Stormwater Management Manual Compliance

For

Rockport Pit

August 28, 2023

Prepared by:

Skagit Aggregates LLC

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1 Introduction

1.1 Purpose and Objective

The Stormwater Management Manual Compliance report has been prepared by Skagit Aggregates LLC for the expansion of the existing Rockport gravel pit in Skagit County, Washington. The purpose of this report is to determine the Stormwater Minium Requirements (MRs) as established in the 2019 Stormwater Management Manual for Western Washington and as supplemental report to the Grading Permit Application as required by Skagit County Code Section 14.22 Land Disturbance and to meet the requirements of Skagit County Code Section 14.32 Stormwater Management.

1.2 Project Summary

The purpose of the proposed expansion of the Rockport pit is to increase the life of the mine to support the surrounding area with a sand and gravel resource. The entire project area is within the Mineral Resource Overlay (MRO) designation in the Skagit County Comprehensive Plan. A Conditional Use Permit is being used for the existing mining operations and the expansion is currently in process with the Skagit County Planning Department under Special Use Permit Application PL20-0507. The proposed project will occur in three phases each consisting of approximately 10 acres each, the mining will begin from the existing mined area and progress south in 10-acre phases following the Department of Natural Resources (DNR) Reclamation Plan currently approved for the entire 40 acres (existing and expansion). Each phase of mining will be completed in three steps; logging clearing and grubbing using existing roads onsite which were used for previous logging activities, mining within the approved site, and reclamation.

In each phase the logging activities will utilize approximately 400 feet of existing logging road for logging, clearing and grubbing operations resulting in the use of approximately 4,800 square feet of hard surface area. Once the logging operation is complete each phase will transition to mining operations that fall under the oversite of the Washington State Department of Natural Resources (DNR).

1.3 Application of Standards

A grading permit is required per Skagit County Code Section 14.22 when an applicant proposes a Forest Practice Conversion, Skagit Aggregates LLC has applied for this Forest Practice Conversion (see FPC #PL22-0435)

The portion of the expansion that is subject to Skagit County Code Section 14.32 Stormwater Management and the 2019 Washington State Department of Ecology “Stormwater Management Manual for Western Washington”, 2019 publication (2019SWMMWW) is the work associated with the logging clearing and grubbing steps of each phase in the mining plan. These items are being permitted under a Skagit County Grading Permit. Other activities will be permitted through the Department of Natural Resources Surface Mining Reclamation Permit (DNR) and the Washington State Department of Ecology Sand and Gravel General Permit (DOE SGGP).

2 Existing Conditions

2.1 Land Use and Zoning

The project is located in Skagit County, outside of city limits and any UGA, and zoned RRc-NRL Rural Resource – NRL with MRO overlays. The site contains an existing and active 10 acre gravel pit operation with scale house and building used for equipment storage which currently falls under the regulation of the Washington State Department of Ecology Sand and Gravel General Permit (SGGP). This project is outside of the NPDES Permit Area identified in Skagit County Code Section 14.32

2.2 Vegetation

Vegetation on the subject property consists of a mixed forest that includes Douglas fir, western red cedar, red alder, big leaf maple, and a few paper birch with an understory of Oregon grape, salal, and sword fern. Appendix F "Stratum Group - Geologic Hazard, Assessment May 11th, 2020"

2.3 Existing Soil Conditions

The NRCS Web Soil Survey indicates that the two dominant soil types are present on the property with one minor constituent. *Winston gravelly slit loam*, *0-8% slopes* make up approximately 66% of the subject property and is described as forming on outwash terraces overlain by volcanic ash and loess. The unit is well drained with moderately high to high hydraulic conductivity. Soil is generally 20 to 40 inches deep before encountering a restrictive layer. *Barnestorn gravelly ashy loam, 8 to 30% slopes* makes up approximately 33% of the subject property and is describes as forming on the crest and sides of glacial features with parent materials consisting of ash and loess over glacial outwash. The unit is somewhat excessively drained with moderately high to high hydraulic conductivity. Soil is generally more than 80 inches thick before encountering a restrictive layer. Appendix E "Stratum Group – Hydraulic Assessment, May 21st, 2020"

2.4 Topography and Drainage

"Topography on the northern portion of the subject property is relatively level, due to the property's position on top of a large glacial outwash terrace. Elevations on the terrace range from approximately 565 feet asl to 540 feet asl with a gentle slope to the southwest. The southern portion of the property consists of several irregular topographic depressions. The morphology of the depressions is consistent with the features being kettles formed by buried or partially buried blocks of ice that then melted forming depressions. The base elevation of these depressions range from approximately 510 feet to 431 asl. Gentle to moderate slopes descend from the level terrace or ridgelines between kettles to the kettle bottoms."

"The subject property is located within the Skagit River drainage basin of the Upper Skagit Water Resource Inventory Area (ARIA) 4 (Washington State Department of Natural Resources, 2020). DNR mapping does not identify any watercourses as being present on the subject property. DNR and U.S. Fish & Wildlife (USFWS) mapping does not identify and wetlands as being present on the subject property

(Washington State Department of Natural Resources, 2020; U.S. Fish & Wildlife Service, 2020). The nearest mapped wetland is adjacent to the Skagit River approximately 500 feet to the southwest and down gradient of the subject property. The mapping is consistent with our own observations."

"The nearest mapped watercourse is an old flood overflow channel approximately 500 feet southwest of the southwest corner of the site and approximately 250 feet in elevation below. Unnamed, fish-bearing streams are located approximately 4,000 feet southeast and 1,900 feet north and northwest of the subject property at its nearest point. Our observations are consistent with the above-described mapping. No evidence of surface water or wetlands or concentrations of hydrophilic vegetation were observed on the property."

Appendix E Stratum Group - Hydraulic Assessment, May 21st, 2020

3 Minimum Stormwater Management Requirements

This project will disturb more than 7,000 square feet and create/utilize up to 4,800 new plus replaced hard surfaces. This project will comply with the minimum requirements outlined in the Skagit County Grading Permit Application v10/11/2022 as determined in part 4a flow chart (see appendix B) and as established in the 2019SWMMWW and Skagit County Code 14.32., this project is subject to the following minimum requirements:

1 Storm Water Site Plan
2 Construction SWPPP
3 Source Control of Pollution
4 Preservation of Natural Drainage Patterns and Outfalls
5 Onsite Stormwater Management

Based on the findings of the Stratum Group – Hydrologic Assessment May 21st, 2020 and the Stratum Group – Geologic Hazard Assessment May 11th, 2020 and observations of existing site characteristics any runoff from the site will be directed to infiltration ditches/ponds as necessary for full infiltration of the site runoff, thus meeting or exceeding the WA DOE Standards as required by Skagit County Code.

3.1 Storm Water Site Plan

This section will serve as our Stormwater Site plan, it has been prepared per the 2019 SWMMWW. The required steps have been performed as follows.

Step 1 Analyze Existing Conditions to Determine LID Feasibility

A Survey and site plans have been prepared by a registered land surveyor and civil engineer, Jepson Engineering. In addition, a Licensed Engineering Geologist has preformed an onsite visit, research and prepared two reports analyzing both the Hydrologic conditions and Geologic Hazards. See section 3 above for a detailed description of existing site conditions.

Minor hydrologic features on site include kettles and there are no major hydrologic features onsite per Stratum Group Hydrologic Assessment review of DNR and US Fish and Wildlife mapping resources. Per FEMA Flood Hazard Area Panel 305, the subject property is located in, Zone C “Area of Minimal Flooding”. The Stratum Group Geologic Hazard Assessment did not identify any hazard areas of concern. Aquifer and wellhead protection areas exist due to the proximity of previous landfill activities.

An underlying soils report has been prepared. See the Stratum Group – Hydrologic Assessment May 21st, 2020. Due to the subsequent use of the site as a gravel pit operation and ultimate reclamation of the site per the oversight of the Washington State Department of Natural Resources the existing approved reclamation plans will determine the native soil and vegetation protection areas.

Step 2 Prepare the Preliminary Development Layout

Phased development plans have been prepared which show the proposed existing logging roads to be used during the logging phase. See appendix A site plan.

Step 3 Preform an Off-Site Analysis

The proposed project does not add 5,000 square feet of new hard surface or convert ¾ acres of vegetation to lawn or landscaped areas, or convert 2.5 forested area to pasture, therefore an off-site analysis is not required. However, per the Stratum Group – Hydrologic Assessment May 21st, 2020. The project does not identify any watercourses or wetlands as being present and in conclusion of the report regarding mining and reclamation, "… is unlikely to result in the formation of new surface water courses on or off the subject property."

Step 4 Determine and Read the Applicable Minimum Requirements

See appendix C Figure I-3.1: Flow Chart for Determining Requirements for New Development. Per the flow chart we have determined that Minimum Requirements #1 through #5 apply.

Step 5 Prepare a Permanent Stormwater Control Plan

Existing Site Hydrology

See section 3 for existing conditions, appendix E (Hydrologic Assessment) and Appendix A (site plan)

Developed Site Hydrology

No alterations to existing hydrology will result from this project. All stormwater will be fully infiltrated into the existing subgrade as in the existing condition. See appendix E (Hydrologic Assessment) and Appendix A (site plan)

Step 6 Prepare a Construction Stormwater Pollution Prevention Plan

See section 4.2 of this document for the Construction Stormwater Pollution Prevention Plan

Step 7 Complete the Stormwater Site Plan

The Stormwater Site Plan has been prepared according to the 2019 SWWMMWW

Step 8 Check Compliance with All Applicable Minimum Requirements

The stormwater management facilities proposed in this report comply with all of the applicable standards per the Skagit County Code Section 14.32. Per Skagit County Code Section 14.32.050 this development project must fully comply with the County's NPDES permit and the 2019 Stormwater Management Manual of Western Washington.

3.2 Construction SWPPP

This section will serve as our Construction Stormwater Pollution Prevention Plan, it has been developed for this project. The SWPPP consists of two parts a narrative and a set of site plan drawings. The narrative portion consist of the thirteen SWPPP elements described below in addition to other components of this stormwater report including descriptions of existing site conditions, proposed project, critical areas, soils, etcetera. The site plan drawings depict implementation of BMP's and outline phasing and are a portion of the site drawings attached in appendix A, See appendix G for descriptions of the proposed BMP's referenced below.

3.2.01 Preserve Vegetation / Mark Clearing Limits

Prior to the commencement of logging activities, the limits of the clearing area and the mining boundaries will be marked in the field.

The minimum required soil stabilizing BMP's are:

C101 Preserve Natural Vegetation

C102 Buffer Zones

3.2.02 Establish Construction Access

Existing access is currently in place with previous logging roads, at all phases the existing logging roads will enter the permitted mine, using quarry spalls, crushed rock, or other equivalent BMPs to minimize tracking of sediment into the pit (Roads leaving the property utilize the existing pit BMPs in place under the SGGP to prevent tracking of sediment onto public roads.)

The minimum required soil stabilizing BMP's are:

C105 Stabilized Construction Entrance

3.2.03 Control Flow Rates

Properties and waterways downstream of development sites shall be protected from erosion and the associated discharge of turbid waters. All storm water runoff will be 100% infiltrated into the existing site.

3.2.04 Install Sediment Controls

Drainage controls will be put in place as one of the first steps in the logging process. Storm water runoff from the disturbed portions of the site shall be routed north to the active mine. Per observations by the Stratum Group the expected porosity of the surrounding soils will infiltrate all storm water prior to reaching the existing mine.

3.2.05 Stabilize Soils

Because the steps immediately following the process of clearing the site in preparation for mining will include the removal and storage of topsoil (as part of the DNR mining plan and DOE SGGP) soil stabilization is not expected to be necessary under this Construction SWPPP however, if necessary, soil stabilizing BMPs will include:

C120 Temporary and Permanent Seeding

C140 Dust Control

3.2.06 Protect Slopes

A Cut and Fill of slopes is not expected to occur during this phase of construction. Protection of existing slopes prior to mining will include:

C120 Temporary and Permanent Seeding

3.2.07 Protect Drain Inlets

Drain inlets are not proposed for this project

3.2.08 Stabilize Channels and Outfalls

Open channels shall be stabilized using armoring material and check dams installed fifty feet on center in all open ditches using the minimum required BMPs are:

C207 Check Dams

C209 Rock Lining Outlet Protection

3.2.09 Control Pollutants

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

3.2.10 Control Dewatering

Dewatering is not anticipated on this project.

