The aforementioned BMPs shall be installed and maintained per the instructions included in *Appendix 'B'*.

1.6 Protect Slopes

There are not steep slopes onsite that require protection during the construction of the proposed improvements.

1.7 Protect Drain Inlets

All existing and newly constructed drainage collecting structures shall be protected from sediment deposition. Catch basin sediment protection (BMP C220) shall be provided on all existing drainage-collecting structures within 500 feet downstream of the project site. All approach roads shall be kept clean. 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. Inlets shall be inspected weekly at a minimum and daily during storm events. Inlet protection devices shall be cleaned or removed and replaced when

sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

1.8 Stabilize Channels and Outlets

The project does not propose any channels or outlets that require protection.

1.9 Control Pollutants

The project will require earth moving equipment. If vehicles are stored onsite care needs to be taken to make sure that any fluid leaks are contained with drip pans and the fluids are disposed of properly. All spills need to be cleaned up immediately as per the Department of Ecology (DOE) and City's standards. A construction staging area is shown on the approved plans. This area is for storing and maintaining vehicles. A wheel wash shall be included in this area per BMP C106 if the construction entrance does not prove adequate to prevent sediment leaving the site from vehicles.

Pollutants from woody debris, concrete and saw cutting shall also be controlled. Concrete shall be handled per BMP C151 while saw cutting shall have its slurry and cuttings cleaned per BMP C152. Woody debris may be chopped and spread cross the site to aid in site stabilization. Chemicals, liquid products, non-inert wastes and petroleum products shall be protected from vandalism stored in a manner to collect leaks and covered when not in use. The aforementioned BMPs shall be installed and maintained per the instructions included in `*Appendix 'B'*.

1.10 Control Dewatering

Dewatering is anticipated for construction of the utilities. If groundwater is encountered it should pumped to temporary sediment storage tanks prior to discharging offsite.

1.11 Maintain BMPs

All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with the approved plans and specifications included in *Appendix 'B'*. Visual monitoring of the BMPs will be conducted at least once every calendar week and within 24 hours of any stormwater or non-stormwater discharge from the site. If the site becomes inactive, and is temporarily stabilized, the inspection frequency will be reduced to once every month. In general, when sediment accumulation has reached 1/3 of the treatment

device or one foot of depth it shall be removed. Also, if there is a major storm event then the proposed BMPs shall be checked and cleaned appropriately.

If the sediment removed from these devices is approved by a geotechnical engineer, they can be stabilized onsite. If not, they must be removed per the Department of Ecology and City of Puyallup standards. 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 resulting from removal of BMPs or vegetation shall be permanently stabilized. Records shall be kept onsite.

1.12 Manage the Project

A construction sequence is provided on the plans. This construction sequence shall be followed to ensure that sediment is not deposited downstream. The City and the Project's Engineer shall inspect the erosion control BMPs after installation and during construction. The contractor is to employ a Certified Erosion and Sediment Control Lead (CESL, BMP C160) as described by the City to help manage and inspect the erosion control devices. The CESL shall provide sampling and record keeping for turbidity and pH. This SWPPP shall be retained on-site or within reasonable access to the site, and it shall be modified whenever there is a change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state. The SWPPP shall be modified if, during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) days following the inspection. Detailed descriptions of each BMP listed above can be found in Volume 2 of the Washington State Department of Ecology Stormwater Management Manual for Western Washington, 2014 Edition and in *Appendix 'B'*.

1.13 Protect Low Impact Development BMPs

The project proposes soil amendments to the new pervious surfaces and permeable pavement. The contractor is to take extra care to prevent over compaction of the soils under these BMPs. Contaminated and sediment laden runoff is to be directed away from these soils prior to site stabilization.

2. Project Description

The Olson Brothers Storage project proposes the remodel of an existing commercial industrial building and portable building on a 1.86-acre site comprised of three parcels (2105200180, 2105200191 and 2105200192) zoned Limited Manufacturing (ML). The site is accessed from Inter Ave with a new commercial driveway approach. The project is located in the Puyallup River Water Resources Inventory Area (WRIA 10). The Vicinity Map has been included in Appendix 'A' of this report. A project summary is as follows:

Permit Applied for – Building Permit and Site Development
Address – 2511 Inter Ave Puyallup, WA 98372
Parcel Numbers – 2105200180, 2105200192 and 2105200192
Legal description – Parcel A, TPN. 2105200191

The west 85 feet of the south 120 feet of the west half of tract 10 of Ackerson's Second Addition to Puyallup, according to the map thereof recorded in volume 8 of plats, page 25, records of Pierce County, Washington.

Parcel B, TPN. 2105200192

The west half of Block 10 of Ackerson's Second Addition to Puyallup, according to the plat thereof recorded in Volume 8 of Plats, page 25, records of Pierce County, Washington.

Except the south 120 feet of the west 85 feet thereof.

Parcel C, TPN. 2105200180

The east one-half of Block 10 of Ackerson's Second Addition to Puyallup, according to the plat thereof recorded in Volume 8 of Plats, page 25, records of Pierce County, Washington.

All situate in the County of Pierce, State of Washington.

The project site has historically been used as a commercial property with a converted single family residence, storage building, portable building and existing gravel lot. The existing site is

to be redeveloped with landscaping and pave the existing gravel parking with permeable pavement (BMP T5.15) when construction permits are approved. The property has frontage along Inter Ave which provides access with a new commercial driveway approach. Improvements are proposed along Inter Ave which include curb, gutter and sidewalk extended across the property's frontage. The project site proposes approximately 31,632 sq.ft. of paving, that does not include overlaying the existing asphalt, across onsite and offsite improvements and 10,432 sq.ft. of landscaping; therefore, according to Figure 2.4.1 and 2.4.2 of Volume I of the Manual, the project must evaluate all minimum requirements for the new and replaced surfaces. The project proposes permeable pavement for flow control of the newly paved and landscaped surfaces. Runoff treatment is provided by the native soils underlying the permeable pavement since they meet the CEC and organic requirements of Section 4.4.2 of Volume V of the Manual. All disturbed areas which are not converted to impervious surface will apply soil amendments per BMP T5.13.

3. Existing Site Conditions

The existing site's current use is a commercial building and paved storage yard. The site is relatively flat between elevations 61-62 (NAVD 88) which gradually slopes towards Inter Avenue. Stormwater runoff from this site is currently collected by an onsite closed conveyance system that outfalls into Inter Avenue's public closed conveyance system. This public closed conveyance system is comprised of 12-inch concrete pipes that flows west. The site is accessed by an existing gravel driveway from Inter Avenue.

There is an existing gravity sewer main in Inter Avenue, which currently serves the property. There are no known aquifer recharge or wellhead protection areas that affect this property. There are no known well or septic systems onsite. If a septic system or well is discovered onsite during construction, it will be decommissioned per Tacoma-Pierce County Health Department standards. The parcel and all the proposed improvements are located within Zone X, which is considered outside of the 100-year floodplain, per FEMA Map # 53053C0334E. A copy of the FIRM Panel map can be found in Appendix 'A' of this report.

4. Adjacent Areas

The site is bound by Inter Avenue to the south, and commercial properties to the north, east and west. There is no significant runoff directed towards the site. Offsite areas should not

experience problems with erosion if the BMPs described within this report and on the approved plans are implemented in accordance with the plans, specifications and Manufacturer recommendations.

5. Critical Areas

There are no known onsite or offsite critical areas within 200-feet of the property.

6. Soil

Onsite soils have been identified as Briscot loam (6A a Type D soil) determined by the USDA SCS maps of Pierce County, Washington. A description of the USDA soils and a copy of the soil map for this portion of Pierce County have been included in Appendix 'A' of this report. A draft geotechnical engineer's report has been prepared by GeoResources, dated January 21, 2021, where they documented 0.5-feet to 1.0-feet of topsoil over silty alluvium. Mottling was observed at a depth 0.5 to 1.0-feet with groundwater observed at a depth of 0.5-feet. An EPA falling head test was performed within the native alluvium soils were a 0.6-inch per hour infiltration rate was measured. Based on the infiltration testing and depth of groundwater the geotech does not recommend infiltration BMPs. A copy of the geotechnical report is included in Appendix 'C'.

7. Potential Erosion Problem Areas

The site does not contain slopes that exceeds 15%. The project should not experience problems with erosion if the BMPs described within this report and on the approved plans are implemented in accordance with the plans, specifications and Manufacturer recommendations.

8. Construction Phasing

The proposed improvements include an erosion/sedimentation control plan designed to prevent sediment-laden runoff from leaving the project site during construction. Construction is to occur in a single phase. The design specifies a combination of structural measures, cover measures and construction practices that are to be implemented to maintain erosion control. Prior to the start of any clearing and grading of the site, all erosion control measures shall be constructed.

A general outline of the proposed construction sequence has been included. The contractor will employ the best construction practices to properly clear and grade the site. The planned construction sequence is as follows:

1. The contractor is to request a pre-construction meeting with the City's inspector.
2. Clearly stake, flag or fence clearing limits/work area. No work shall be performed outside these limits without prior approval from the City of Puyallup.
3. Prior to starting site work, request an inspection for erosion and sediment, inspection code #1010, by calling the inspection request line at 1-877-232-6456.
4. Provide silt fencing as shown on the approved plans
5. Grade site as shown on the approved plans.
6. Construct the conveyance system and install inlet protect on the new catch basins.
7. Construct onsite planters and pave the storage area.
8. Construct frontage improvements and amend the landscape and lawn areas with soil amendments.
9. Amend soils per CS 01.02.08a on Sheet C2.
10. Relocate erosion control measures or install new measures so that as site conditions change, the erosion and sediment control is always in accordance with City of Puyallup and department of ecology erosion and sediment control standards.
11. Cover all areas, including stockpiles, that will be unworked for more than seven days during the dry season or two days during the wet season with straw, wood fiber mulch, plastic sheeting or equivalent.
12. Stabilize all areas within seven days of reaching final grade.
13. Seed, sod, stabilize, or cover any areas to remain unworked for more than 30 days.
14. Call for final inspections. Upon completion of the project, stabilize all disturbed areas and remove BMPs if appropriate.

9. Construction Schedule

Construction is anticipated to begin in summer of 2021 and be completed by fall, 2021. Construction that exposes soils should be limited during the wet season (October 1 to April 30). During this time erosion control BMPs should be checked regularly (once a week) and after each runoff producing storm event. Grading, utility installation, and paving should be completed prior to the wet season.