3.2.11 Maintain BMPs

All temporary and permanent erosion and sediment control BMPs shall be inspected weekly, maintained, and repaired as required to assure continued performance.

C150 Materials on Hand

3.2.12 Manage the Project

BMPs shall be inspected, maintained, and repaired to assure continued performance of their intended function. The SWPPP shall be maintained and implemented as needed.

3.2.13 Protect Low Impact Development

The primary purpose of On-Site Stormwater Management is to reduce the disruption of the natural site hydrology through infiltration. BMP's used to meet LID BMP's are permanent facilities. Where applicable we will; Maintain the infiltration capabilities of LID BMP's by protecting against compaction by construction equipment and foot traffic, and keep all heavy equipment off existing soils under LID BMP's that have been excavated to final grade to retain the infiltration rate of the soils.

C102 Buffer Zones

C234 Vegetated Strip

3.3 Source Control of Pollution

Upon Completion of construction the following pollutant source control BMPs are recommended for implementation associated with the management and maintenance of the development, obtained from the 2019 SWMMWW, volume IV.

S407 BMPs for Dust Control at Disturbed Land Areas and Unpaved Roadways Parking Lots

S412 BMPs for Loading and Unloading Areas for Liquid or Solid Material

S414 BMPs for Maintenance and Repair of Vehicles and Equipment

S416 BMPs for Maintenance of Roadside Ditches

S417 BMPs for Maintenance of Stormwater Drainage and Treatment Systems

3.4 Preservation of Natural Drainage Patterns and Outfalls

This project proposed to fully infiltrate all runoff from the site. As no defined surface drainage courses exist downstream of the site, the existing outfall of the site will remain subsurface.

3.5 Onsite Stormwater Management

This project, including logging and clearing and grubbing activities, will meet on-site stormwater management requirement per the 2019 SWMMWW. This project does not discharge to flow control exempt waters, triggers only minimum requirements 1-5 as shown in Figure I-3.3: Flow Chart for Determining MR #5 Requirements, see appendix D. Accordingly, this project is required to meet the LID performance standard. This project does meet the LID performance standard by fully infiltrating all runoff from the site, BMP T5.30 Full Dispersion.

3.6 Runoff Treatment

Not necessary for requirements 1-5 only see appendix C Figure I-3.1: Flow Chart for Determining Requirements for New Development and see appendix B grading permit flow chart 4a.

3.7 Flow Control

Not necessary for requirements 1-5 only see appendix C Figure I-3.1: Flow Chart for Determining Requirements for New Development and see appendix B grading permit flow chart 4a.

3.8 Wetlands Protection

Not necessary for requirements 1-5 only see appendix C Figure I-3.1: Flow Chart for Determining Requirements for New Development and see appendix B grading permit flow chart 4a.

3.9 Operations and Maintenance

Not necessary for requirements 1-5 only see appendix C Figure I-3.1: Flow Chart for Determining Requirements for New Development and see appendix B grading permit flow chart 4a.

4 Findings and Recommendations

This document has shown that all drainage requirements can be met for the proposed project site. All stormwater management associated with the proposed project shall comply with the Skagit County Code Section 14.32 and minimum requirements in the 2019 SWMMWW

5 Appendix

Publications generally available to the public referenced in this document are not included in this appendix including…

2019 Washington State Department of Ecology Stormwater Management Manual for Western Washington, however selected BMP's have been included below

Skagit County Code Section 14.22 and 14.32

A Site Plan Map

B flow chart 4a Skagit County Grading Application

C Figure I-3.1: flow chart for determining requirements for new development 2019 SWMMWW

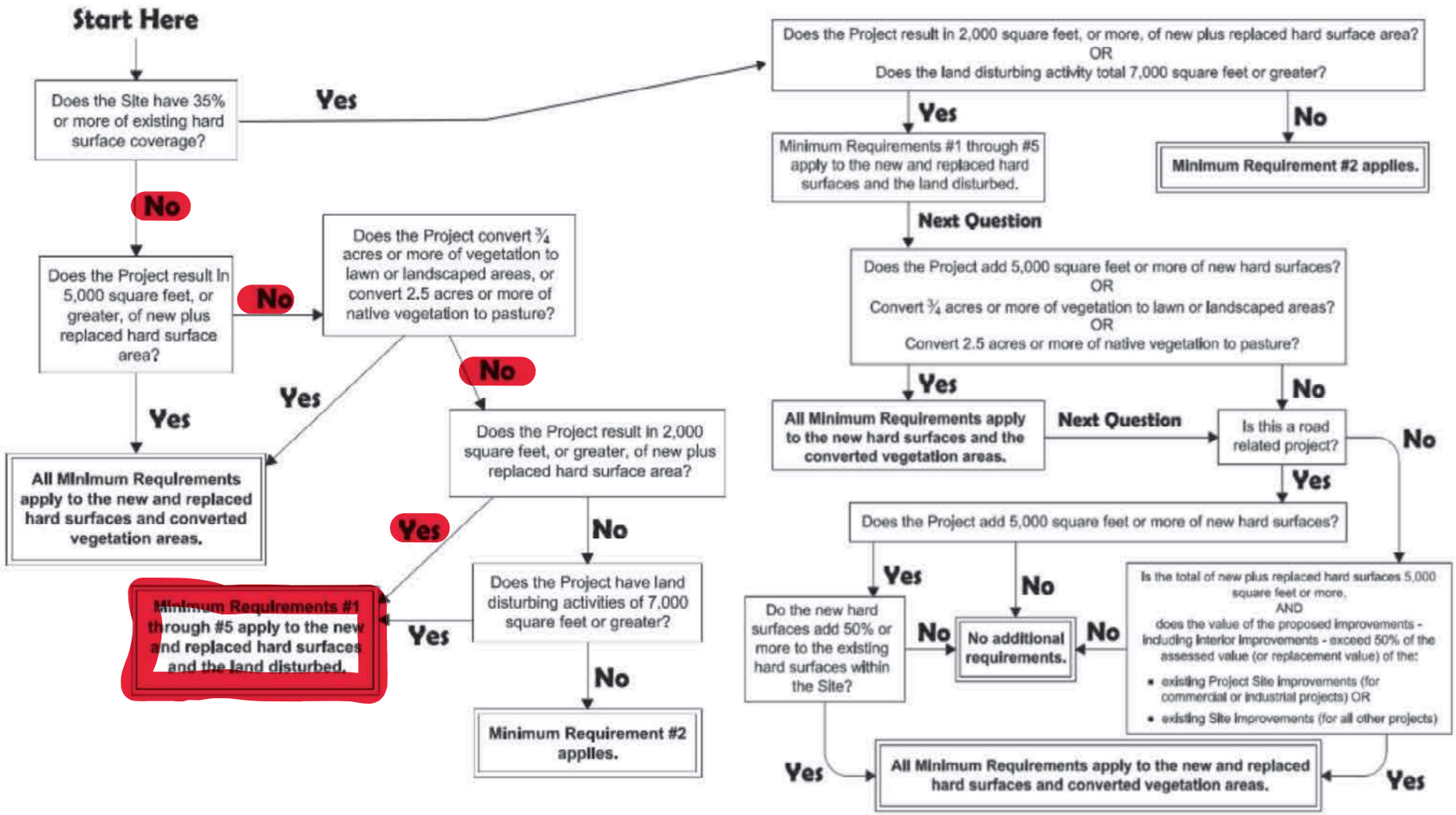
D Figure I-3.3: flowchart for determining MR #5 requirements

E Stratum Group Hydrologic Assessment May 21st, 2020

F Stratum Group Geologic Hazard Assessment May 11th, 2020

G BMPs for Construction Stormwater Pollution Prevention Plan

Part 4a Flow Chart for Determining Stormwater Minimum Requirements.



Guidance for complying with the Stormwater Management Manual is on the next page →.

Figure I-3.1: Flow Chart for Determining Requirements for New Development

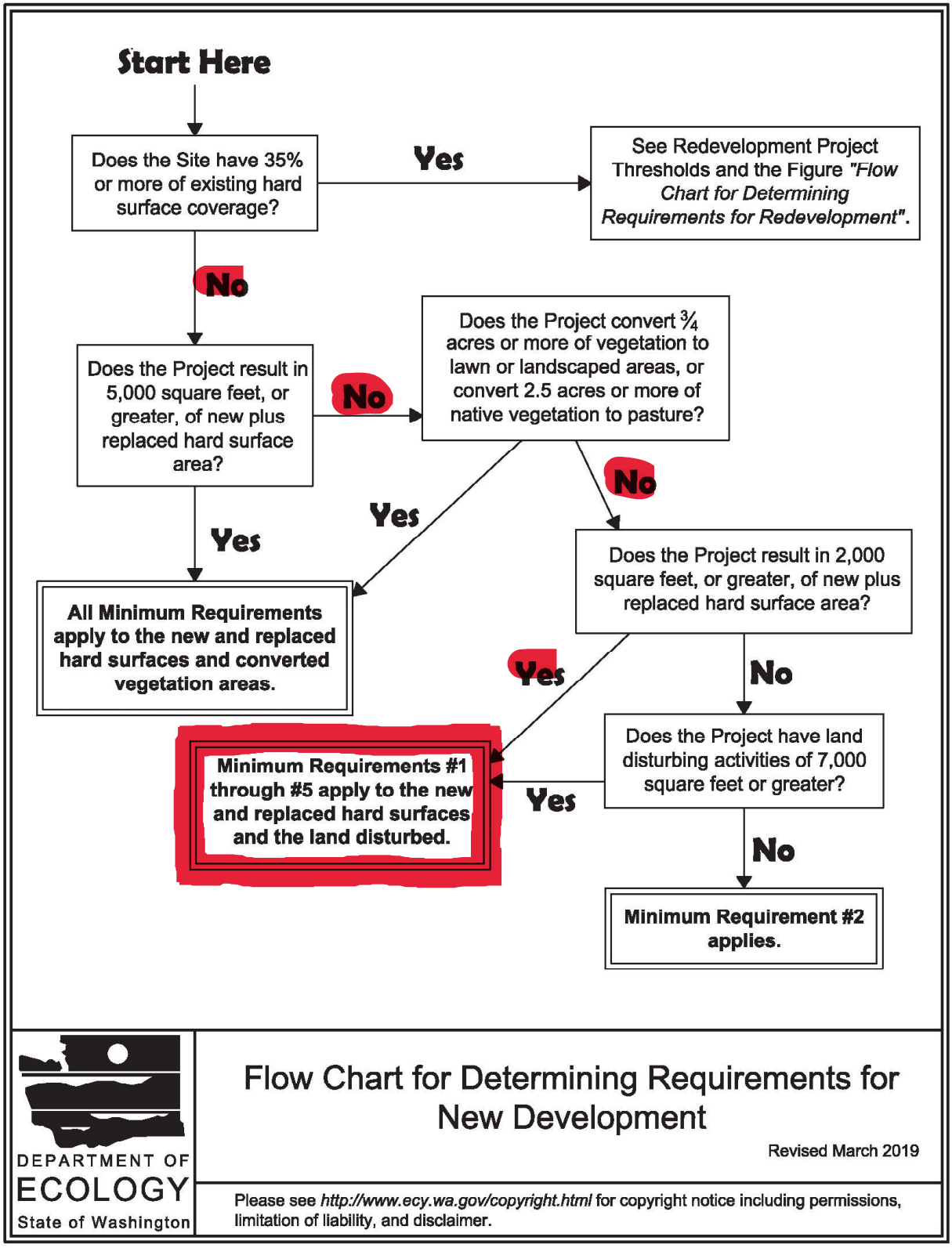
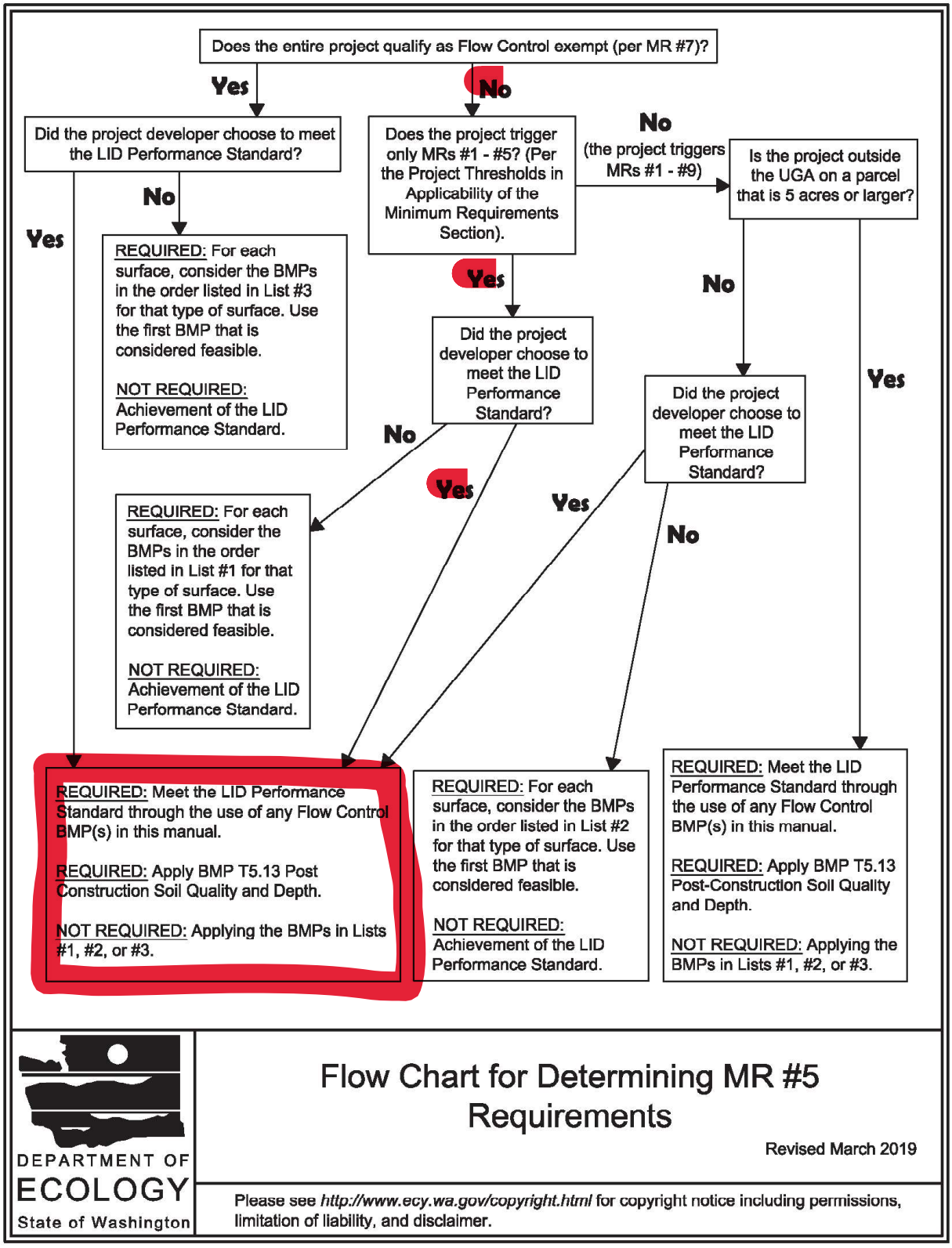


Figure I-3.3: Flow Chart for Determining MR #5 Requirements



STRATUM GROUP
PO Box 2546, Bellingham, Washington 98227
Phone: (360) 714-9409

May 21, 2020

Steven Dahl
Skagit Aggregates, LLC
14107 State Route 9
Mount Vernon, WA 98273
stevend@skagitaggretaes.com

Re: **Hydrologic Assessment**
Proposed surface mine expansion
Skagit County Parcel P44865

Dear Mr. Dahl:

This report was conducted to assess the potential impacts to groundwater and surface water resources from the proposed expansion of the existing surface gravel mine onto the Skagit County Parcel P44865. The pre-application meeting with the Skagit County Planning and Development Services indicated that a report characterizing the area's groundwater is a required element of the Mining Special Use Permit.

Based on our assessment of the subject property and vicinity and the water resources in the vicinity, it is our opinion that the gravel mine expansion will not have an appreciable impact on groundwater or surface water resources.

This assessment included a field inspection of the subject property, review of available geologic mapping and lidar (light detection and ranging) imagery of the site and vicinity, review of Department of Ecology records documenting existing domestic water use in the vicinity, and review of previously prepared reports on the existing mine on the adjoining property to the north and a landfill on a property to the east.

Geology

The Geologic Map of the Sauk River 30- by 60-minute Quadrangle, Washington (Tabor and others, 2002) indicates that the subject property is underlain by Vashon recessional outwash (Figure 1).

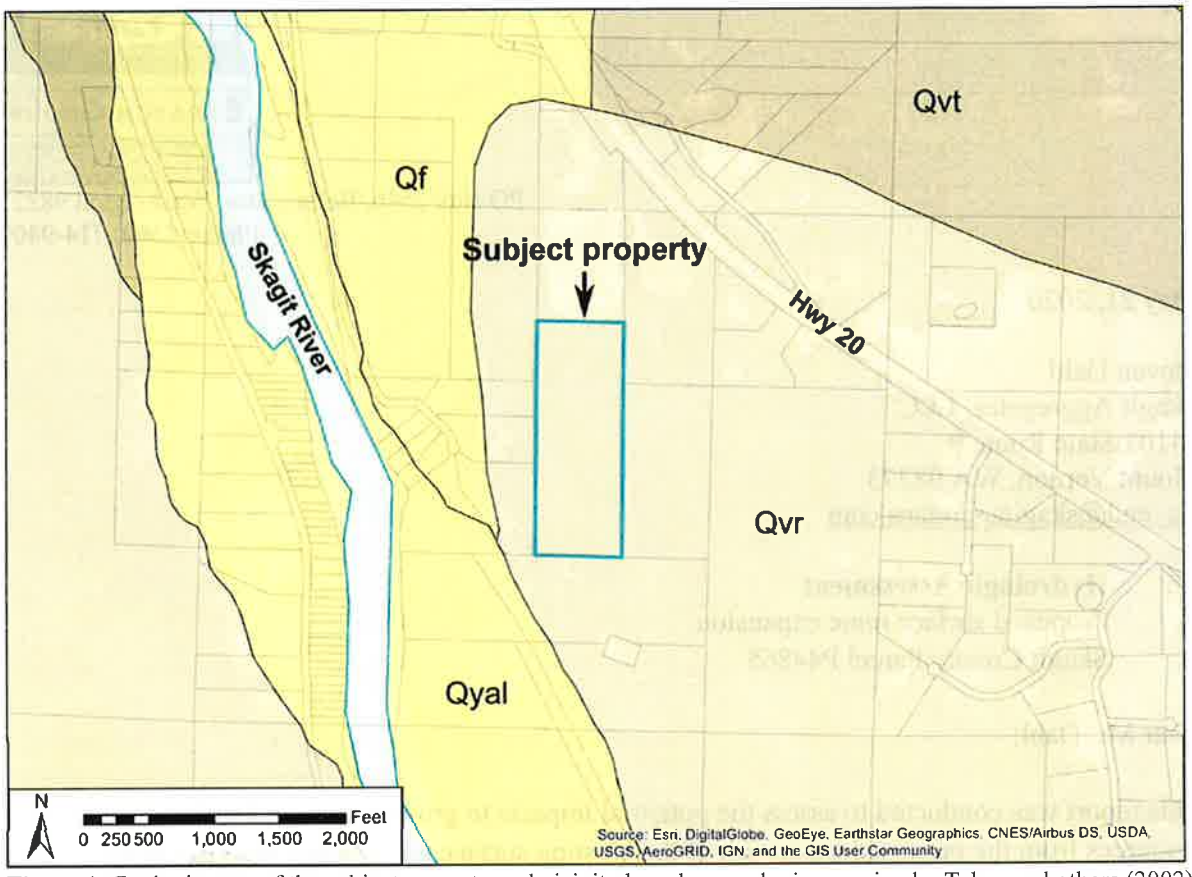


Figure 1. Geologic map of the subject property and vicinity based on geologic mapping by Tabor and others (2002). Qvr = Vashon recessional outwash, Qvt = Vashon till, Qf = Quaternary alluvial fan, Qyal = Quaternary younger alluvium.

Vashon recessional outwash consists of well-sorted and stratified sand and gravel deposits with minor silts and clays. The unit is typically parallel bedded but can also be locally cross-bedded. Recessional outwash was deposited in and along meltwater streams emanating from the receding glacial ice in the later stages of the last major glacial period, the Vashon Stade of the Fraser Glaciation approximately 14,000 to 12,000 years ago. Vashon recessional outwash was not overridden by glacial ice so tends to be less dense and compact than other glacial units.

Our site observations and lidar interpretation are generally consistent with the above-described mapping. The subject property is located on top of an outwash surface that has since been incised through by the Skagit River located to the west leaving the outwash surface as an elevated terrace. Hand-dug test pits on the site and observations of exposures in the existing gravel mine revealed medium dense sand and gravel with rounded pebbles and cobbles consistent with Vashon recessional outwash (Figure 2). Areas of slightly siltier soils were observed in the bottom of the topographic depressions (kettles) on the southern portion of the property. The observed recessional outwash deposits are well drained with no pooled water areas or evidence of surface water observed anywhere on the subject property.

Figure 2. Photograph of outwash in existing gravel mine on adjacent property to the north.

Four monitoring wells constructed on the adjacent property to the east, the Sauk Landfill, provide insight into geologic conditions at greater depth (Hong West & Associates, 1990 and Ecological Land Services, 2002). Well logs indicate that clean sand and gravel deposits extend to approximately 65 feet below the ground surface (bgs) on the east side of the property to approximately 140 feet bgs on the west side of the property (approximately 400 feet elevation above mean sea level (asl)). Two layers of siltier material were encountered at approximately 400 and 360 feet asl. The upper siltier layer was discontinuous and therefore not considered a perching layer. The lower silt layer was only approximately 2.5 feet thick but was more continuous and was deemed capable of acting as a confining layer for the underlying aquifer. An approximately 10- to 15-foot thick layer of silty gravel underlies the silt layer, which itself is underlain by strata of silt and clay to approximately 200 feet asl. A gravel deposit lies beneath the silt and clay unit to an unknown depth.

Soil Survey

The NRCS Web Soil Survey indicates that two dominant soil types are present on the property with one minor constituent. *Winston gravelly silt loam, 0 - 8% slopes* makes up approximately

66% of the subject property and is described as forming on outwash terraces overlain by volcanic ash and loess. The unit is well drained with moderately high to high hydraulic conductivity. Soil is generally 20 to 40 inches deep before encountering a restrictive layer. *Barneston gravelly ashy loam, 8 to 30% slopes* makes up approximately 33% of the subject property and is described as forming on the crest and sides of glacial features with parent materials consisting of ash and loess over glacial outwash. The unit is somewhat excessively drained with moderately high to high hydraulic conductivity. Soil is generally more than 80 inches thick before encountering a restrictive layer.

Topography

The topography of the site and vicinity is represented on Figure 3, a lidar bare earth image of the site and vicinity.