10.Financial/Ownership Responsibilities

The owner and responsible party for the initiation of financial securities is BPLC Properties LLC. Their contact information is as follows:

2412 Inter Ave

Puyallup, WA

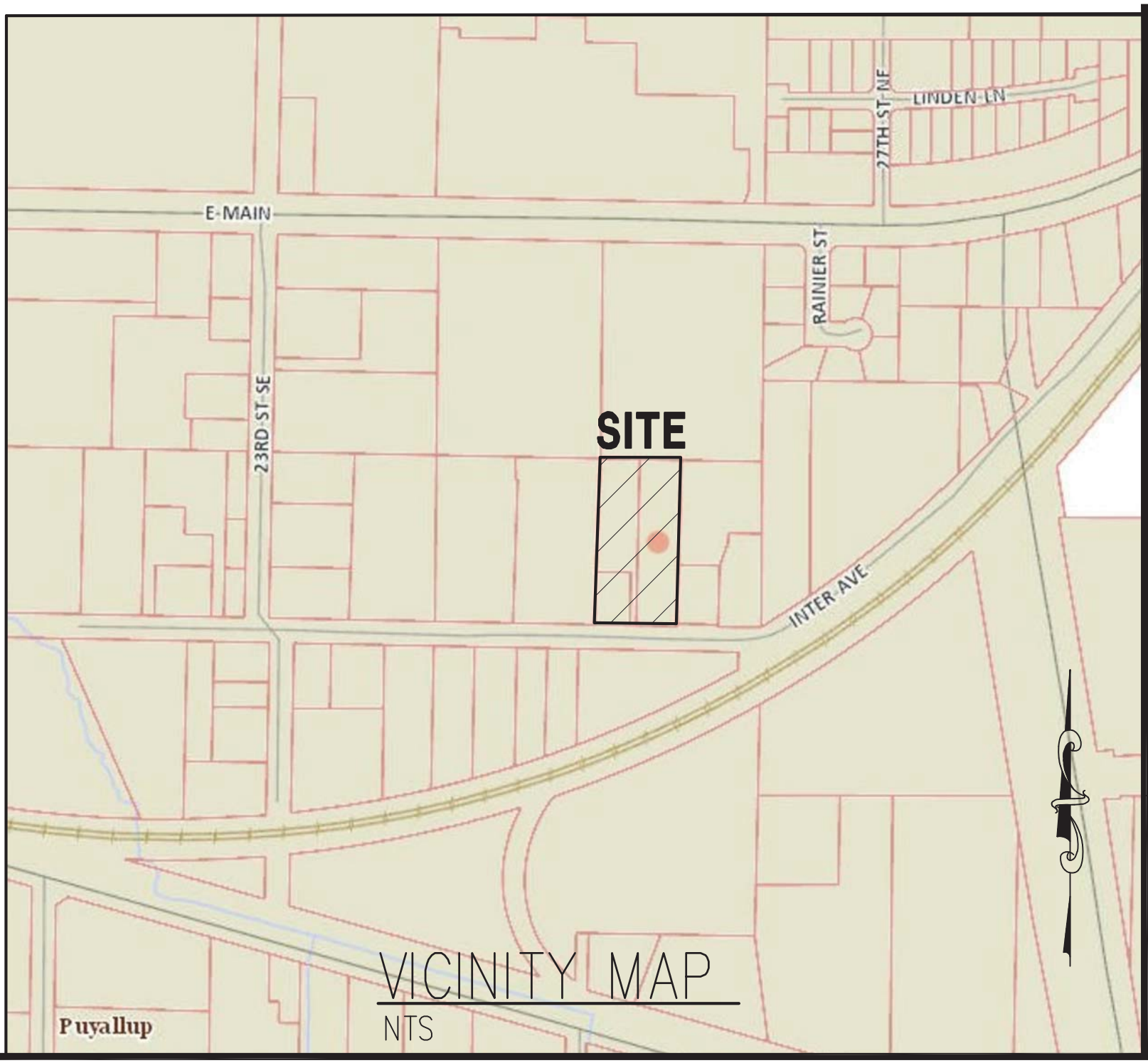
98372-3425

11.Engineering Calculations

The project does not propose BMPs which require engineering calculations.

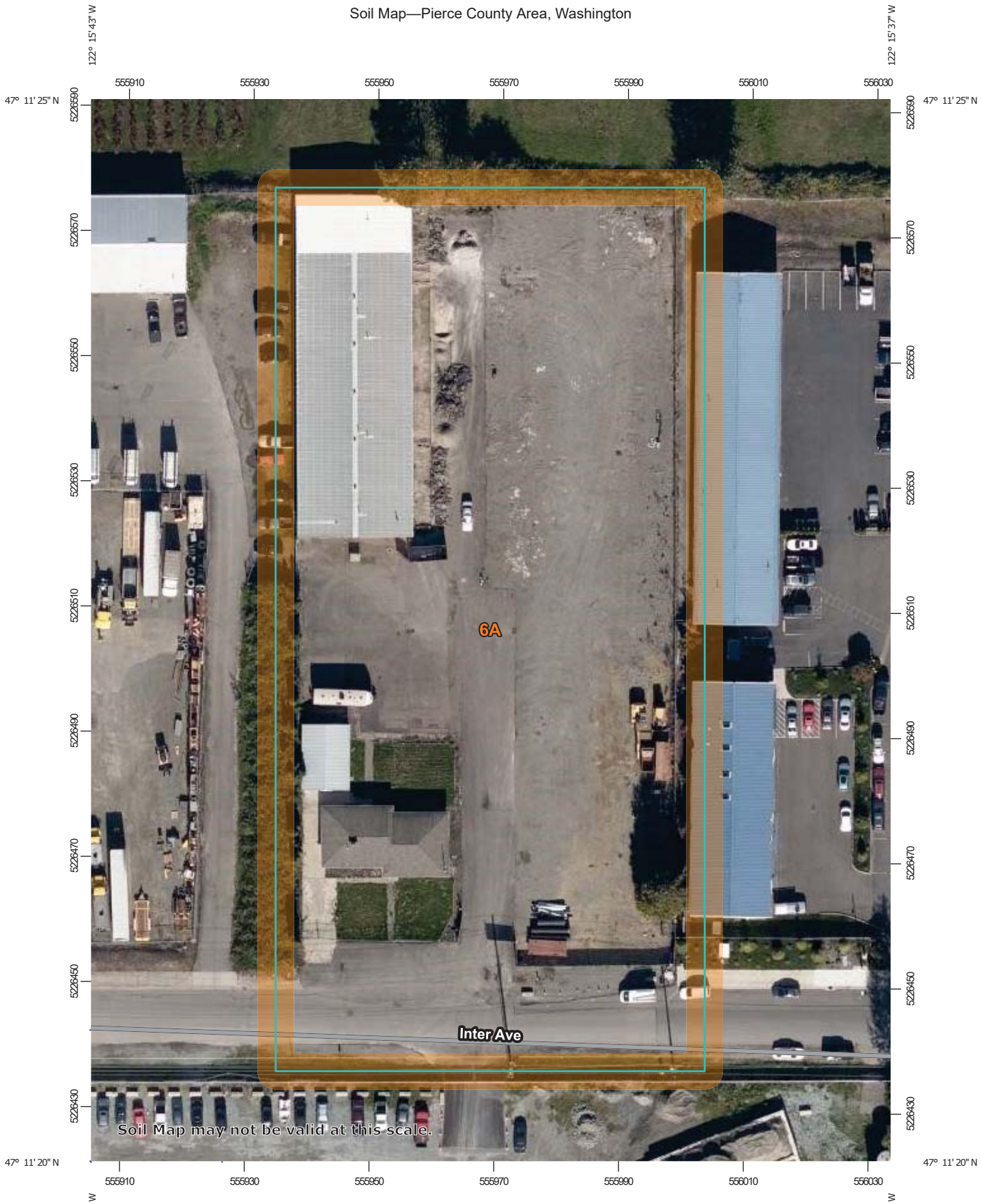
APPENDIX A

MAPS



VICINITY MAP

NTS



Map Scale: 1:826 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 10 20 40 60

Feet
0 40 80 160 240

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Pierce County Area, Washington
Survey Area Data: Version 16, Jun 4, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 29, 2018—Jul 22, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

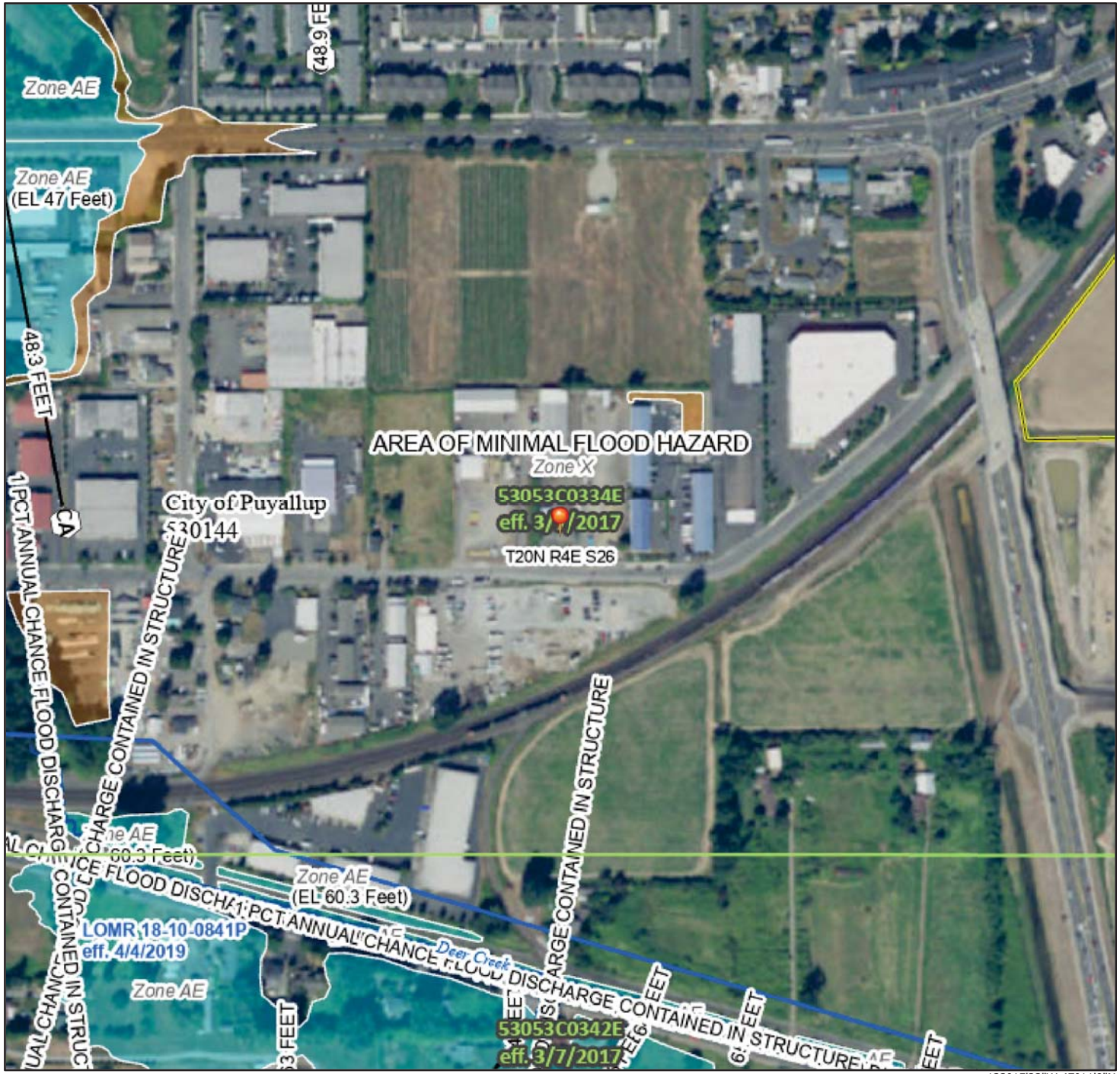
Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Briscot loam	2.4	100.0%
Totals for Area of Interest		**2.4**	**100.0%**

National Flood Hazard Layer FIRMette

FEMA

122°16'W 47°11'34"N



122°15'22"W 47°11'9"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/1/2021 at 1:21 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX B

Construction Best Management Practices (BMPs)

BMP C105: Stabilized Construction Entrance / Exit

Purpose

Stabilized Construction entrances are established to reduce the amount of sediment transported onto paved roads by vehicles or equipment. This is done by constructing a stabilized pad of quarry spalls at entrances and exits for construction sites.

Conditions of Use

Construction entrances 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 construction provide stabilized construction entrances 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/configuration.

On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized entrances 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 4.1.1 for details. Note: the 100' minimum length of the entrance 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 entrances 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 entrance stabilization because these products raise pH levels in stormwater and concrete discharge to surface 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 following standards:

Grab Tensile Strength (ASTM D4751)	200 psi min.
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 paved; this can be used as a stabilized entrance. Also consider the installation of excess concrete as a stabilized entrance. During large concrete pours, excess concrete is often available for this purpose.

- Fencing (see BMP C103) shall be installed as necessary to restrict traffic to the construction entrance.
- Whenever possible, the entrance shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.
- Construction entrances should avoid crossing existing sidewalks and back of walk drains if at all possible. If a construction entrance 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.

Maintenance Standards

Quarry spalls shall be added if the pad is no longer in accordance with the specifications.

- If the entrance 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 entrance, or the installation of a 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 entrance(s), fencing (see BMP C103) 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.