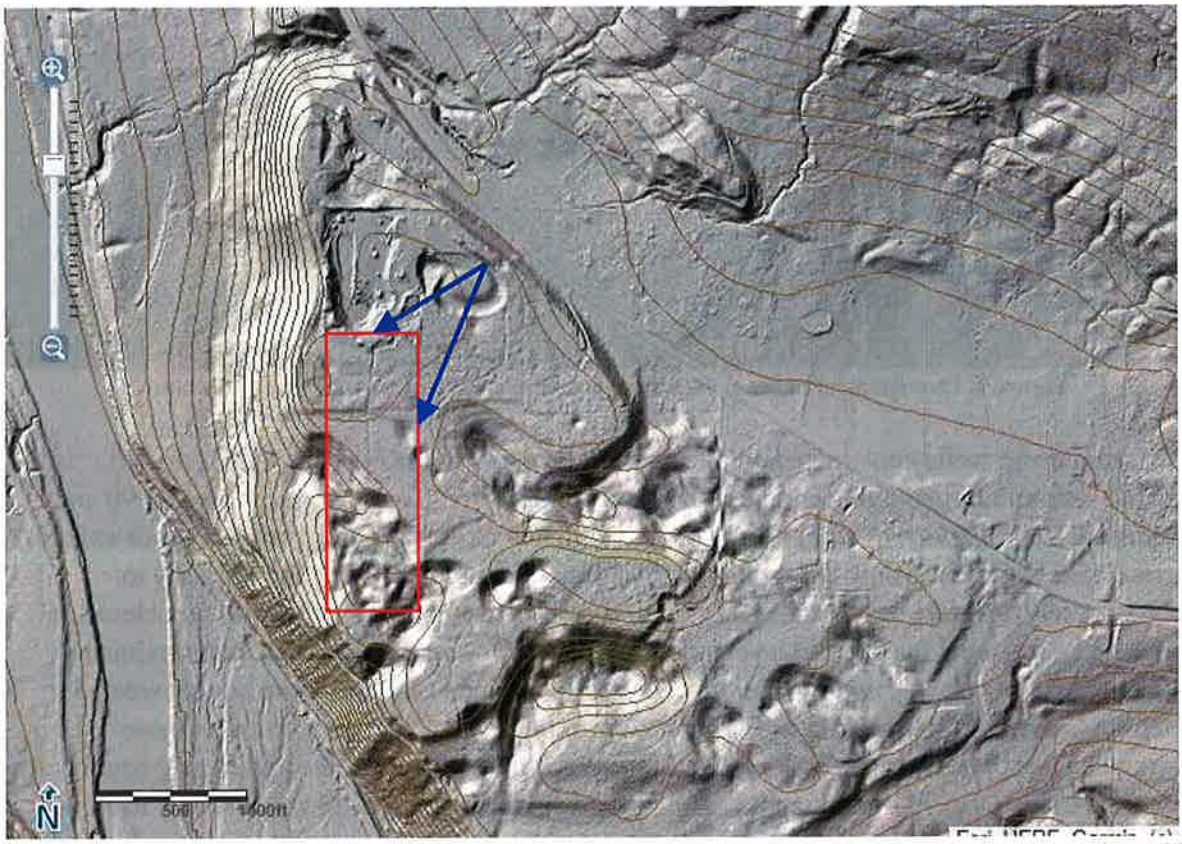


Figure 3. Lidar bare image of proposed expansion property and vicinity from Skagit iMap. Contour intervals are 20 feet. Blue arrows show range of groundwater flow directions of upper semi confined aquifer based on water levels at adjoining landfill site.

Topography on the northern portion of the subject property is relatively level, due to the property's position on top of a large glacial outwash terrace. Elevations on the terrace range from approximately 565 feet asl to 540 feet asl with a gentle slope to the southwest.

The southern portion of the property consists of several irregular topographic depressions. The morphology of the depressions is consistent with the features being kettles formed by buried or partially buried blocks of ice that then melted leaving forming depressions. The base elevation of these depressions range from approximately 510 feet to 431 feet asl. Gentle to moderate slopes descend from the level terrace or ridgelines between kettles to the kettle bottoms.

Streams and Wetlands

The subject property is located within the Skagit River drainage basin of the Upper Skagit Water Resource Inventory Area (WRIA) 4 (Wasington State Department of Natural Resources, 2020). DNR mapping does not identify any watercourses as being present on the subject property. DNR and U.S. Fish & Wildlife (USFWS) mapping also does not identify any wetlands as being present on the subject property (Wasington State Department of Natural Resources, 2020; U.S. Fish & Wildlife Service, 2020). The nearest mapped wetland is adjacent to the Skagit River approximately 500 feet to the southwest and down gradient of the subject property. The mapping is consistent with our own observations.

The nearest mapped watercourse is an old flood overflow channel approximately 500 feet southwest of the southwest corner of the site and approximately 250 in elevation below. Unnamed, fish-bearing streams are located approximately 4,000 feet southeast and 1,900 feet north and northwest of the subject property. The Skagit River is located approximately 1,100 feet west of the subject property at its nearest point.

Our observations are consistent with the above-described mapping. No evidence of surface water or wetlands or concentrations of hydrophilic vegetation were observed on the property.

Hydrology and Groundwater Flow

Groundwater wells were installed to assess the aquifers underlying the Sauk Landfill property immediately to the east of the subject property by Hong West & Associates (HWA, 1990). HWA identified two aquifers beneath the area: 1) A semi-confined aquifer is within an approximately a 10- to 15-foot thick silty outwash gravel unit capped by a thin (~2 ft) but apparently continuous silt layer, and 2) A deeper confined aquifer beneath a 150-foot thick silt and clay cap. HWA found that Sauk Landfill site is underlain by glacio-fluvial deposits. Well-graded sand and gravel deposits are present from the surface to depths ranging from approximately 30 feet below ground surface (bgs) on the north side of the landfill to about 90 feet bgs on the southeast side of the landfill. This unit is underlain by poorly graded (well sorted) sand that varies from about 140 feet thick on the western site margin to about 65 feet thick on the eastern site margin. A thin (1 to 15 feet thick) silt unit underlies the sand layer. The silt unit is subsequently underlain by an approximately 10- to 20-foot thick silty gravel unit that hosts the uppermost aquifer. The overlying silt layer appears to act as a semi-confining layer for the uppermost aquifer. All four on-site monitoring wells are screened within this semi-confined aquifer. Beneath the silty gravel

unit is a clayey silt to silty clay unit. Nearby domestic well logs indicate this unit is about 150 feet thick. Domestic well logs indicate a gravel deposit of unknown thickness underlies the clayey silt unit. This gravel deposit is host to a deep confined aquifer(s) that is the principal water supply for domestic wells in the area.

Potentiometric surfaces calculated for the semi-confined aquifer fluctuate between approximately 360 and 390 feet above mean sea level (asl) (Skagit County Public Works, 2018). Water level measurements from this aquifer indicate that groundwater flow direction varies from south to west (see Figure 3) and is generally towards the Skagit River. A review of drinking water wells indicates that domestic drinking water wells do not tap this aquifer for local drinking water.

Potentiometric surfaces calculated for the deeper aquifer are between approximately 200 and 210 feet asl indicating the confined nature of this deeper aquifer in that it has a higher potentiometric surface than the semiconfined aquifer above it. Water level data reviewed by Hong West & Associates (1990) indicate that groundwater flow in this deeper confined aquifer is to the southwest, toward the Skagit River.

Based on the inferred flow directions, both of the above described aquifers are believed to by hydrologically connected to the Skagit River and water from the aquifers is in continuity with the Skagit River and discharge water to the river.

Measurements of outwash material from the shallow unconfined aquifer on the adjacent Sauk Landfill provide estimates of hydraulic gradient (0.007 ft/ft), hydraulic conductivity (1.4 ft/day), porosity (25%), and groundwater flow velocity (0.04 ft/day) (Skagit County Public Works, 2018).

Proposed mining activities on the subject property are planned to result in the excavation of approximately the upper 70 feet of sand and gravel material, reaching a maximum depth of approximately 450 feet asl (Ecological Land Services, 2002). Therefore, the maximum depth of mining activities will be a minimum of 60 feet above the measured upper limit of the upper aquifer underlying the subject property. Since planned planed maximum depth of excavation is well above the local upper aquifer, mine excavation will not alter groundwater flow direction.

Geologic materials in the mine at the end of excavation are still expected to be highly porous and permeable sand and gravel material. Surface runoff and infiltration characteristics will not be altered appreciably from present conditions as all areas around the perimeter of the mine will remain highly permeable as most areas at the base of the final mine excavation. We observed no evidence of springs or seepage on the slopes below the proposed mine expansion area to the west or on slopes within the mine area kettles. We do not anticipate that groundwater or surface water will be encountered by mining activities.

Water Quality

Groundwater monitoring from the adjacent landfill property has indicated that landfill decomposition and leachate are not significantly impacting local groundwater quality (Ecological Land Services, 2002; Skagit County, 2018). The pH values are slightly below state groundwater quality standards, but pH values in the groundwater upgradient of the landfill has been observed to have similar pH values. Other than pH, groundwater beneath the landfill has met applicable groundwater quality standards since at least 2012.

The mine will not impact surface waters. Groundwater will not be impacted by the mine activity as long as no hazardous or organic rich materials are used as back fill material in the mine and best practices are followed for mine operations to prevent fuel releases.

Conclusions & Recommendations

Based on our review of existing subsurface and surficial geologic and hydrologic data for the subject property and vicinity, it is our opinion that the surface gravel mine expansion will not impact groundwater quality, quantity, or distribution as long as the proposed mine plans are followed. Any fueling and equipment management should follow best practices. Back fill of soils in the mine excavation will not alter water quantity or quality as long as no hazardous materials or organic wastes are utilized as back fill soils.

Long-term groundwater monitoring immediately adjacent to the subject property indicates that groundwater will remain at least 60 feet below the base of planned mining activities. Domestic water wells in the vicinity tap a deeper confined aquifer capped with approximately 150 feet of silt and clay. Therefore, domestic water supplies will not be impacted by planned mining activities.

The high expected infiltration capacity of site soils currently exposed and at the planned base of mining activities is expected to result in full infiltration of all precipitation not taken up by evaporation and transpiration and is unlikely to result in the formation of new surface water courses on or off the subject property.

Stratum Group appreciates the opportunity to be of service to you. Should you have any questions regarding this assessment please contact our office at (360) 714-9409.

Sincerely yours,

Stratum Group

Dan McShane, L.E.G., M.Sc.
Licensed Engineering Geologist

Benjamin Carlson, G.I.T., M.Sc.
Geologist-in-Training

State of Washington
Engineering Geologist
1376
Licensed Geologist
5-21-20
DANIEL McSHANE

References

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May 11, 2020

Steven Dahl
Skagit Aggregates, LLC
14107 State Route 9
Mount Vernon, WA 98273
stevend@skagitaggretaes.com

Re: **Geologic Hazard Assessment**
Proposed surface mine expansion
Skagit County Parcel P44865

Dear Mr. Dahl:

This geologic hazard assessment was conducted to assess the risk of erosion and landslide hazards on the subject property and to determine whether the planned expansion of the existing surface gravel mine would increase the risk of significant erosion or landsliding.

Based on our assessment of the property and vicinity, it is our opinion that the planned gravel mine expansion is not located within any geologically hazardous area and will not be at risk of landslides or erosion. Furthermore, the proposed mine expansion will not increase the risk of landslide or erosion hazards on or off the site.

This geologic hazard assessment included a field inspection of the subject property and slopes in the immediate vicinity of the property. Our evaluation also included review of historic aerial photographs, available geologic mapping, and lidar (light detecting and ranging) imagery of the site and vicinity. Observations in the vicinity of the subject property and at sites with similar geology conditions also aided in our interpretations.

GENERAL GEOLOGY

The Geologic Map of the Sauk River 30- by 60-minute Quadrangle, Washington (Tabor and others, 2002) indicates that the subject property is underlain by Vashon recessional outwash (Figure 1).