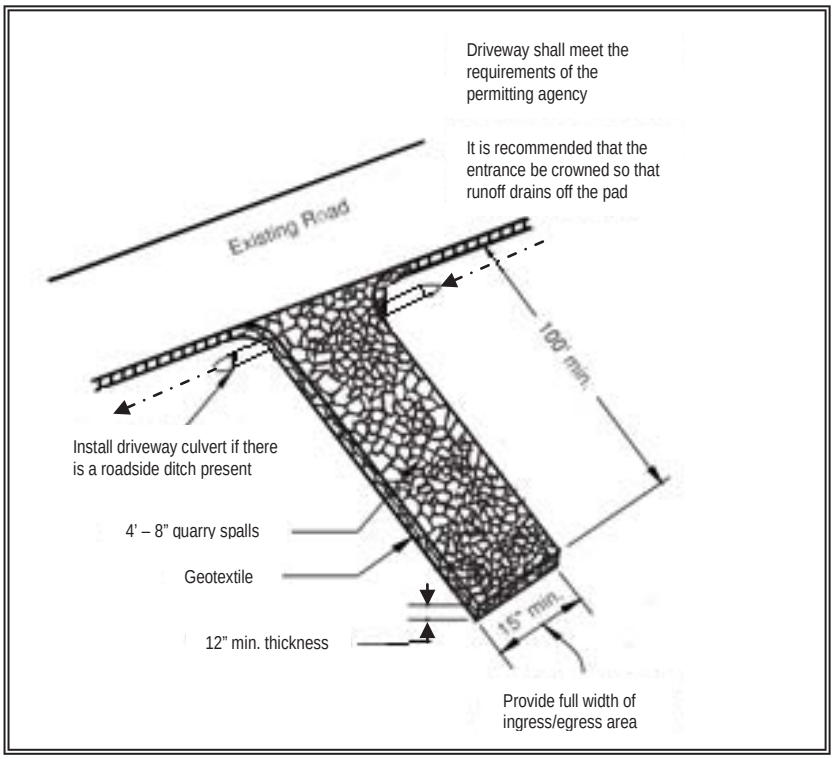


Figure 4.1.1 – Stabilized Construction Entrance

Approved as Equivalent

Ecology has approved products as able to meet the requirements of BMP C105. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept this product approved as equivalent, or may require additional testing prior to consideration for local use. The products are available for review on Ecology's website at http://www.ecy.wa.gov/programs/wq/stormwater/newtech/equivalent.html

BMP C106: Wheel Wash

Purpose

Wheel washes reduce the amount of sediment transported onto paved roads by motor vehicles.

Conditions of Use

When a stabilized construction entrance (see BMP C105) is not preventing sediment from being tracked onto pavement.

- 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.

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 with straw 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.

Design and Installation Specifications

Seed retention/detention ponds as required.

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 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 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.
- 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:

  1. Phase 1- Install all seed and fertilizer with 25-30 percent mulch and tackifier onto soil in the first lift.
  2. Phase 2- Install the rest of the mulch and tackifier over the first lift.

  Or, enhance vegetation by:

  1. Installing the mulch, seed, fertilizer, and tackifier in one lift.
  2. Spread or blow straw over the top of the hydromulch at a rate of 800-1000 pounds per acre.
  3. 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 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 the tables below include recommended mixes for both temporary and permanent seeding.

- Apply these mixes, with the exception of the wetland mix, at a rate of 120 pounds per acre. This rate can be reduced if soil amendments or slow-release fertilizers are used.
- Consult the local suppliers or the local conservation district for their recommendations because 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.
- Other mixes may be appropriate, depending on the soil type and hydrology of the area.

- Table 4.1.2 lists the standard mix for areas requiring a temporary vegetative cover.

Table 4.1.2
Temporary Erosion Control Seed Mix

	% Weight	% Purity	% Germination
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

- Table 4.1.3 lists a recommended mix for landscaping seed.

Table 4.1.3
Landscaping Seed Mix

	% Weight	% Purity	% Germination
Perennial rye blend *Lolium perenne*	70	98	90
Chewings and red fescue blend *Festuca rubra var. commutata* or *Festuca rubra*	30	98	90

- Table 4.1.4 lists a turf seed mix for dry situations where there is no need for watering. This mix requires very little maintenance.

Table 4.1.4
Low-Growing Turf Seed Mix

	% Weight	% Purity	% Germination
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

- Table 4.1.5 lists a mix for bioswales and other intermittently wet areas.

Table 4.1.5
Bioswale Seed Mix*

	% Weight	% Purity	% Germination
Tall or meadow fescue *Festuca arundinacea* or *Festuca elatior*	75-80	98	90
Seaside/Creeping bentgrass *Agrostis palustris*	10-15	92	85
Redtop bentgrass *Agrostis alba* or *Agrostis gigantea*	5-10	90	80

* *Modified Briargreen, Inc. Hydroseeding Guide Wetlands Seed Mix*

- Table 4.1.6 lists a low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Apply this mixture at a rate of 60 pounds per acre. Consult Hydraulic Permit Authority (HPA) for seed mixes if applicable.

Table 4.1.6
Wet Area Seed Mix*

	% Weight	% Purity	% Germination
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

** Modified Briargreen, Inc. Hydroseeding Guide Wetlands Seed Mix*

- Table 4.1.7 lists 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.

Table 4.1.7
Meadow Seed Mix

	% Weight	% Purity	% Germination
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 of mulch with approximately 10 percent tackifier. Achieve a minimum of 95 percent soil coverage during application. Numerous products are available commercially. Installed products per manufacturer's instructions. 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.

- 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 80 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, or nets/blankets. If winter weather prevents adequate grass growth, this time limit may be relaxed at the discretion of the local authority when sensitive areas would otherwise be protected.

- 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 runoff.

Approved as Equivalent

Ecology has approved products as able to meet the requirements of BMP C120. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept this product approved as equivalent, or may require additional testing prior to consideration for local use. The products are available for review on Ecology's website at http://www.ecy.wa.gov/programs/wq/stormwater/newtech/equivalent.html.

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 is an enormous 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, 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. Any mulch or tackifier product used shall be installed per manufacturer's instructions. Generally, mulches come in 40-50 pound bags. Seed and fertilizer are added at time of application.

Design and Installation Specifications

For mulch materials, application rates, and specifications, see Table 4.1.8. Always use a 2-inch minimum mulch thickness; increase the thickness 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 following size gradations when tested in accordance with the U.S. Composting Council "Test Methods for the Examination of Compost and Composting" (TMECC) Test Method 02.02-B.

Coarse Compost

Minimum Percent passing 3" sieve openings 100%

Minimum Percent passing 1" sieve openings 90%

Minimum Percent passing ¾" sieve openings 70%

Minimum Percent passing ¼" sieve openings 40%

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 Hydraulic Permit Authority (HPA) for mulch mixes if applicable.

Maintenance Standards

- The thickness of the 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 4.1.8
Mulch Standards and Guidelines

Mulch Material	Quality Standards	Application Rates	Remarks
Straw	Air-dried; free from undesirable seed and coarse material.	2"-3" thick; 5 bales per 1,000 sf or 2-3 tons per acre	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	No growth inhibiting factors.	Approx. 25-30 lbs per 1,000 sf or 1,500 - 2,000 lbs per acre	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 ¾-1 inch clog hydromulch equipment. Fibers should be kept to less than ¾ inch.
Compost	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.	2" thick min.; approx. 100 tons per acre (approx. 800 lbs per yard)	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 or BMP T5.13 (see Chapter 5 of Volume V of this manual) 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	Average size shall be several inches. Gradations from fines to 6 inches in length for texture, variation, and interlocking properties.	2" thick min.;	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 seeding is expected shortly after mulch, the decomposition of the chipped vegetation may tie up nutrients important to grass establishment.
Wood-based Mulch or Wood Straw	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.	2” thick min.; approx. 100 tons per acre (approx. 800 lbs. per cubic yard)	This material is often called “hog or hogged 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	A blend of loose, long, thin wood pieces derived from native conifer or deciduous trees with high length-to-width ratio.	2” thick min.	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 ⅜-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. (WSDOT specification (9-14.4(4))

BMP C123: Plastic Covering

Purpose

Plastic covering provides immediate, short-term erosion protection to slopes and disturbed areas.

Conditions of Use

Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.

- Plastic is particularly useful for protecting cut and fill slopes and stockpiles. Note: The relatively rapid breakdown of most polyethylene sheeting makes it unsuitable for long-term (greater than six months) applications.
- Due to rapid runoff caused by plastic covering, do not use this method upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- Plastic sheeting may result in increased runoff volumes and velocities, requiring additional on-site measures to counteract the increases. Creating a trough with wattles or other material can convey clean water away from these areas.
- To prevent undercutting, trench and backfill rolled plastic covering products.
- While plastic is inexpensive to purchase, the added cost of installation, maintenance, removal, and disposal make this an expensive material, up to $1.50-2.00 per square yard.
- Whenever plastic is used to protect slopes install water collection measures at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to covey clean rainwater away from bare soil and disturbed areas. Do not mix clean runoff from a plastic covered slope with dirty runoff from a project.
- Other uses for plastic include:
    1. Temporary ditch liner.
    2. Pond liner in temporary sediment pond.
    3. Liner for bermed temporary fuel storage area if plastic is not reactive to the type of fuel being stored.
    4. Emergency slope protection during heavy rains.
    5. Temporary drainpipe (“elephant trunk”) used to direct water.

Design and Installation Specifications

- Plastic slope cover must be installed as follows:
    1. Run plastic up and down slope, not across slope.
    2. Plastic may be installed perpendicular to a slope if the slope length is less than 10 feet.
    3. Minimum of 8-inch overlap at seams.

4. On long or wide slopes, or slopes subject to wind, tape all seams.
5. Place plastic into a small (12-inch wide by 6-inch deep) slot trench at the top of the slope and backfill with soil to keep water from flowing underneath.
6. Place sand filled burlap or geotextile bags every 3 to 6 feet along seams and tie them together with twine to hold them in place.
7. Inspect plastic for rips, tears, and open seams regularly and repair immediately. This prevents high velocity runoff from contacting bare soil which causes extreme erosion.
8. Sandbags may be lowered into place tied to ropes. However, all sandbags must be staked in place.

- Plastic sheeting shall have a minimum thickness of 0.06 millimeters.
- If erosion at the toe of a slope is likely, a gravel berm, riprap, or other suitable protection shall be installed at the toe of the slope in order to reduce the velocity of runoff.

Maintenance Standards

- Torn sheets must be replaced and open seams repaired.
- Completely remove and replace the plastic if it begins to deteriorate due to ultraviolet radiation.
- Completely remove plastic when no longer needed.
- Dispose of old tires used to weight down plastic sheeting appropriately.

Approved as Equivalent

Ecology has approved products as able to meet the requirements of BMP C123. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept this product approved as equivalent, or may require additional testing prior to consideration for local use. The products are available for review on Ecology's website at http://www.ecy.wa.gov/programs/wq/stormwater/newtech/equivalent.html

BMP C124: Sodding

Purpose

The purpose of sodding is to establish permanent turf for immediate erosion protection and to stabilize drainage ways where concentrated overland flow will occur.

Conditions of Use

Sodding may be used in the following areas:

- Disturbed areas that require short-term or long-term cover.
- Disturbed areas that require immediate vegetative cover.
- All waterways that require vegetative lining. Waterways may also be seeded rather than sodded, and protected with a net or blanket.

Design and Installation Specifications

Sod shall be free of weeds, of uniform thickness (approximately 1-inch thick), and shall have a dense root mat for mechanical strength.