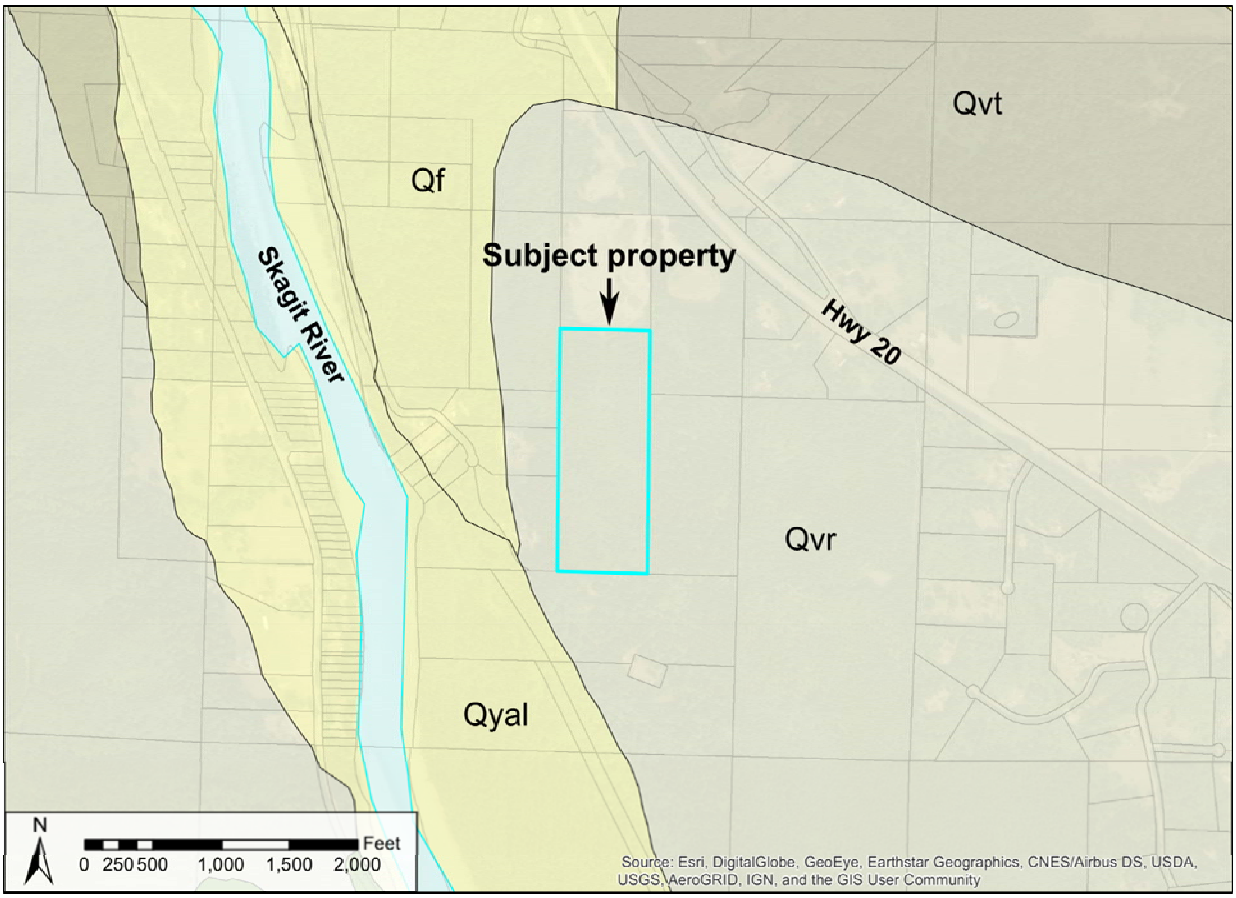


Figure 1. Geologic map of the subject property and vicinity based on geologic mapping by Tabor and others (2002). Qvr = Vashon recessional outwash, Qvt = Vashon till, Qf = Quaternary alluvial fan, Qyal = Quaternary younger alluvium.

Vashon recessional outwash consists of well-sorted and stratified sand and gravel deposits with minor silts and clays. The unit is typically parallel bedded but can also be locally cross-bedded. Recessional outwash was deposited in and along meltwater streams emanating from the toe of the receding glacial ice in the later stages of the last major glacial period, the Vashon Stade of the Fraser Glaciation approximately 14,000 to 12,000 years ago. Vashon recessional outwash was not overridden by glacial ice so tends to be less dense and compact than other glacial units.

Our observations are generally consistent with the above-described mapping. Observations at the existing gravel mine, review of well logs in the vicinity and hang-dug test pits on top of and along the gentle to moderate slopes of the subject property revealed medium dense sand and gravel with rounded pebbles and cobbles consistent with Vashon recessional outwash (Figure 2).

Figure 2. Photograph of recessional outwash in shallow test pit on subject property.

Soil observed from a hand-dug test pit excavated in the middle of one of the topographic depressions on the southern portion of the subject property was similar to that seen elsewhere on the property but had a higher silt and clay content with abundant charcoal, more consistent with a lower energy depositional. We interpret these depressions to be kettles, created when blocks of dead ice detached from the receding glacial ice and became buried or surrounded by sediment. The melting of the ice then formed the observed depressions. We observed no standing water or indications of saturated ground in any of the kettles.

Observations from the adjacent parcel to the north, which consists of an operational sand and gravel mine, are also generally consistent with mapped geology. Mine exposures revealed well-stratified sand and gravel deposits in excess of 75 to 100 feet thick (Figure 3). The sand and gravel deposits in the mine were generally medium dense to dense and able to maintain near-

vertical faces. Rip-up clasts of Vashon till up to 5 feet long were observed locally and are consistent with these deposits being recessional outwash.

Figure 3. Photograph of outwash in existing gravel mine on adjacent property to the north.

A road cut along Evergreen Hill Lane, near the base of the slope immediately west of the subject property, revealed similar deposits of fine to coarse sand and gravel consistent with outwash.

SITE SPECIFIC OBSERVATIONS

Pertinent features on the property and vicinity are indicated on the lidar bare earth image of the area (Figure 4). The subject property is located on a late-Pleistocene terrace in the Skagit River valley. We interpret this terrace to be remnant of the valley floor that formed at the late stages of the last glacial period.

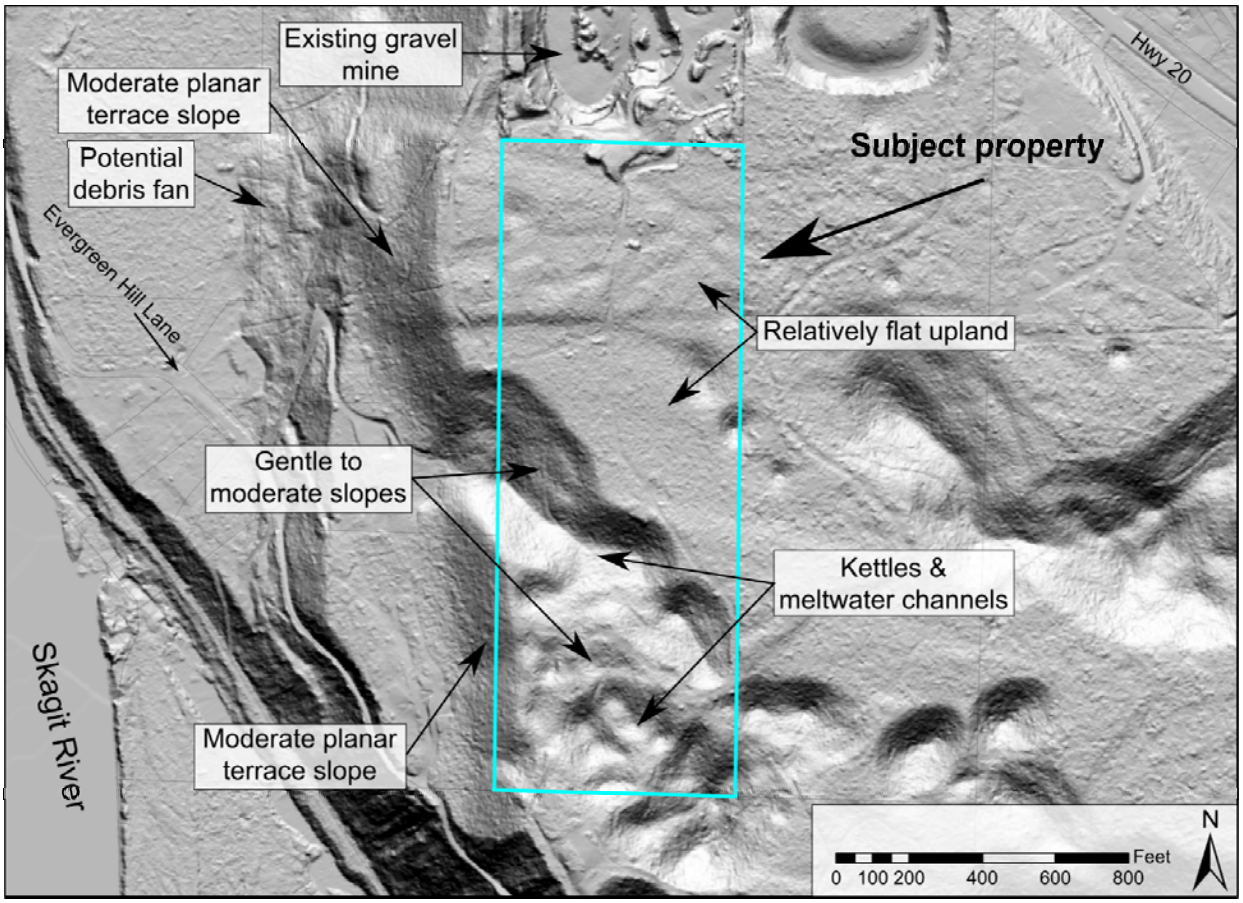


Figure 4. Annotated lidar hillshade image of the subject property and vicinity.

The northern portion of the property is a relatively flat terrace surface. The area is forested. A few old logging roads are present on the property. A moderate slope measuring approximately 25 degrees slopes down to the west approximately 150 feet from the west property boundary. The slope is relatively planar and shows no indications of instability. A fan of debris is located on the lower third of slope and is observable in lidar imagery (Figure 4). We interpret this debris fan slope to be colluvium derived from the slope above as a result of the past erosion of the terrace during river down cutting. The debris fan area is now stable as it is deposited on a lower terrace level above the active river valley.

The southern portion of the subject property consists of more irregular topography defined by depressions in the terrace formed by kettles. Slopes that descend to the base of the kettle features are typically moderate, measuring 10 to 20 degrees, increasing locally to 25 degrees for short sections of slope (Figure 5 and 6). Slopes are generally planar with no evidence of slope instability and slopes generally contain mature trees that stand vertically. One of the kettle slopes contains a sequence of several 3- to 4-foot wide benches. However, no fresh scarps, active raveling, or significantly bowed trees that would indicate slope instability are present. No surface water or evidence of intermittent surface water accumulation was observed in the kettles and soils are well drained throughout the property.

The western edge of the southern portion of the property is located on top of a moderate planar west-facing slope that measures approximately 25 to 30 degrees (Figure 7). This slope slopes down to another remnant terrace. No evidence of instability is evident on this slope and no existing or incipient fractures are present near the slope crest.

Vegetation on the subject property consists of a mixed forest that includes Douglas fir, western red cedar, red alder, big leaf maple, and few paper birch with an understory of Oregon grape, salal, and sword fern.

Figure 5. Photograph of the steeper slopes on the southern portion of the property that drop into a kettle.

Figure 6. Photograph of some of the gentler, undulating topography on the southern portion of the subject property.

Figure 7. Photograph of the moderate west-facing slope that drops from the southwestern edge of the subject property to a lower terrace below.

GEOLOGIC HAZARD EVALUATION

Slopes on the subject property generally consist of gentle to moderate slopes on the south side of the property associated with glacial landforms. During our site visit, we did not observe any evidence of previous, ongoing, or incipient slope failure on the site. The terraces observed locally on site slopes are more likely associated with historical logging activities and are not interpreted to represent historic or ongoing slope instability. We also did not observe any evidence of surface water features or groundwater perching, seepage, or springs on the subject property. Slope activity on the property is limited to minor surface raveling and/or soil creep on steeper slopes.

The planned use of the subject property as a gravel will eventually result in the excavation of the property, including these slopes, for the purpose of mining sand and gravel. This activity will further subdue or completely remove these slopes.

The western edge of the outwash terrace that composes the subject property rolls over onto a long, moderate, planar, west-facing slope towards elevated terraces above the Skagit River valley bottom. These slopes are adjacent to the subject property to the south and up to 150 feet from the western property edge to the north. These slopes also present no indications of previous, ongoing, on incipient slope failure that could negatively impact the subject property in the future.

We observed no evidence of a confining layer within the terrace that could promote future instability. Minor surface raveling or soil creep may occur along the surface of the slope but planned mining activities are unlikely to impact these slopes. Furthermore, we understand that mining regulations require mining activity to be set back from the property line, which will further remove any land disturbance from the steepest slopes in the vicinity of the property, such as those by the southwestern property edge.

The Skagit River is at least 350 feet from the toe of the slopes below the subject property and does not pose significant erosion or channel migration hazard.

CONCLUSIONS AND RECOMMENDATIONS

Based on our geologic hazard assessment, the subject property is not at risk of landslides or significant erosion. Furthermore, it is our opinion that the planned mining activity will not increase the risk of landslides or erosion on or off the property as long as the final mine slopes are completed consistent with the mine plans and best management practices.

We recommend that no soil or vegetation debris be placed on or within the 10 feet of the top edge of the slope to the west of the subject property. Such debris piles can eventually build up and form a wet unstable mass that will slide down the slope, damaging the slope and increasing the likelihood of a future slope failure.

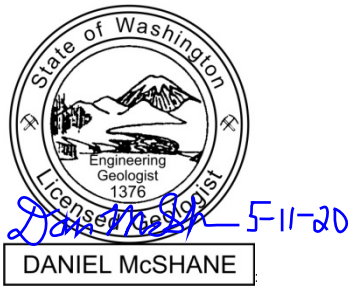
Stratum Group appreciates the opportunity to be of service to you. Should you have any questions regarding this assessment please contact our office at (360) 714-9409.

Sincerely yours,

Stratum Group

Dan McShane, L.E.G., M.Sc.
Licensed Engineering Geologist

Benjamin Carlson, G.I.T., M.Sc.
Geologist-in-Training



Stormwater Management Manual for Western Washington

July 2019

DEPARTMENT OF ECOLOGY
State of Washington

Publication Number 19-10-021

II-3 Construction Stormwater BMPs

II-3.1 A Summary of Construction Stormwater BMPs

This chapter contains standards and specifications for temporary BMPs, used as appropriate during the construction phase of a project. Often using BMPs in combination is the best method to meet Construction Stormwater Pollution Prevention Plan (Construction SWPPP) requirements.

The standards and specifications in this chapter are not intended to limit innovative efforts to effectively control erosion and sedimentation. Construction SWPPPs can contain experimental BMPs or make minor modifications to standard BMPs. However, the permitting authority (state, local, or both) must approve such practices before use. Experimental and modified BMPs must achieve the same or better performance than the BMPs listed below.

None of the BMPs listed below will work successfully throughout the construction project without inspection and maintenance. Regular inspections to identify problems with the operation of each BMP, and the timely repair of any problems are essential to the continued operation of the BMPs. As site conditions change, BMPs must change to remain in compliance.

Construction stormwater BMPs are divided into two categories: Construction Source Control BMPs and Construction Runoff BMPs.

Table II-3.1: Construction Stormwater BMPs by SWPPP Element shows the relationship of the Construction Stormwater BMPs to the Construction SWPPP Elements described in I-3.4.2 MR2: Construction Stormwater Pollution Prevention Plan (SWPPP).

Table II-3.1: Construction Stormwater BMPs by SWPPP Element

Construction Stormwater BMP	Construction SWPPP Element #												
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13
Construction Source Control BMPs													
BMP C101: Preserving Natural Vegetation	✓												
BMP C102: Buffer Zones	✓												✓
BMP C103: High-Visibility Fence	✓												✓
BMP C105: Stabilized Construction Access		✓											
BMP C106: Wheel Wash		✓											

Table II-3.1: Construction Stormwater BMPs by SWPPP Element (continued)

Construction Storm-water BMP	Construction SWPPP Element #												
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13
BMP C107: Construction Road / Parking Area Stabilization		✓											
BMP C120: Temporary and Permanent Seeding					✓	✓							
BMP C121: Mulching					✓	✓							
BMP C122: Nets and Blankets					✓	✓		✓					
BMP C123: Plastic Covering					✓	✓							
BMP C124: Sodding					✓	✓							
BMP C125: Topsoiling / Composting					✓								
BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection					✓								
BMP C130: Surface Roughening					✓	✓							
BMP C131: Gradient Terraces					✓	✓							
BMP C140: Dust Control					✓								
BMP C150: Materials on Hand											✓	✓	
BMP C151: Concrete Handling									✓				
BMP C152: Sawcutting and Surfacing Pollution Prevention									✓				
BMP C153: Material Delivery, Storage, and Containment									✓				

Table II-3.1: Construction Stormwater BMPs by SWPPP Element (continued)

Construction Storm-water BMP	Construction SWPPP Element #												
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13
BMP C154: Concrete Washout Area									✓				
BMP C160: Certified Erosion and Sediment Control Lead											✓	✓	
BMP C162: Scheduling												✓	
Construction Runoff BMPs													
BMP C200: Interceptor Dike and Swale						✓							✓
BMP C201: Grass-Lined Channels						✓							✓
BMP C202: Riprap Channel Lining								✓					
BMP C203: Water Bars			✓			✓				✓			
BMP C204: Pipe Slope Drains						✓							
BMP C205: Subsurface Drains						✓							
BMP C206: Level Spreader						✓				✓			
BMP C207: Check Dams			✓			✓		✓					✓
BMP C208: Triangular Silt Dike (TSD)						✓							✓
BMP C209: Outlet Protection			✓					✓					
BMP C220: Inlet Protection							✓						
BMP C231: Brush Barrier				✓									✓
BMP C232: Gravel Filter Berm				✓									

Table II-3.1: Construction Stormwater BMPs by SWPPP Element (continued)

Construction Storm-water BMP	Construction SWPPP Element #												
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13
BMP C233: Silt Fence				✓									✓
BMP C234: Vegetated Strip				✓									✓
BMP C235: Wattles			✓	✓									
BMP C236: Vegetative Filtration										✓			
BMP C240: Sediment Trap			✓	✓									
BMP C241: Sediment Pond (Temporary)			✓	✓									
BMP C250: Con-struction Stormwater Chemical Treatment				✓					✓				
BMP C251: Con-struction Stormwater Filtration				✓					✓				
BMP C252: Treating and Disposing of High pH Water									✓				

Construction SWPPP Elements:

Element 1: Preserve Vegetation / Mark Clearing Limits
Element 2: Establish Construction Access
Element 3: Control Flow Rates
Element 4: Install Sediment Controls
Element 5: Stabilize Soils
Element 6: Protect Slopes
Element 7: Protect Drain Inlets
Element 8: Stabilize Channels and Outlets
Element 9: Control Pollutants
Element 10: Control Dewatering
Element 11: Maintain BMPs
Element 12: Manage the Project
Element 13: Protect Low Impact Development BMPs

II-3.2 Construction Source Control BMPs

BMP C101: Preserving Natural Vegetation

Purpose

The purpose of preserving natural vegetation is to reduce erosion wherever practicable. Limiting site disturbance is the single most effective method for reducing erosion. For example, conifers can hold up to about 50 percent of all rain that falls during a storm. Up to 20-30 percent of this rain may never reach the ground but is taken up by the tree or evaporates. Another benefit is that the rain held in the tree can be released slowly to the ground after the storm.

Conditions of Use

Natural vegetation should be preserved on steep slopes, near perennial and intermittent water-courses or swales, and on building sites in wooded areas.

- As required by local governments.
- Phase construction to preserve natural vegetation on the project site for as long as possible during the construction period.

Design and Installation Specifications

Natural vegetation can be preserved in natural clumps or as individual trees, shrubs and vines.

The preservation of individual plants is more difficult because heavy equipment is generally used to remove unwanted vegetation. The points to remember when attempting to save individual plants are:

- Is the plant worth saving? Consider the location, species, size, age, vigor, and the work involved. Local governments may also have ordinances to save natural vegetation and trees.
- Fence or clearly mark areas around trees that are to be saved. It is preferable to keep ground disturbance away from the trees at least as far out as the dripline.

Plants need protection from three kinds of injuries:

- *Construction Equipment* - This injury can be above or below the ground level. Damage results from scarring, cutting of roots, and compaction of the soil. Placing a fenced buffer zone around plants to be saved prior to construction can prevent construction equipment injuries.
- *Grade Changes* - Changing the natural ground level will alter grades, which affects the plant's ability to obtain the necessary air, water, and minerals. Minor fills usually do not cause problems although sensitivity between species does vary and should be checked. Trees can typically tolerate fill of 6 inches or less. For shrubs and other plants, the fill should be less.

  When there are major changes in grade, it may become necessary to supply air to the roots of plants. This can be done by placing a layer of gravel and a tile system over the roots before the fill is made. The tile system should be laid out on the original grade leading from a dry well

around the tree trunk. The system should then be covered with small stones to allow air to circulate over the root area.

Lowering the natural ground level can seriously damage trees and shrubs. The highest percentage of the plant roots are in the upper 12 inches of the soil and cuts of only 2-3 inches can cause serious injury. To protect the roots it may be necessary to terrace the immediate area around the plants to be saved. If roots are exposed, construction of retaining walls may be needed to keep the soil in place. Plants can also be preserved by leaving them on an undisturbed, gently sloping mound. To increase the chances for survival, it is best to limit grade changes and other soil disturbances to areas outside the dripline of the plant.

- *Excavations* - Protect trees and other plants when excavating for drainfields, power, water, and sewer lines. Where possible, the trenches should be routed around trees and large shrubs. When this is not possible, it is best to tunnel under them. This can be done with hand tools or with power augers. If it is not possible to route the trench around plants to be saved, then the following should be observed:
    - Cut as few roots as possible. When you have to cut, cut clean. Paint cut root ends with a wood dressing like asphalt base paint if roots will be exposed for more than 24-hours.
    - Backfill the trench as soon as possible.
    - Tunnel beneath root systems as close to the center of the main trunk to preserve most of the important feeder roots.

Some problems that can be encountered with a few specific trees are:

- Maple, Dogwood, Red alder, Western hemlock, Western red cedar, and Douglas fir do not readily adjust to changes in environment and special care should be taken to protect these trees.
- The windthrow hazard of Pacific silver fir and madrona is high, while that of Western hemlock is moderate. The danger of windthrow increases where dense stands have been thinned. Other species (unless they are on shallow, wet soils less than 20 inches deep) have a low windthrow hazard.
- Cottonwoods, maples, and willows have water-seeking roots. These can cause trouble in sewer lines and infiltration fields. On the other hand, they thrive in high moisture conditions that other trees would not.
- Thinning operations in pure or mixed stands of Grand fir, Pacific silver fir, Noble fir, Sitka spruce, Western red cedar, Western hemlock, Pacific dogwood, and Red alder can cause serious disease problems. Disease can become established through damaged limbs, trunks, roots, and freshly cut stumps. Diseased and weakened trees are also susceptible to insect attack.

Maintenance Standards

Inspect flagged and/or fenced areas regularly to make sure flagging or fencing has not been removed or damaged. If the flagging or fencing has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

If tree roots have been exposed or injured, "prune" cleanly with an appropriate pruning saw or loppers directly above the damaged roots and recover with native soils. Treatment of sap flowing trees (fir, hemlock, pine, soft maples) is not advised as sap forms a natural healing barrier.

BMP C102: Buffer Zones

Purpose

Creation of an undisturbed area or strip of natural vegetation or an established suitable planting that will provide a living filter to reduce soil erosion and stormwater runoff velocities.