The following steps are recommended for sod installation:

- Shape and smooth the surface to final grade in accordance with the approved grading plan. The swale needs to be overexcavated 4 to 6 inches below design elevation to allow room for placing soil amendment and sod.
- Amend 4 inches (minimum) of compost into the top 8 inches of the soil if the organic content of the soil is less than ten percent or the permeability is less than 0.6 inches per hour. See http://www.ecy.wa.gov/programs/swfa/organics/soil.html for further information.
- Fertilize according to the supplier's recommendations.
- Work lime and fertilizer 1 to 2 inches into the soil, and smooth the surface.
- Lay strips of sod beginning at the lowest area to be sodded and perpendicular to the direction of water flow. Wedge strips securely into place. Square the ends of each strip to provide for a close, tight fit. Stagger joints at least 12 inches. Staple on slopes steeper than 3H:1V. Staple the upstream edge of each sod strip.
- Roll the sodded area and irrigate.
- When sodding is carried out in alternating strips or other patterns, seed the areas between the sod immediately after sodding.

Maintenance Standards

If the grass is unhealthy, the cause shall be determined and appropriate action taken to reestablish a healthy groundcover. If it is impossible to establish a healthy groundcover due to frequent saturation, instability, or some other cause, the sod shall be removed, the area seeded with an appropriate mix, and protected with a net or blanket.

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 seeding, mulching, or sodding. Note that this BMP is functionally the same as BMP T5.13 (see Chapter 5 of Volume V of this manual) which is required for all disturbed areas that will be developed as lawn or landscaped areas at the completed project site.

Native soils and disturbed soils that have been organically amended not only retain much more stormwater, but they also serve as effective

Design and Installation Specifications

Depending on project type, size, complexity, and length, materials and quantities will vary. A good minimum list of items that will cover numerous situations includes:

Material
Clear Plastic, 6 mil
Drainpipe, 6 or 8 inch diameter
Sandbags, filled
Straw Bales for mulching,
Quarry Spalls
Washed Gravel
Geotextile Fabric
Catch Basin Inserts
Steel "T" Posts
Silt fence material
Straw Wattles

Maintenance Standards

- All materials with the exception of the quarry spalls, steel "T" posts, and gravel should be kept covered and out of both sun and rain.
- Re-stock materials used as needed.

BMP C151: Concrete Handling

Purpose

Concrete work can generate process water and slurry that contain fine particles and high pH, both of which can violate water quality standards in the receiving water. Concrete spillage or concrete discharge to surface waters of the State is prohibited. Use this BMP to minimize and eliminate concrete, concrete process water, and concrete slurry from entering waters of the state.

Conditions of Use

Any time concrete is used, utilize these management practices. Concrete construction projects include, but are not limited to, the following:

- Curbs
- Sidewalks
- Roads
- Bridges
- Foundations
- Floors
- Runways

Design and Installation

- Assure that washout of concrete trucks, chutes, pumps, and internals is performed at an approved off-site location or in designated concrete

Specifications

washout areas. Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams. Refer to BMP C154 for information on concrete washout areas.

- Return unused concrete remaining in the truck and pump to the originating batch plant for recycling. Do not dump excess concrete on site, except in designated concrete washout areas.
- Wash off hand tools including, but not limited to, screeds, shovels, rakes, floats, and trowels into formed areas only.
- Wash equipment difficult to move, such as concrete pavers in areas that do not directly drain to natural or constructed stormwater conveyances.
- Do not allow washdown from areas, such as concrete aggregate driveways, to drain directly to natural or constructed stormwater conveyances.
- Contain washwater and leftover product in a lined container when no formed areas are available. Dispose of contained concrete in a manner that does not violate ground water or surface water quality standards.
- Always use forms or solid barriers for concrete pours, such as pilings, within 15-feet of surface waters.
- Refer to BMPs C252 and C253 for pH adjustment requirements.
- Refer to the Construction Stormwater General Permit for pH monitoring requirements if the project involves one of the following activities:
  - Significant concrete work (greater than 1,000 cubic yards poured concrete or recycled concrete used over the life of a project).
  - The use of engineered soils amended with (but not limited to) Portland cement-treated base, cement kiln dust or fly ash.
  - Discharging stormwater to segments of water bodies on the 303(d) list (Category 5) for high pH.

Maintenance Standards

Check containers for holes in the liner daily during concrete pours and repair the same day.

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 the Certified Erosion and Sediment Control Lead (CESCL) who is responsible for ensuring compliance with all local, state, and federal erosion and sediment control and water quality requirements.

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; sampling is not required on sites that disturb less than an acre.

- 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 (see details below).

    Ecology will maintain a list of ESC training and certification providers at:
    http://www.ecy.wa.gov/programs/wq/stormwater/cescl.html

    OR

  - Be a Certified Professional in Erosion and Sediment Control (CPESC); for additional information go to: www.cpesc.net

Specifications

- Certification shall remain valid for three years.
- The CESCL shall have authority to act on behalf of the contractor or developer 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.
- A CESCL may provide inspection and compliance services for multiple construction projects in the same geographic region.

Duties and responsibilities of the CESCL shall include, but are not limited to the following:

- Maintaining 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 WebDMR.
- 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.
    - 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.
    - 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.
- Facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies or the owner.

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.

Conditions of Use The construction sequence schedule is an orderly listing of all major land-disturbing activities together with the necessary erosion and sedimentation control measures planned for the project. This type of schedule guides the contractor on work to be done before other work is started so that serious erosion and sedimentation problems can be avoided.

Following a specified work schedule that coordinates the timing of land-disturbing activities and the installation of control measures is perhaps the most cost-effective way of controlling erosion during construction. The removal of surface ground cover leaves a site vulnerable to accelerated

erosion. Construction procedures that limit land clearing provide timely installation of erosion and sedimentation controls, and restore protective cover quickly can significantly reduce the erosion potential of a site.

Design Considerations

- Minimize construction during rainy periods.
- Schedule projects to disturb only small portions of the site at any one time. Complete grading as soon as possible. Immediately stabilize the disturbed portion before grading the next portion. Practice staged seeding in order to revegetate cut and fill slopes as the work progresses.

BMP C232: Gravel Filter Berm

Purpose

A gravel filter berm is constructed on rights-of-way or traffic areas within a construction site to retain sediment by using a filter berm of gravel or crushed rock.

Conditions of Use

Where a temporary measure is needed to retain sediment from rights-of-way or in traffic areas on construction sites.

Design and Installation Specifications

- Berm material shall be ¾ to 3 inches in size, washed well-grade gravel or crushed rock with less than 5 percent fines.
- Spacing of berms:
  - Every 300 feet on slopes less than 5 percent
  - Every 200 feet on slopes between 5 percent and 10 percent
  - Every 100 feet on slopes greater than 10 percent
- Berm dimensions:
  - 1 foot high with 3H:1V side slopes
  - 8 linear feet per 1 cfs runoff based on the 10-year, 24-hour design storm

Maintenance Standards

- Regular inspection is required. Sediment shall be removed and filter material replaced as needed.

BMP C233: Silt Fence

Purpose

Use of a silt fence reduces 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. See Figure 4.2.12 for details on silt fence construction.

Conditions of Use

Silt fence may be used downslope of all disturbed areas.

- Silt fence shall prevent soil carried by runoff water from going beneath, through, or over the top of the silt fence, but shall allow the water to pass through the fence.
- Silt fence is not intended to treat concentrated flows, nor is it intended to treat substantial amounts of overland flow. Convey any concentrated flows through the drainage system to a sediment pond.
- Do not construct silt fences in streams or use in V-shaped ditches. Silt fences do not provide an adequate method of silt control for anything deeper than sheet or overland flow.

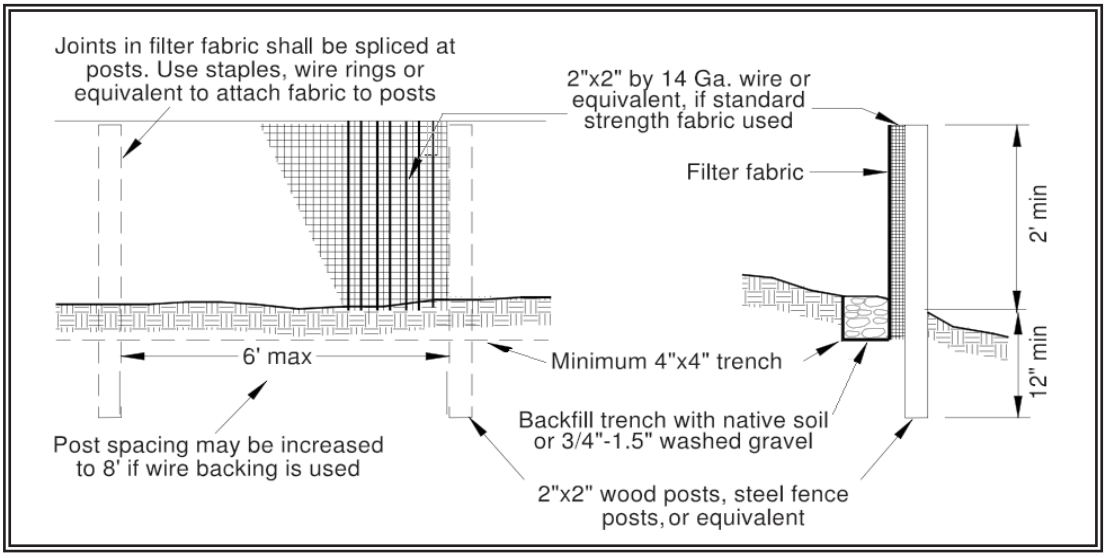


Figure 4.2.12 – Silt Fence

Design and Installation Specifications

- Use in combination with sediment basins or other BMPs.
- Maximum slope steepness (normal (perpendicular) to fence line) 1H:1V.
- Maximum sheet or overland flow path length to the fence of 100 feet.
- Do not allow flows greater than 0.5 cfs.
- The geotextile used shall meet the following standards. All geotextile properties listed below are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in Table 4.2.3):

Table 4.2.3
Geotextile Standards

Polymeric Mesh AOS (ASTM D4751)	0.60 mm maximum for slit film woven (#30 sieve). 0.30 mm maximum for all other geotextile types (#50 sieve). 0.15 mm minimum for all fabric types (#100 sieve).
Water Permittivity (ASTM D4491)	0.02 sec^{-1} minimum
Grab Tensile Strength (ASTM D4632)	180 lbs. Minimum for extra strength fabric. 100 lbs minimum for standard strength fabric.
Grab Tensile Strength (ASTM D4632)	30% maximum
Ultraviolet Resistance (ASTM D4355)	70% minimum

- Support standard strength fabrics with wire mesh, chicken wire, 2-inch x 2-inch wire, safety fence, or jute mesh to increase the strength of the fabric. Silt fence materials are available that have synthetic mesh backing attached.

- Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0°F. to 120°F.
- One-hundred percent biodegradable silt fence is available that is strong, long lasting, and can be left in place after the project is completed, if permitted by local regulations.
- Refer to Figure 4.2.12 for standard silt fence details. Include the following standard Notes for silt fence on construction plans and specifications:

    1. The contractor shall install and maintain temporary silt fences at the locations shown in the Plans.
    2. Construct silt fences in areas of clearing, grading, or drainage prior to starting those activities.
    3. The silt fence shall have a 2-feet min. and a 2½-feet max. height above the original ground surface.
    4. The filter fabric shall be sewn together at the point of manufacture to form filter fabric lengths as required. Locate all sewn seams at support posts. Alternatively, two sections of silt fence can be overlapped, provided the Contractor can demonstrate, to the satisfaction of the Engineer, that the overlap is long enough and that the adjacent fence sections are close enough together to prevent silt laden water from escaping through the fence at the overlap.
    5. Attach the filter fabric on the up-slope side of the posts and secure with staples, wire, or in accordance with the manufacturer's recommendations. Attach the filter fabric to the posts in a manner that reduces the potential for tearing.
    6. Support the filter fabric with wire or plastic mesh, dependent on the properties of the geotextile selected for use. If wire or plastic mesh is used, fasten the mesh securely to the up-slope side of the posts with the filter fabric up-slope of the mesh.
    7. Mesh support, if used, shall consist of steel wire with a maximum mesh spacing of 2-inches, or a prefabricated polymeric mesh. The strength of the wire or polymeric mesh shall be equivalent to or greater than 180 lbs. grab tensile strength. The polymeric mesh must be as resistant to the same level of ultraviolet radiation as the filter fabric it supports.
    8. Bury the bottom of the filter fabric 4-inches min. below the ground surface. Backfill and tamp soil in place over the buried portion of the filter fabric, so that no flow can pass beneath the fence and scouring cannot occur. When wire or polymeric back-up support

mesh is used, the wire or polymeric mesh shall extend into the ground 3-inches min.