Conditions of Use

Buffer zones are used along streams, wetlands and other bodies of water that need protection from erosion and sedimentation. Contractors can use vegetative buffer zone BMPs to protect natural swales and they can incorporate them into the natural landscaping of an area.

Do not use critical-areas buffer zones as sediment treatment areas. These areas shall remain completely undisturbed. The local permitting authority may expand the buffer widths temporarily to allow the use of the expanded area for removal of sediment.

The types of buffer zones can change the level of protection required as shown below:

Designated Critical Area Buffers - buffers that protect Critical Areas, as defined by the Washington State Growth Management Act, and are established and managed by the local permitting authority. These should not be disturbed and must protected with sediment control BMPs to prevent impacts. The local permitting authority may expand the buffer widths temporarily to allow the use of the expanded area for removal of sediment.

Vegetative Buffer Zones - areas that may be identified in undisturbed vegetation areas or managed vegetation areas that are outside any Designated Critical Area Buffer. They may be utilized to provide an additional sediment control area and/or reduce runoff velocities. If being used for preservation of natural vegetation, they should be arranged in clumps or strips. They can be used to protect natural swales and incorporated into the natural landscaping area.

Design and Installation Specifications

- Preserving natural vegetation or plantings in clumps, blocks, or strips is generally the easiest and most successful method.
- Leave all unstable steep slopes in natural vegetation.
- Mark clearing limits and keep all equipment and construction debris out of the natural areas and buffer zones. Steel construction fencing is the most effective method to protect sensitive areas and buffers. Alternatively, wire-backed silt fence on steel posts is marginally effective. Flagging alone is typically not effective.
- Keep all excavations outside the dripline of trees and shrubs.
- Do not push debris or extra soil into the buffer zone area because it will cause damage by

burying and smothering vegetation.

- Vegetative buffer zones for streams, lakes or other waterways shall be established by the local permitting authority or other state or federal permits or approvals.

Maintenance Standards

Inspect the area frequently to make sure flagging remains in place and the area remains undisturbed. Replace all damaged flagging immediately. Remove all materials located in the buffer area that may impede the ability of the vegetation to act as a filter.

BMP C103: High-Visibility Fence

Purpose

High-visibility fencing is intended to:

- Restrict clearing to approved limits.
- Prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed.
- Limit construction traffic to designated construction entrances, exits, or internal roads.
- Protect areas where marking with survey tape may not provide adequate protection.

Conditions of Use

To establish clearing limits plastic, fabric, or metal fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left uncleared.
- As necessary to control vehicle access to and on the site.

Design and Installation Specifications

High-visibility plastic fence shall be composed of a high-density polyethylene material and shall be at least four feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every six inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The fence color shall be high-visibility orange. The fence tensile strength shall be 360 lbs/ft using the ASTM D4595 testing method.

If appropriate install fabric silt fence in accordance with BMP C233: Silt Fence to act as high-visibility fence. Silt fence shall be at least 3 feet high and must be highly visible to meet the requirements of this BMP.

Metal fences shall be designed and installed according to the manufacturer's specifications.

Metal fences shall be at least 3 feet high and must be highly visible.

Fences shall not be wired or stapled to trees.

Maintenance Standards

If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

BMP C105: Stabilized Construction Access

Purpose

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

Conditions of Use

Construction accesses shall be stabilized wherever traffic will be entering or leaving a construction site if paved roads or other paved areas are within 1,000 feet of the site.

For residential subdivision construction sites, provide a stabilized construction access for each residence, rather than only at the main subdivision entrance. Stabilized surfaces shall be of sufficient length/width to provide vehicle access/parking, based on lot size and configuration.

On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized accesses not shown in the initial Construction SWPPP. It is difficult to determine exactly where access to these projects will take place; additional materials will enable the contractor to install them where needed.

Design and Installation Specifications

See Figure II-3.1: Stabilized Construction Access for details. Note: the 100' minimum length of the access shall be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (100').

Construct stabilized construction accesses with a 12-inch thick pad of 4-inch to 8-inch quarry spalls, a 4-inch course of asphalt treated base (ATB), or use existing pavement. Do not use crushed concrete, cement, or calcium chloride for construction access stabilization because these products raise pH levels in stormwater and concrete discharge to waters of the State is prohibited.

A separation geotextile shall be placed under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet the standards listed in Table II-3.2: Stabilized Construction Access Geotextile Standards.

Table II-3.2: Stabilized Construction Access Geotextile Standards

Geotextile Property	Required Value
Grab Tensile Strength (ASTM D4751)	200 psi min.

Table II-3.2: Stabilized Construction Access Geotextile Standards (continued)

Geotextile Property	Required Value
Grab Tensile Elongation (ASTM D4632)	30% max.
Mullen Burst Strength (ASTM D3786-80a)	400 psi min.
AOS (ASTM D4751)	20-45 (U.S. standard sieve size)

- Consider early installation of the first lift of asphalt in areas that will be paved; this can be used as a stabilized access. Also consider the installation of excess concrete as a stabilized access. During large concrete pours, excess concrete is often available for this purpose.
- Fencing (see BMP C103: High-Visibility Fence) shall be installed as necessary to restrict traffic to the construction access.
- Whenever possible, the access shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.
- Construction accesses should avoid crossing existing sidewalks and back of walk drains if at all possible. If a construction access must cross a sidewalk or back of walk drain, the full length of the sidewalk and back of walk drain must be covered and protected from sediment leaving the site.

Alternative Material Specification

WSDOT has raised safety concerns about the Quarry Spall rock specified above. WSDOT observes that the 4-inch to 8-inch rock sizes can become trapped between Dually truck tires, and then released off-site at highway speeds. WSDOT has chosen to use a modified specification for the rock while continuously verifying that the Stabilized Construction Access remains effective. To remain effective, the BMP must prevent sediment from migrating off site. To date, there has been no performance testing to verify operation of this new specification. Jurisdictions may use the alternative specification, but must perform increased off-site inspection if they use, or allow others to use, it.

Stabilized Construction Accesses may use material that meets the requirements of WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* Section 9-03.9(1) (WSDOT, 2016) for ballast except for the following special requirements.

The grading and quality requirements are listed in Table II-3.3: Stabilized Construction Access Alternative Material Requirements.

Table II-3.3: Stabilized Construction Access Alternative Material Requirements

Sieve Size	Percent Passing
2½"	99-100

Table II-3.3: Stabilized Construction Access Alternative Material Requirements (continued)

Sieve Size	Percent Passing
2″	65-100
¾″	40-80
No. 4	5 max.
No. 100	0-2
% Fracture	75 min.

- All percentages are by weight.
- The sand equivalent value and dust ratio requirements do not apply.
- The fracture requirement shall be at least one fractured face and will apply the combined aggregate retained on the No. 4 sieve in accordance with FOP for AASHTO T 335.

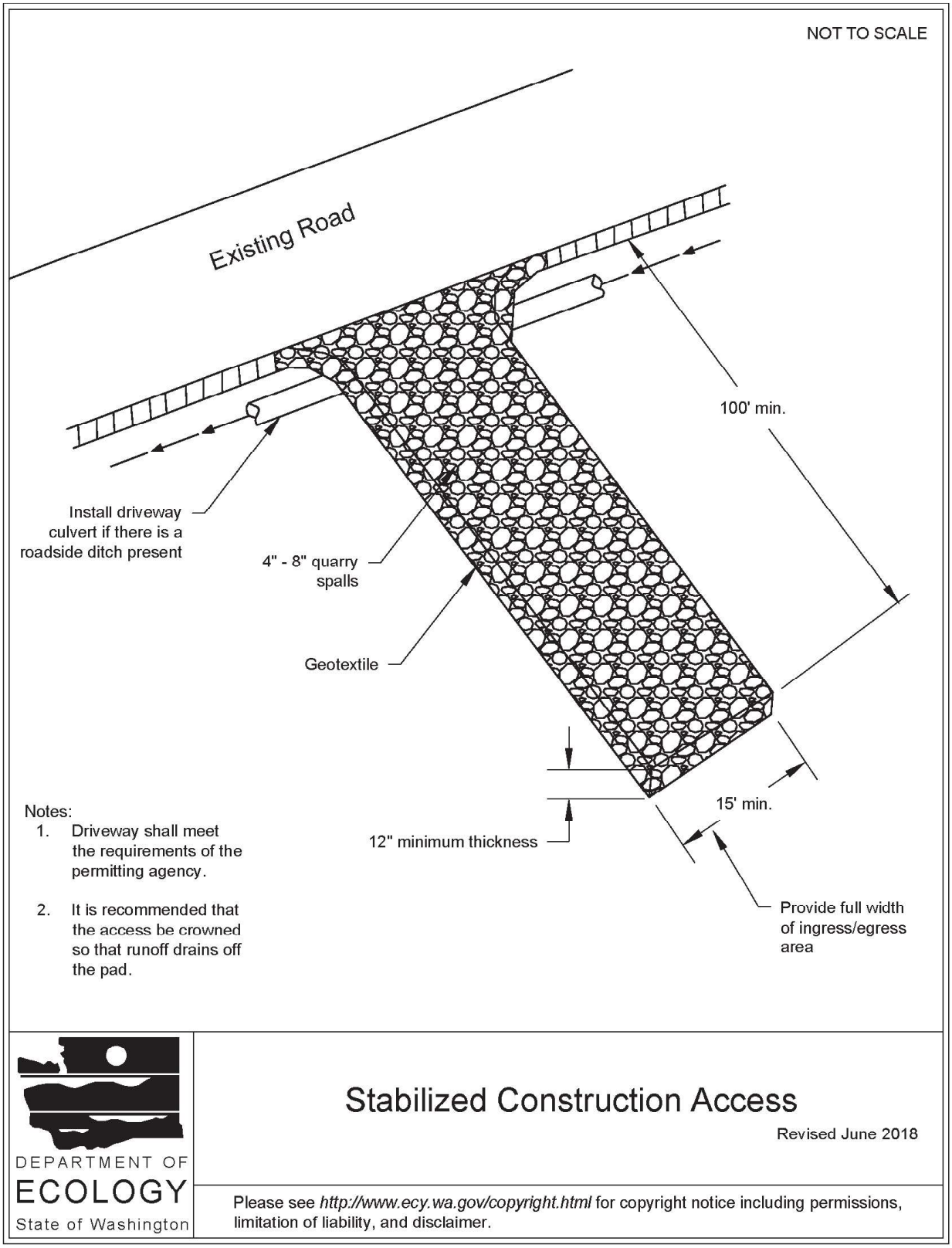
Maintenance Standards

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

- If the access is not preventing sediment from being tracked onto pavement, then alternative measures to keep the streets free of sediment shall be used. This may include replacement/cleaning of the existing quarry spalls, street sweeping, an increase in the dimensions of the access, or the installation of BMP C106: Wheel Wash.
- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be removed or stabilized on site. The pavement shall not be cleaned by washing down the street, except when high efficiency sweeping is ineffective and there is a threat to public safety. If it is necessary to wash the streets, the construction of a small sump to contain the wash water shall be considered. The sediment would then be washed into the sump where it can be controlled.
- Perform street sweeping by hand or with a high efficiency sweeper. Do not use a non-high efficiency mechanical sweeper because this creates dust and throws soils into storm systems or conveyance ditches.
- Any quarry spalls that are loosened from the pad, which end up on the roadway shall be removed immediately.
- If vehicles are entering or exiting the site at points other than the construction access(es), BMP C103: High-Visibility Fence shall be installed to control traffic.

- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

Figure II-3.1: Stabilized Construction Access



Crushed rock, gravel base, etc., shall be added as required to maintain a stable driving surface and to stabilize any areas that have eroded.

Following construction, these areas shall be restored to pre-construction condition or better to prevent future erosion.

Perform street cleaning at the end of each day or more often if necessary.

BMP C120: Temporary and Permanent Seeding

Purpose

Seeding reduces erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Conditions of Use

Use seeding throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days.