9. Drive or place the fence posts into the ground 18-inches min. A 12–inch min. depth is allowed if topsoil or other soft subgrade soil is not present and 18-inches cannot be reached. Increase fence post min. depths by 6 inches if the fence is located on slopes of 3H:1V or steeper and the slope is perpendicular to the fence. If required post depths cannot be obtained, the posts shall be adequately secured by bracing or guying to prevent overturning of the fence due to sediment loading.
10. Use wood, steel or equivalent posts. The spacing of the support posts shall be a maximum of 6-feet. Posts shall consist of either:
    - Wood with dimensions of 2-inches by 2-inches wide min. and a 3-feet min. length. Wood posts shall be free of defects such as knots, splits, or gouges.
    - No. 6 steel rebar or larger.
    - ASTM A 120 steel pipe with a minimum diameter of 1-inch.
    - U, T, L, or C shape steel posts with a minimum weight of 1.35 lbs./ft.
    - Other steel posts having equivalent strength and bending resistance to the post sizes listed above.
11. Locate silt fences on contour as much as possible, except at the ends of the fence, where the fence shall be turned uphill such that the silt fence captures the runoff water and prevents water from flowing around the end of the fence.
12. If the fence must cross contours, with the exception of the ends of the fence, place gravel check dams perpendicular to the back of the fence to minimize concentrated flow and erosion. The slope of the fence line where contours must be crossed shall not be steeper than 3H:1V.
    - Gravel check dams shall be approximately 1-foot deep at the back of the fence. Gravel check dams shall be continued perpendicular to the fence at the same elevation until the top of the check dam intercepts the ground surface behind the fence.
    - Gravel check dams shall consist of crushed surfacing base course, gravel backfill for walls, or shoulder ballast. Gravel check dams shall be located every 10 feet along the fence where the fence must cross contours.

- Refer to Figure 4.2.13 for slicing method details. Silt fence installation using the slicing method specifications:

1. The base of both end posts must be at least 2- to 4-inches above the top of the filter fabric on the middle posts for ditch checks to drain properly. Use a hand level or string level, if necessary, to mark base points before installation.
2. Install posts 3- to 4-feet apart in critical retention areas and 6- to 7-feet apart in standard applications.
3. Install posts 24-inches deep on the downstream side of the silt fence, and as close as possible to the filter fabric, enabling posts to support the filter fabric from upstream water pressure.
4. Install posts with the nipples facing away from the filter fabric.
5. Attach the filter fabric to each post with three ties, all spaced within the top 8-inches of the filter fabric. Attach each tie diagonally 45 degrees through the filter fabric, with each puncture at least 1-inch vertically apart. Each tie should be positioned to hang on a post nipple when tightening to prevent sagging.
6. Wrap approximately 6-inches of fabric around the end posts and secure with 3 ties.
7. No more than 24-inches of a 36-inch filter fabric is allowed above ground level.

   Compact the soil immediately next to the filter fabric with the front wheel of the tractor, skid steer, or roller exerting at least 60 pounds per square inch. Compact the upstream side first and then each side twice for a total of four trips. Check and correct the silt fence installation for any deviation before compaction. Use a flat-bladed shovel to tuck fabric deeper into the ground if necessary.

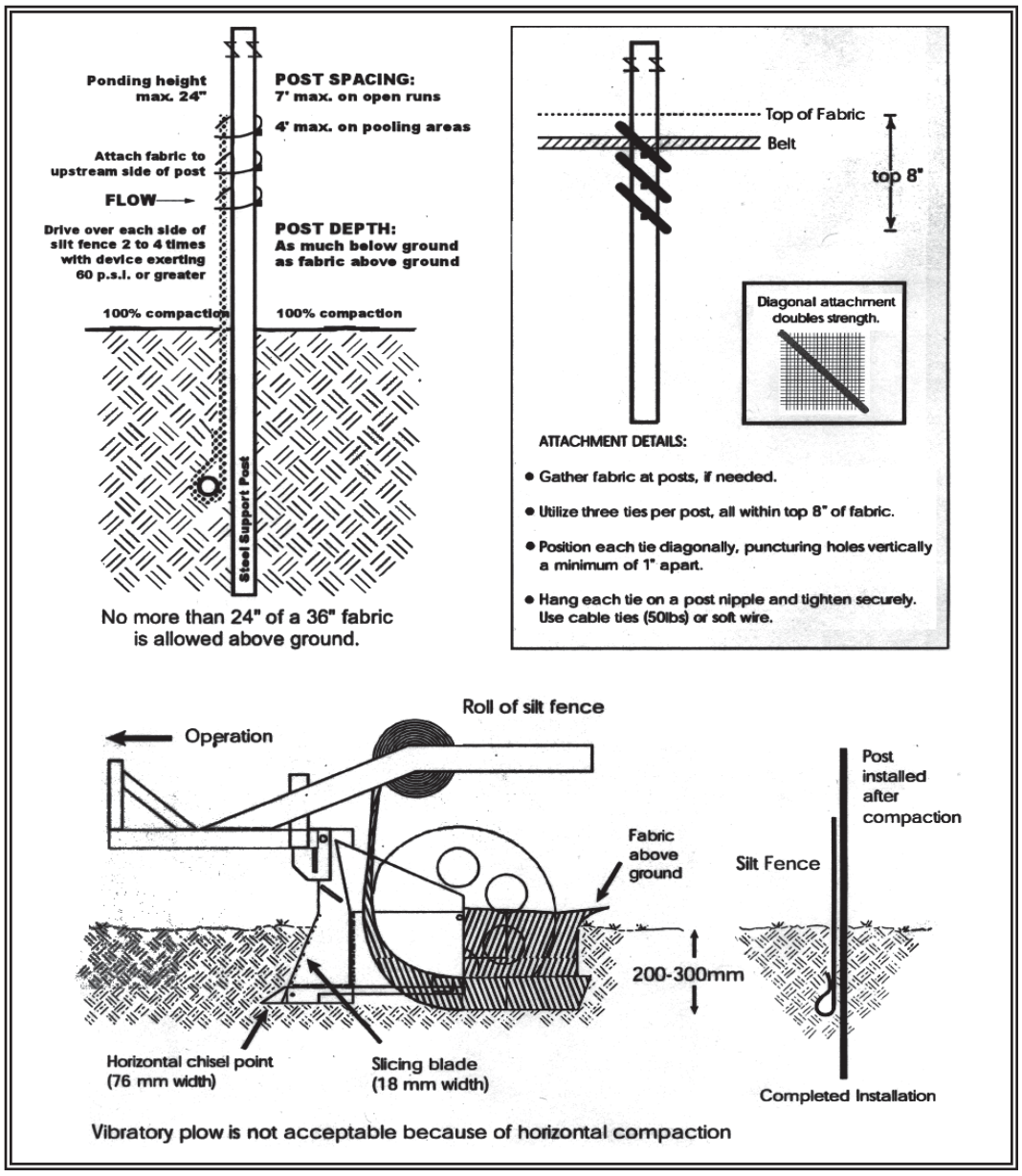


Figure 4.2.13 – Silt Fence Installation by Slicing Method

Maintenance Standards

- Repair any damage immediately.
- Intercept and convey all evident concentrated flows uphill of the silt fence to a sediment pond.
- Check the uphill side of the fence for signs of the fence clogging and acting as a barrier to flow and then causing channelization of flows parallel to the fence. If this occurs, replace the fence or remove the trapped sediment.

- Remove sediment deposits when the deposit reaches approximately one-third the height of the silt fence, or install a second silt fence.
- Replace filter fabric that has deteriorated due to ultraviolet breakdown.

BMP C234: Vegetated Strip

Purpose

Vegetated strips 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

- Vegetated strips may be used downslope of all disturbed areas.
- Vegetated strips are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a strip, rather than by a sediment pond, is when the following criteria are met (see Table 4.2.4):

Table 4.2.4
Contributing Drainage Area for Vegetated Strips

Average Contributing area Slope	Average Contributing area Percent Slope	Max Contributing area Flowpath Length
1.5H:1V or flatter	67% or flatter	100 feet
2H:1V or flatter	50% or flatter	115 feet
4H:1V or flatter	25% or flatter	150 feet
6H:1V or flatter	16.7% or flatter	200 feet
10H:1V or flatter	10% or flatter	250 feet

Design and Installation Specifications

- The vegetated strip shall consist of a minimum of a 25-foot flowpath length continuous strip of dense vegetation with topsoil. Grass-covered, landscaped areas are generally not adequate because the volume of sediment overwhelms the grass. Ideally, vegetated strips shall consist of undisturbed native growth with a well-developed soil that allows for infiltration of runoff.
- The slope within the strip shall not exceed 4H:1V.
- The uphill boundary of the vegetated strip shall be delineated with clearing limits.

Maintenance Standards

- Any areas damaged by erosion or construction activity shall be seeded immediately and protected by mulch.
- If more than 5 feet of the original vegetated strip width has had vegetation removed or is being eroded, sod must be installed.
- If there are indications that concentrated flows are traveling across the buffer, surface water controls must be installed to reduce the flows

APPENDIX C

Geotechnical Engineer's Report

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December 10, 2021

Olson Brothers Pro Vac, LLC
c/o C.E.S. NW, Inc.
310 – 29th Street NE, Suite 101
Puyallup, Washington 98372
(253) 848-4282

Attn: Mr. Craig Deaver
cdeaver@cesnwinc.com

Stormwater Soils Report: Infiltration Feasibility
Proposed Permeable Pavement
2511 Inter Avenue
Puyallup, Washington
PN: 2105200-180, -192
Doc ID: CES.ProVac.InterAve.SR

INTRODUCTION

This *soils report* evaluates the feasibility of the site soils to support shallow infiltration of stormwater runoff from the proposed new hard surfacing to be installed at 2511 Inter Avenue in Puyallup, Washington. The site is currently a gravel surfaced contractor's yard. The approximate site location is shown on the attached Site Location Map, Figure 1.

Our understanding of the project is based on our email correspondence with Mr. Craig Deaver of C.E.S. NW, our review of the provided Cover Sheet by C.E.S NW Inc. dated October 21, 2020 our review of the available geologic and soils data, our December 9, 2020 site visit and subsurface explorations, our groundwater monitoring throughout the 2020/21 wet season, our understanding of the City of Puyallup development codes, and our experience in the area.

We understand the site consists of two separate tax parcels that are currently developed with an existing repair shop, paved and gravel parking areas, and utilities. We further understand that you would like to place an additional 8,771 square feet of new asphalt pavement at the site.

Because of the amount of proposed hard surfacing associated with the project, we understand the City of Puyallup is requiring a *Soils Report* be prepared in accordance with the 2014 Stormwater Management Manual for Western Washington (SWMMWW), which includes in-situ infiltration testing and wet season groundwater monitoring.

SCOPE

The purpose of our services was to evaluate the surface and subsurface conditions at the site as a basis for determining the feasibility for onsite stormwater infiltration and providing pertinent conclusions and recommendations relative to stormwater management for the proposed permeable pavement. Specifically, our scope of services for the project included the following:

1. Reviewing the available geologic, hydrogeologic, and geotechnical data for the site area;

2. Exploring surface and subsurface conditions by reconnoitering the site and monitoring the excavation of two test pits to depths of 5.0 feet below existing grades at select locations across the site, and installing two shallow piezometers in each test pit;
3. Performing one EPA falling test in-situ infiltration test;
4. Describing surface and subsurface conditions, including soil type, depth to groundwater, and an estimate of seasonal high groundwater levels;
5. Monitoring groundwater levels at the site during the prescriptive wet season;
6. Providing our opinion about the feasibility of onsite infiltration in accordance with the 2014 SWMMWW, including a preliminary design infiltration rate based on grain size analysis and in-situ testing, as applicable;
7. Preparing this written *Soils Report* summarizing our site observations and conclusions, and our geotechnical recommendations and design criteria, along with the supporting data; and
8. Preparing a written *Addendum Report* following the groundwater monitoring period, which ends in April.

The above scope of work was completed in accordance with our *Proposal for Geotechnical Engineering Services* dated November 18, 2020. We received written authorization to proceed from you on November 19, 2020.

SITE CONDITIONS

Surface Conditions

The site consists of two contiguous parcels located at 2511 Inter Avenue within the City of Puyallup, Washington, within an area of existing residential and commercial development. Based on the information provided the Cover Sheet prepared by C.E.S. NW and Pierce County GIS, the west parcel is generally flagpole in shape, and the east parcel is generally rectangular in shape. When combined, these parcels form an irregularly shaped site. The full site measures approximately 115 to 195 feet wide (east to west) by about 408 feet long (north to south) and encompasses about 1.59 acres. The site is bounded by Inter Avenue to the south, by existing commercial development to the east and west, and by land being developed to the north.

The site is generally level, with a slight slope of about 1 percent down to the north. A large office and repair shop building is located in the northwest portion of the site, and the rest of the site is developed with gravel parking stalls for the ProVac trucks and paved or concrete parking stalls for automobiles. Total topographic relief across the site is on the order of about 1 to 2 feet.

Vegetation across the site generally was generally cleared, except for typical landscaping grass lawn surrounding the residence located southwest and adjacent to the site. Standing water was observed throughout the gravel parking area.

Site Soils

The USDA Natural Resources Conservation Service (NRCS) Web Soil Survey maps the site as being underlain by Briscot silt loam (6A) soils. A copy of the NRCS soils map for the site area is included as Figure 3.

- *Briscot silt loam (6A)*: The Briscot soils are derived from alluvium and are included in hydrologic soils group B/D. These soils typically form on slopes of 0 to 2 percent and are listed as having a "slight" erosion hazard when exposed.

Site Geology

The draft *Geologic Map of the Puyallup 7.5-minute Quadrangle, Washington* by K.G. Troost maps the site as being underlain by alluvium (Qal). An excerpt of the above referenced geologic map is included as Figure 4.

- *Alluvium (Qal)*: Alluvial soils generally consist of normally consolidated, stratified deposits of sand, silt, clay, and occasional peat that were deposited along the Puyallup River channel. The existing topography, as well as the surficial and shallow soils in the area, are the result of fluvial action, including down-cutting by the river, channel meandering and migration, and flood deposits. Alluvium typically offers unfavorable infiltration characteristics because of the silty nature of the soils.

Subsurface Explorations

On December 9, 2020, a representative from GeoResources, LLC (GeoResources) visited the site and monitored the excavation of two test pits at selected locations across the site to depths of about 5.0 feet below the existing ground surface. The test pits were excavated by a licensed earthwork contractor under contract to GeoResources. Piezometers were installed at the termination depth of each test pit.

The specific number, locations, and depths of our explorations were selected based on the configuration of the proposed development and were adjusted in the field based on consideration for underground utilities, existing site conditions, site access limitations, and encountered stratigraphy. Test pit TP-1 was excavated on the adjacent property to the proposed project site because no other areas on the site were clear of utilities. The densities presented in the logs were based on the difficulty of excavation and our experience. Representative soil samples obtained from the test pits were placed in sealed plastic bags then taken to a laboratory for further examination and testing as deemed necessary. The test pits were then backfilled with the excavated soils and bucket tamped, but not otherwise compacted.

The subsurface explorations indicate the subsurface conditions at specific locations only, as actual subsurface conditions can vary across the site. Furthermore, the nature and extent of such variation would not become evident until additional explorations are performed or until construction activities have begun. Based on our experience, it is our opinion that the soils encountered in the explorations are generally representative of the soils at the site.

The approximate locations and numbers of our explorations are shown on the attached Site & Exploration Plan, Figure 2. The soils encountered were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM D2488. The USCS is included in Appendix A as Figure A-1, while the descriptive logs of our explorations are included as Figure A-2.

Subsurface Conditions

Our explorations encountered relatively uniform subsurface conditions that, in our opinion, generally confirmed the mapped stratigraphy. Our test pits generally encountered about ½-foot of dark-colored topsoil with roots or 1 foot of crushed rock and reddish brown silty sand with gravel,

consistent with fill. Beneath the topsoil and fill, we observed about 0.8 feet of medium dense brown, orange iron stained silty sand or sandy silt in a moist to wet condition, mantling about 2.5 to 2.8 feet of soft gray, orange iron oxide stained silt in a moist condition. Medium dense gray orange iron oxide stained fine sand with silt was observed beneath the surficial soils to the termination depth of each test pit. We interpret these soils to be consistent with native alluvium soils. Table 1, below, summarizes the approximate thicknesses, depths, and elevations of selected soil layers.

TABLE 1:
APPROXIMATE THICKNESS, DEPTHS, AND ELEVATION OF SOIL TYPES ENCOUNTERED IN EXPLORATIONS

Exploration Number	Thickness of Topsoil/Fill (feet)	Thickness of Silty Alluvium (feet)	Depth to Mottling (feet)	Depth to Groundwater (feet)	Elevation of Sandy Alluvium (feet)
TP-1	0.5	3.3	0.5	2.0(perched)/5.0	57.2
TP-2	1.0	3.5	1.0	N/E	57.5

Notes: Elevation datum: Provided *Cover Sheet* by CES NW Inc dated October 21, 2020 N/E: Not encountered

Groundwater Conditions

Perched groundwater was encountered at the time of excavation in TP-1 at a depth of 2.0 feet below the existing ground surface on top of the gray, orange iron oxide stained sandy silt alluvium. Additional groundwater seepage was observed at about 5 feet below existing grades in the sandy alluvium. No groundwater seepage was observed in test pit TP-2 at the time of excavation; however, an old drainage pipe with washed rock was encountered in the western portion of the test pit during the over dig of the infiltration test. Orange iron oxide staining, a form of mottling was observed throughout the soils in each of our test pit explorations. Mottling can be indicative of a seasonal or fluctuating groundwater table. We anticipate fluctuations in the local groundwater levels may occur in response to season, precipitation patterns, off-site construction activities, and site utilization.

We returned to the site throughout the prescriptive wet season observe the depth to groundwater within the piezometers installed in each test pit. Both piezometers had seasonal high groundwater at about 0.5 feet below existing grades. Table 2 summarizes the approximate depths and elevations of groundwater and mottling observed at the time of our explorations and our subsequent readings in both piezometers. We were unable to record groundwater levels during some days in TP-2 because a car had parked over the piezometer. The measurements from our groundwater monitoring are attached in Appendix B.

TABLE 2:
APPROXIMATE DEPTHS, AND ELEVATION OF GROUNDWATER ENCOUNTERED IN EXPLORATIONS

Exploration Number	Depth to Groundwater (feet)	Elevation of Groundwater (feet)	Dated Measured
TP-1	2(perched), 5	59(perched), 56	12/9/2020
	0.5	60.5	12/21/2020
	0.5	60.5	12/31/2020
	0.5	60.5	1/8/2021
	0.5	60.5	1/14/2021
	1.1	59.9	1/29/2021
	1.8	59.2	2/5/2021
	1.7	59.3	2/12/2021
	0.5	60.5	2/16/2021
	1.5	59.5	3/5/2021
	2.4	58.6	3/12/2021
	2.4	58.6	3/19/2021
	1.7	59.3	3/26/2021
	2.1	58.9	4/1/2021
TP-2	NE	NE	12/9/2020
	0.5	61.5	12/21/2020
	1.0	61.0	12/31/2020
	0.7	61.3	1/8/2021
	0.5	61.5	1/14/2021
	1.9	60.1	1/29/2021
	1.2	60.8	2/5/2021
	2.3	59.7	2/12/2021
	Inaccessible	-	2/16/2021
	Inaccessible	-	3/5/2021
	Inaccessible	-	3/12/2021
	Inaccessible	-	3/19/2021
	2.2	59.8	3/26/2021
	Inaccessible	-	4/1/2021

Laboratory Testing

Geotechnical laboratory tests were performed on selected samples retrieved from the test pits to estimate index engineering properties of the soils encountered. Laboratory testing included visual soil classification per ASTM D2488 and ASTM D2487. We also submitted representative samples to an independent analytical laboratory for determination of organic content and cation exchange capacity. Organic content was determined per ASTM D2974 and cation exchange capacity was determined per SW846 9081. Test results are included in Appendix B.

CONCLUSIONS AND RECOMMENDATIONS

Based on our site reconnaissance and subsurface explorations, it is our opinion that the infiltration of stormwater runoff generated onsite by the proposed development is not feasible for the site.

Infiltration Recommendations

Mottled silty sand was encountered near the surface in both of our subsurface explorations, and groundwater was observed at about 0.5 feet below existing grades during our December 21, 2020 site visit to check the groundwater levels in each piezometer.

The City of Puyallup uses the 2012 *Stormwater Management Manual for Western Washington, with 2014 updates* (2014 SWMMWW). Per the 2014 SWMMWW, Volume V, BMP T5.15, a minimum of 1 foot of separation is required between the bottom of the storage course for permeable pavement and the top of an impermeable layer, such as mottling, or the sandy silt soils encountered at the site. Based on the conditions encountered, permeable pavement appears to be infeasible. We performed an EPA falling head test in the brown mottled silty sand in test pit TP-2 and measured an initial rate of 0.6 inches per hour. An EPA falling head test was chosen for this project because the use of a PIT would interfere with the function of the ProVac yard for that day, and in our opinion, would give an inaccurate rate for the soils encountered in our test pits. Based on the above, a long-term design rate of 0.04 inches per hour is applicable for this project, if the site grades can be adjusted to meet the required vertical separation to the seasonal high groundwater. This would require site grades to be raised on the order of 2 to 3 feet.

Per the 2014 SWMMWW, minimum cation exchange capacity of 5 milliequivalents per 100 milligrams of soil and 1 percent organic content is required for soils to provide adequate water quality treatment to the stormwater. Testing was conducted on the shallow soils at the site located at about 2 feet below existing grades by a third party laboratory. The organic content of the site soils were determined to be 5.79 and 9.94 percent per ASTM D: 2974-13, with a cation exchange capacity of 18.0 and 17.6 milliequivalents per 100 grams as determined by SW-846 Test Method 9081. The shallow onsite soils have the required treatment capacity per the 2014 SWMMWW.

Alternative stormwater management methods, such as detention or dispersion, should be considered for this project in accordance with the 2014 SWMMWW. All minimum setback requirements and infeasibility criteria per the 2014 SWMMWW should be considered prior to the selection of any stormwater facility for the proposed development.

LIMITATIONS

We have prepared this report for use by CES NW Inc, and other members of the design team, for use in the design of a portion of this project. The data used in preparing this report and this report should be provided to prospective contractors for their bidding or estimating purposes only. Our report, conclusions and interpretations are based on our subsurface explorations, data from others and limited site reconnaissance, and should not be construed as a warranty of the subsurface conditions.

Variations in subsurface conditions are possible between the explorations and may also occur with time. A contingency for unanticipated conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to

provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork and foundation installation activities comply with contract plans and specifications.

The scope of our services does not include services related to environmental remediation and construction safety precautions. Our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design.

If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as appropriate.

◆ ◆ ◆

We have appreciated the opportunity to be of service to you on this project. If you have any questions or comments, please do not hesitate to call at your earliest convenience.

Respectfully submitted,
GeoResources, LLC

Andrew Schnitger, EIT
Engineer in Training

State of Washington
Engineering Geologist
925
Licensed Geologist
12/10/2021
KEITH SCOTT SCHEMBS

Keith S. Schembs, LEG
Principal

ERIC WILLIAM HELLER
STATE OF WASHINGTON
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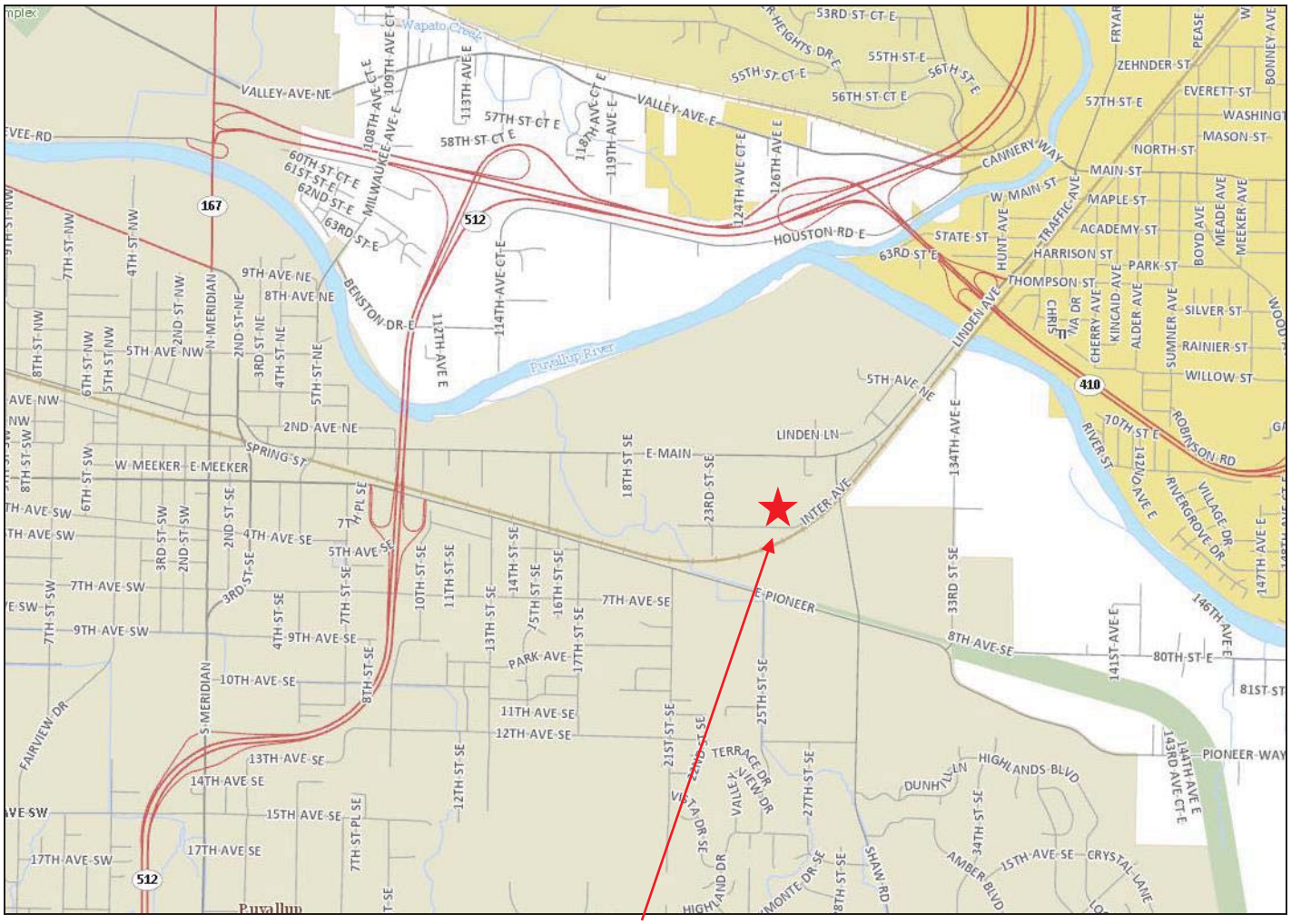
REGISTERED
PROFESSIONAL ENGINEER
12/10/2021

Eric W. Heller, PE, LG
Senior Geotechnical Engineer

AES:KSS:KEB/aes
DocID: CES.ProVac.InterAve.SR
Attachments: Figure 1: Site Location Map
Figure 2: Site & Exploration Plan
Figure 3: NRCS Soils Map
Figure 4: USGS Geologic Map
Appendix A – Subsurface Explorations
Appendix B – Laboratory Test Results



Approximate Site Location

Map created from Pierce County Public GIS (https://matterhornwab.co.pierce.wa.us/publicgis/)

N W E S

Not to Scale

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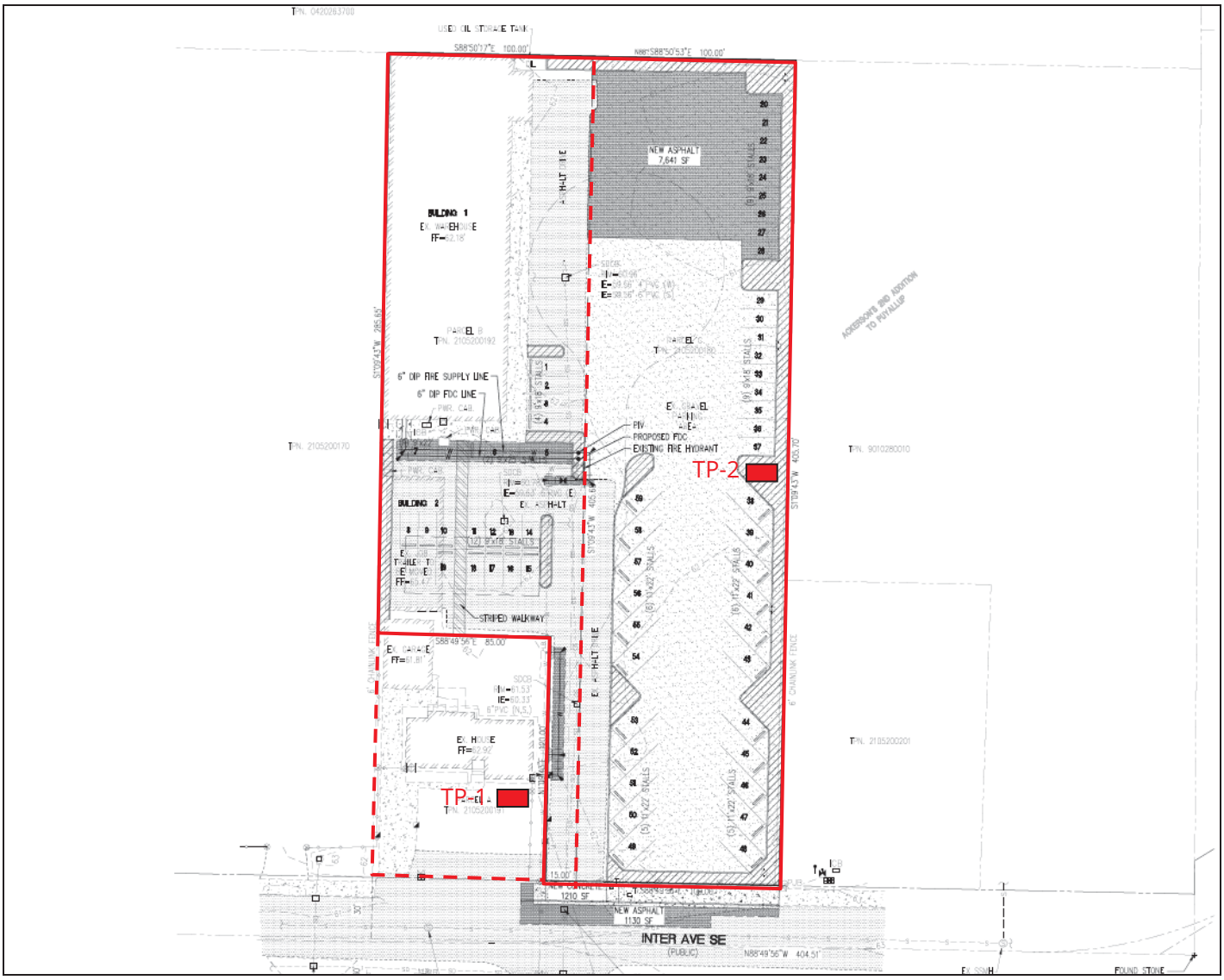
Site Location Map

Olson Brothers Storage
2511 Inter Avenue
Puyallup, Washington
PN: 2105200-180, -192

DocID: CES.ProVac.InterAve.F	December 2021	Figure 1



Approximate Site Location

Map created from Pierce County Public GIS (https://matterhornwab.co.pierce.wa.us/publicgis/)

Approximate test pit and piezometer location

Approximate site boundary

Approximate locations of property lines

N W E S

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Site & Exploration Plan

Olson Brothers Storage
2511 Inter Avenue
Puyallup, Washington
PN: 2105200-180, -192

DocID: CES.ProVac.InterAve.F	December 2021	Figure 2

Approximate Site Location

Map created from Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

Soil Type	Soil Name	Parent Material	Slopes	Erosion Hazard	Hydrologic Soils Group
6A	Briscot silt loam	Alluvium	0 to 2	Slight	B/D

Not to Scale

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NRCS Soils Map

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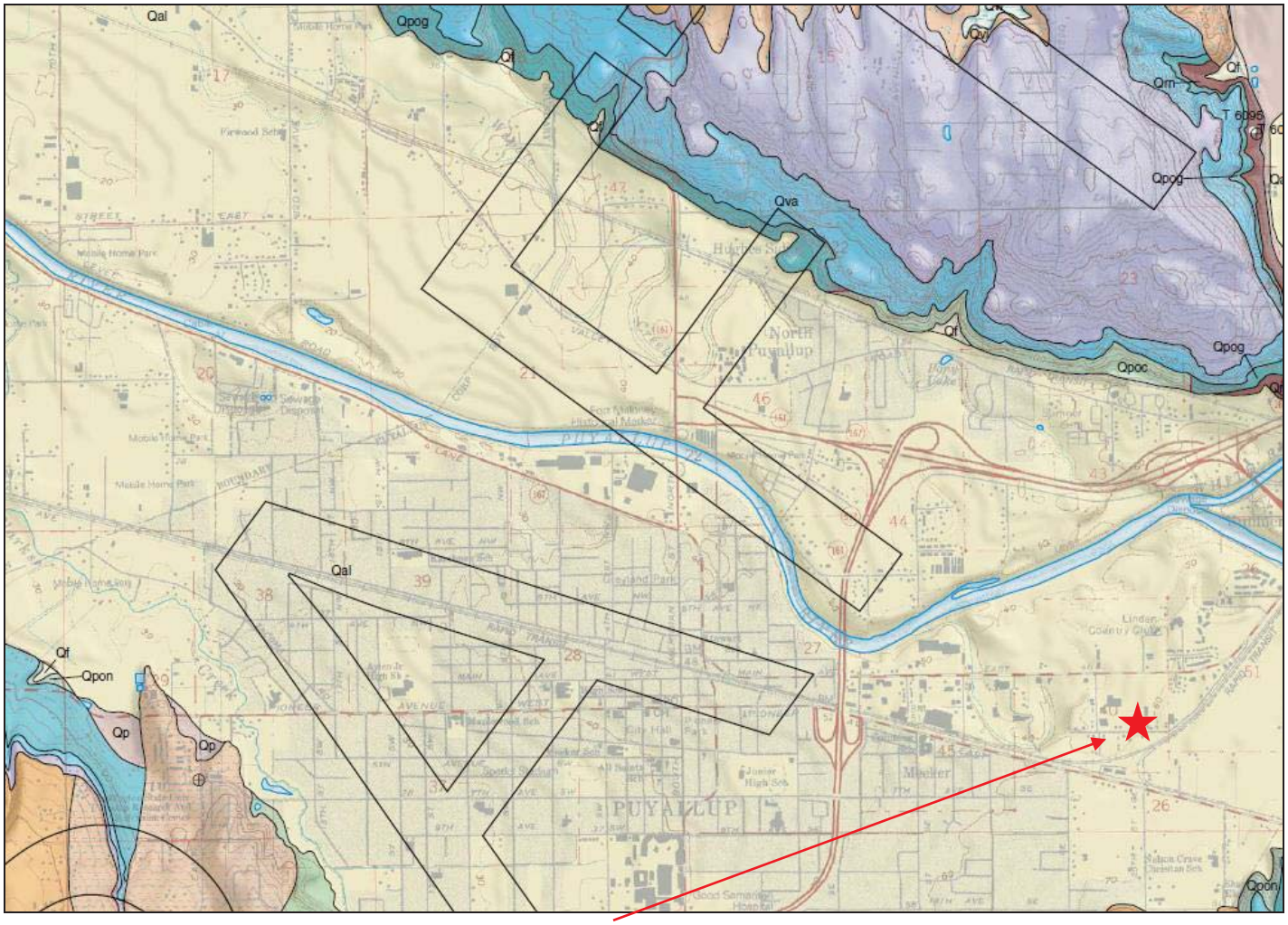

Approximate Site Location

An excerpt from the draft *Geologic Map of the Puyallup 7.5-minute Quadrangle*, Washington, by K.G. Troost (in review)

Qal	Alluvium

Not to Scale

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USGS Geologic Map

Olson Brothers Storage
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Appendix A

Subsurface Explorations

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVEL More than 50% Of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less than 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY Liquid Limit 50 or more	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.
2. Soil classification using laboratory tests is based on ASTM D2487-90.
3. Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

Dry- Absence of moisture, dry to the touch

Moist- Damp, but no visible water

Wet- Visible free water or saturated, usually soil is obtained from below water table

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Unified Soils Classification System

Olson Brothers Storage
2511 Inter Avenue
Puyallup, Washington
PN: 2105200-180, -192

Test Pit TP-1

Location: South of existing residence, off of proposed permeable area
Approximate Elevation: 61’

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Topsoil
0.5	-	1.3	SM	Brown, orange iron oxide stained silty fine SAND (loose, moist) (alluvium)
1.3	-	3.8	SM	Gray, orange iron oxide stained silty fine SAND (loose, moist) (alluvium)
3.8	-	5.0	SP-SM	Gray, orange iron oxide stained fine SAND with some silt (medium dense, moist) (alluvium)

Terminated at 5.0 feet below ground surface.
Caving observed 2 feet below existing ground surface.
Perched groundwater observed at 2 feet below existing grades, fast groundwater seepage observed at termination depth of test pit.
Mottling observed throughout entire excavation.

Test Pit TP-2

Location: Central portion of site, near eastern site boundary
Approximate Elevation: 62’

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Crushed rock (dense, moist) (fill)
0.5	-	1.0	SM	Reddish brown silty SAND with gravel (dense, moist) (fill)
1.0	-	1.7	SM	Brown, orange iron oxide stained silty SAND (loose, moist) (alluvium)
1.7	-	4.5	ML	Gray, orange iron oxide stained SILT (soft, moist) (alluvium) (drainage pipe encountered during overdig at about 3 feet)
4.5	-	5.0	SP-SM	Gray, orange iron oxide stained fine SAND with some silt (medium dense, moist) (alluvium)

Terminated at 5.5 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed at time of excavation.
Mottling observed throughout entire excavation.
Infiltration test performed at about 1.5 feet below existing grades.

Logged by: AES **Excavated on: December 9, 2020**

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Test Pit Logs
Olson Brothers Storage
2511 Inter Avenue
Puyallup, Washington
PN: 2105200-180, -192

Appendix B

Laboratory Results

SPECTRA Laboratories ...Where experience matters

2221 Ross Way • Tacoma, WA 98421 • (253) 272-4850 • Fax (253) 572-9838 • www.spectra-lab.com

11/18/2021

GeoResources, LLC
4809 Pacific Hwy E
Fife, WA 98424

Project: CES.Provac
Sample Matrix: Soil
Date Sampled: 11/12/2021
Date Received: 11/15/2021
Spectra Project: 2021110413
Rush

Client ID	Spectra #	Analyte	Result	Units	Method	Analyzed
TP-1, 1'	1	Organic Matter	5.79	wt. % Dry	ASTM D-2974-13	11/17/2021
TP-1, 1'	1	Cation Exchange Capacity	18.0	Na, mEq/ 100g	SW846 9081	11/18/2021
TP-2, 1'	2	Organic Matter	9.94	wt. % Dry	ASTM D-2974-13	11/17/2021
TP-2, 1'	2	Cation Exchange Capacity	17.6	Na, mEq/ 100g	SW846 9081	11/18/2021

SPECTRA LABORATORIES

Ben Frans, Laboratory Manager

a7/scj

SPECTRA Laboratories

2221 Ross Way, Tacoma, WA 98421
(253) 272-4850 Fax (253) 572-9838
www.spectra-lab.com info@spectra-lab.com

SPECIAL INSTRUCTIONS/COMMENTS:

CHAIN OF CUSTODY

SPECTRA PROJECT # 2021110413

Return Samples: Y N Page _____ of _____ STANDARD ☐ RUSH ☑

CLIENT: GeoResources ADDRESS: 4809 Pacific Hwy E, Fife WA ADDRESS CHANGE ☐

PROJECT: CES. Provac

CONTACT: Andrews

SAMPLED BY: Andrews

PHONE: 253 896 1004 FAX:

e-MAIL: Andrews@Georesources.y Prefer FAX ☐ or e-MAIL ☑

PURCHASE ORDER #

	SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	NUMBER OF CONTAINERS	HYDROCARBONS: NWTPH-HCID	BTEX	BTEX/NWTPH-G	NWTPH-G	NWTPH-Dx	1664 SGT-HEM (TPH)	1664 HEM (FOG)	ORGANICS: 8260/624 VOA	8260 CHLOR SOLVENTS	8270-625 SEMI VOA	8270 PAH/PNA	8082/608 PCB	METALS: TOTAL METALS RCRA 8	TOTAL METALS (SPECIFY)	TCLP METALS RCRA 8	TCLP METALS (SPECIFY)	OTHER: PH 9040/9045	TX/TOX/EOX	TURBIDITY	FLASH POINT	BOD	SOLIDS (SPECIFY)	Cation Exchange	Organic content
1	TP-1, 1'	11/12/21	1700	Soil	1																							X	X
2	TP-2, 1'	11/12/21	1705	Soil	1																							X	X
3																													
4																													
5																													
6																													
7																													
8																													
9																													
10																													

LAB USE ONLY

	SIGNATURE	PRINTED NAME	COMPANY	DATE	TIME
RELINQUISHED BY	[signature]	Andrew Schmitzer	GeoResources	11/15/21	1058
RECEIVED BY	[signature]	Taylor Burkhart	Spectra	11/15/21	1058
RELINQUISHED BY					
RECEIVED BY					

Payment Terms: Net 30 days. Past due accounts subject to 1 1/2% per month interest. Customer agrees to pay all costs of collection including reasonable attorney's fees and all other costs of collection regardless of whether suit is filed in Pierce Co., WA venue. *Spectra Laboratories, LLC*

Appendix C

Groundwater Monitoring Logs

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MONITORING WELL LOGS

Project ID: CES.ProVac.InterAve

*****Depths are in reference with ground surface*****

Date:	12/9/2020 (ATD)
Field Tech:	AES
Well #	**Depth** (ft)
1	2 (perched), 5
2	NE

Date:	12/21/2020
Field Tech:	AES
Well #	**Depth** (ft)
1	0.5
2	0.5

Date:	12/31/2020
Field Tech:	AES
Well #	**Depth** (ft)
1	0.5
2	1.0

Date:	1/8/2021
Field Tech:	AES
Well #	**Depth** (ft)
1	0.5
2	0.7

Date:	1/14/2021
Field Tech:	AES
Well #	**Depth** (ft)
1	0.5
2	0.5

Date:	1/29/2021
Field Tech:	AES
Well #	**Depth** (ft)
1	1.1
2	1.9

Date:	2/5/2021
Field Tech:	AES
Well #	**Depth** (ft)
1	1.8
2	1.2

Date:	2/12/2021
Field Tech:	AES
Well #	**Depth** (ft)
1	1.7
2	2.3

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MONITORING WELL LOGS

Project ID: CES.ProVac.InterAve

*****Depths are in reference with ground surface*****

Date:	2/16/2021
Field Tech:	AES
Well #	**Depth** (ft)
1	0.5
2	Unaccessable

Date:	3/5/2021
Field Tech:	AES
Well #	**Depth** (ft)
1	1.5
2	Unaccessable

Date:	3/12/2021
Field Tech:	CB
Well #	**Depth** (ft)
1	2.4
2	Unaccessable

Date:	3/19/2021
Field Tech:	CB
Well #	**Depth** (ft)
1	2.4
2	Unaccessable

Date:	3/26/2021
Field Tech:	CB
Well #	**Depth** (ft)
1	1.7
2	2.2

Date:	4/1/2021
Field Tech:	CB
Well #	**Depth** (ft)
1	2.1
2	Unaccessable

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February 14, 2022

Olson Brothers Pro Vac, LLC
c/o C.E.S. NW, Inc.
310 – 29th Street NE, Suite 101
Puyallup, Washington 98372
(253) 848-4282

Attn: Mr. Craig Deaver
cdeaver@cesnwinc.com

Soils Report Addendum: Supplemental Infiltration Testing
Proposed Permeable Pavement
2511 Inter Avenue
Puyallup, Washington
PN: 2105200-180, -192
Doc: CES.ProVac.InterAve.SRa.rev2

INTRODUCTION

We are pleased to submit this addendum to our previously prepared *soils report* dated December 10, 2021. On December 21, 2021, we returned to the site to perform one Pilot Infiltration Test (PIT) in the green space on the southern portion of the site, in the front yard of the existing residence. The bottom of the PIT was excavated approximately 1 foot below the existing grades. The soils at the bottom of the PIT were consistent with the native alluvium soils described in our original report of a medium dense brown, orange iron stained silty sand or sandy silt that was in a moist to wet condition.

At the time of our testing, water was being pumped out from beneath the crawl space of the existing residence, and the surface water ponding on the gravel surface and adjacent sod area was flowing towards our PIT. No groundwater was encountered in our PIT, but the surface water was flowing into our PIT. Our excavation slowly started to fill in as the rate of inflow as greater than the infiltration rate of the soils. During the limited time of our testing prior to surface water inflow, the measured rate appeared consistent with the rates provided in our December 2021 report, and those rates are still appropriate. We also monitored groundwater during the winter of 2020/2021. The results of our groundwater monitoring and original infiltration testing are summarized in our December 10, 2021 report.

Based on the Paving & Utility Plan by C.E.S. NW Inc., dated February 9, 2022, the grades at the site will be raised by 2 feet to meet the vertical separation requirements for permeable pavement. Catch basins and overflows will also be implemented. It is our opinion that vertical separation requirements can be met at the site once the site grades have been raised, and permeable pavement would therefore be feasible for this project.

◆ ◆ ◆

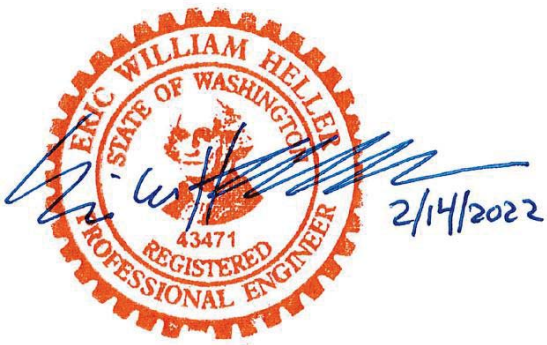
CLOSURE

We trust that this is sufficient for your needs. If you have any questions regarding the content of this letter, please call.

Yours very truly
GeoResources, LLC

Andrew Schnitger, EIT
Engineer in Training

Keith Schembs, LEG
Principal



Eric W. Heller, PE, LG
Senior Geotechnical Engineer

AES:KSS:EWH/aes
DocID: CES.ProVac.InterAve.SRa.rev2