The optimum seeding windows for western Washington are April 1 through June 30 and September 1 through October 1.

Between July 1 and August 30 seeding requires irrigation until 75 percent grass cover is established.

Between October 1 and March 30 seeding requires a cover of mulch or an erosion control blanket until 75 percent grass cover is established.

Review all disturbed areas in late August to early September and complete all seeding by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.

Mulch is required at all times for seeding because it protects seeds from heat, moisture loss, and transport due to runoff. Mulch can be applied on top of the seed or simultaneously by hydroseeding. See BMP C121: Mulching for specifications.

Seed and mulch all disturbed areas not otherwise vegetated at final site stabilization. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions, or geotextiles) which will prevent erosion. See BMP T5.13: Post-Construction Soil Quality and Depth.

Design and Installation Specifications

General

- Install channels intended for vegetation before starting major earthwork and hydroseed with a Bonded Fiber Matrix. For vegetated channels that will have high flows, install erosion control blankets over the top of hydroseed. Before allowing water to flow in vegetated channels, establish 75 percent vegetation cover. If vegetated channels cannot be established by seed

before water flow; install sod in the channel bottom — over top of hydromulch and erosion control blankets.

- Confirm the installation of all required surface water control measures to prevent seed from washing away.
- Hydroseed applications shall include a minimum of 1,500 pounds per acre of mulch with 3 percent tackifier. See BMP C121: Mulching for specifications.
- Areas that will have seeding only and not landscaping may need compost or meal-based mulch included in the hydroseed in order to establish vegetation. Re-install native topsoil on the disturbed soil surface before application. See BMP T5.13: Post-Construction Soil Quality and Depth.
- When installing seed via hydroseeding operations, only about 1/3 of the seed actually ends up in contact with the soil surface. This reduces the ability to establish a good stand of grass quickly. To overcome this, consider increasing seed quantities by up to 50 percent.
- Enhance vegetation establishment by dividing the hydromulch operation into two phases:
    - Phase 1- Install all seed and fertilizer with 25-30 percent mulch and tackifier onto soil in the first lift.
    - Phase 2- Install the rest of the mulch and tackifier over the first lift.

  Or, enhance vegetation by:
    - Installing the mulch, seed, fertilizer, and tackifier in one lift.
    - Spread or blow straw over the top of the hydromulch at a rate of 800-1000 pounds per acre.
    - Hold straw in place with a standard tackifier.

  Both of these approaches will increase cost moderately but will greatly improve and enhance vegetative establishment. The increased cost may be offset by the reduced need for:
    - Irrigation.
    - Reapplication of mulch.
    - Repair of failed slope surfaces.

  This technique works with standard hydromulch (1,500 pounds per acre minimum) and Bonded Fiber Matrix/ Mechanically Bonded Fiber Matrix (BFM/MBFMs) (3,000 pounds per acre minimum).
- Seed may be installed by hand if:
    - Temporary and covered by straw, mulch, or topsoil.
    - Permanent in small areas (usually less than 1 acre) and covered with mulch, topsoil, or erosion blankets.
- The seed mixes listed in Table II-3.4: Temporary and Permanent Seed Mixes include

recommended mixes for both temporary and permanent seeding.

- Apply these mixes, with the exception of the wet area seed mix, at a rate of 120 pounds per acre. This rate can be reduced if soil amendments or slow-release fertilizers are used. Apply the wet area seed mix at a rate of 60 pounds per acre.
- Consult the local suppliers or the local conservation district for their recommendations. The appropriate mix depends on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic. Alternative seed mixes approved by the local authority may be used, depending on the soil type and hydrology of the area.

Table II-3.4: Temporary and Permanent Seed Mixes

Common Name	Latin Name	% Weight	% Purity	% Germination
Temporary Erosion Control Seed Mix A standard mix for areas requiring a temporary vegetative cover.				
Chewings or annual blue grass	*Festuca rubra var. commutata* or *Poa anna*	40	98	90
Perennial rye	*Lolium perenne*	50	98	90
Redtop or colonial bentgrass	*Agrostis alba* or *Agrostis tenuis*	5	92	85
White dutch clover	*Trifolium repens*	5	98	90
Landscaping Seed Mix A recommended mix for landscaping seed.				
Perennial rye blend	*Lolium perenne*	70	98	90
Chewings and red fescue blend	*Festuca rubra var. commutata* or *Festuca rubra*	30	98	90
Low-Growing Turf Seed Mix A turf seed mix for dry situations where there is no need for watering. This mix requires very little maintenance.				
Dwarf tall fescue (several varieties)	*Festuca arundinacea var.*	45	98	90
Dwarf perennial rye (Barclay)	*Lolium perenne var. barclay*	30	98	90
Red fescue	*Festuca rubra*	20	98	90
Colonial bentgrass	*Agrostis tenuis*	5	98	90
Bioswale Seed Mix A seed mix for bioswales and other intermittently wet areas.				
Tall or meadow fes-	*Festuca arundin-*	75-80	98	90

Table II-3.4: Temporary and Permanent Seed Mixes (continued)

Common Name	Latin Name	% Weight	% Purity	% Germination
cue	*acea* or *Festuca elatior*			
Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	92	85
Redtop bentgrass	*Agrostis alba* or *Agrostis gigantea*	5-10	90	80
Wet Area Seed Mix A low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Consult Hydraulic Permit Authority (HPA) for seed mixes if applicable.				
Tall or meadow fescue	*Festuca arundinacea* or *Festuca elatior*	60-70	98	90
Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	98	85
Meadow foxtail	*Alepocurus pratensis*	10-15	90	80
Alsike clover	*Trifolium hybridum*	1-6	98	90
Redtop bentgrass	*Agrostis alba*	1-6	92	85
Meadow Seed Mix A recommended meadow seed mix for infrequently maintained areas or non-maintained areas where colonization by native plants is desirable. Likely applications include rural road and utility right-of-way. Seeding should take place in September or very early October in order to obtain adequate establishment prior to the winter months. Consider the appropriateness of clover, a fairly invasive species, in the mix. Amending the soil can reduce the need for clover.				
Redtop or Oregon bentgrass	*Agrostis alba* or *Agrostis oregonensis*	20	92	85
Red fescue	*Festuca rubra*	70	98	90
White dutch clover	*Trifolium repens*	10	98	90

Roughening and Rototilling

- The seedbed should be firm and rough. Roughen all soil no matter what the slope. Track walk slopes before seeding if engineering purposes require compaction. Backblading or smoothing of slopes greater than 4H:1V is not allowed if they are to be seeded.
- Restoration-based landscape practices require deeper incorporation than that provided by a simple single-pass rototilling treatment. Wherever practical, initially rip the subgrade to improve long-term permeability, infiltration, and water inflow qualities. At a minimum,

permanent areas shall use soil amendments to achieve organic matter and permeability performance defined in engineered soil/landscape systems. For systems that are deeper than 8 inches complete the rototilling process in multiple lifts, or prepare the engineered soil system per specifications and place to achieve the specified depth.

Fertilizers

- Conducting soil tests to determine the exact type and quantity of fertilizer is recommended. This will prevent the over-application of fertilizer.
- Organic matter is the most appropriate form of fertilizer because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form.
- In general, use 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer at a rate of 90 pounds per acre. Always use slow-release fertilizers because they are more efficient and have fewer environmental impacts. Do not add fertilizer to the hydromulch machine, or agitate, more than 20 minutes before use. Too much agitation destroys the slow-release coating.
- There are numerous products available that take the place of chemical fertilizers. These include several with seaweed extracts that are beneficial to soil microbes and organisms. If 100 percent cottonseed meal is used as the mulch in hydroseed, chemical fertilizer may not be necessary. Cottonseed meal provides a good source of long-term, slow-release, available nitrogen.

Bonded Fiber Matrix and Mechanically Bonded Fiber Matrix

- On steep slopes use Bonded Fiber Matrix (BFM) or Mechanically Bonded Fiber Matrix (MBFM) products. Apply BFM/MBFM products at a minimum rate of 3,000 pounds per acre with approximately 10 percent tackifier. Achieve a minimum of 95 percent soil coverage during application. Numerous products are available commercially. Most products require 24-36 hours to cure before rainfall and cannot be installed on wet or saturated soils. Generally, products come in 40-50 pound bags and include all necessary ingredients except for seed and fertilizer.
- Install products per manufacturer's instructions.
- BFMs and MBFMs provide good alternatives to blankets in most areas requiring vegetation establishment. Advantages over blankets include:
    - BFM and MBFMs do not require surface preparation.
    - Helicopters can assist in installing BFM and MBFMs in remote areas.
    - On slopes steeper than 2.5H:1V, blanket installers may require ropes and harnesses for safety.
    - Installing BFM and MBFMs can save at least $1,000 per acre compared to blankets.

Maintenance Standards

Reseed any seeded areas that fail to establish at least 75 percent cover (100 percent cover for areas that receive sheet or concentrated flows). If reseeding is ineffective, use an alternate method such as sodding, mulching, nets, or blankets.

- Reseed and protect by mulch any areas that experience erosion after achieving adequate cover. Reseed and protect by mulch any eroded area.
- Supply seeded areas with adequate moisture, but do not water to the extent that it causes run-off.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C121: Mulching

Purpose

Mulching soils provides immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures. There are a variety of mulches that can be used. This section discusses only the most common types of mulch.

Conditions of Use

As a temporary cover measure, mulch should be used:

- For less than 30 days on disturbed areas that require cover.
- At all times for seeded areas, especially during the wet season and during the hot summer months.
- During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.

Mulch may be applied at any time of the year and must be refreshed periodically.

For seeded areas, mulch may be made up of 100 percent:

- cottonseed meal;
- fibers made of wood, recycled cellulose, hemp, or kenaf;

BMP C140: Dust Control

Purpose

Dust control prevents wind transport of dust from disturbed soil surfaces onto roadways, drainage ways, and surface waters.

Conditions of Use

Use dust control in areas (including roadways) subject to surface and air movement of dust where on-site or off-site impacts to roadways, drainage ways, or surface waters are likely.

Design and Installation Specifications

- Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
- Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition. Maintain the original ground cover as long as practical.
- Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.
- Sprinkle the site with water until the surface is wet. Repeat as needed. To prevent carryout of mud onto the street, refer to BMP C105: Stabilized Construction Access and BMP C106: Wheel Wash.
- Irrigation water can be used for dust control. Irrigation systems should be installed as a first step on sites where dust control is a concern.
- Spray exposed soil areas with a dust palliative, following the manufacturer's instructions and cautions regarding handling and application. Used oil is prohibited from use as a dust suppressant. Local governments may approve other dust palliatives such as calcium chloride or PAM.
- PAM (BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection) added to water at a rate of 0.5 pounds per 1,000 gallons of water per acre and applied from a water truck is more effective than water alone. This is due to increased infiltration of water into the soil and reduced evaporation. In addition, small soil particles are bonded together and are not as easily transported by wind. Adding PAM may reduce the quantity of water needed for dust control. Note that the application rate specified here applies to this BMP, and is not the same application rate that is specified in BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection, but the downstream protections still apply.

  Refer to BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection for conditions of use. PAM shall not be directly applied to water or allowed to enter a water body.
- Contact your local Air Pollution Control Authority for guidance and training on other dust control measures. Compliance with the local Air Pollution Control Authority constitutes

compliance with this BMP.

- Use vacuum street sweepers.
- Remove mud and other dirt promptly so it does not dry and then turn into dust.
- Techniques that can be used for unpaved roads and lots include:
    - Lower speed limits. High vehicle speed increases the amount of dust stirred up from unpaved roads and lots.
    - Upgrade the road surface strength by improving particle size, shape, and mineral types that make up the surface and base materials.
    - Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those smaller than .075 mm) to 10 to 20 percent.
    - Use geotextile fabrics to increase the strength of new roads or roads undergoing reconstruction.
    - Encourage the use of alternate, paved routes, if available.
    - Apply chemical dust suppressants using the admix method, blending the product with the top few inches of surface material. Suppressants may also be applied as surface treatments.
    - Limit dust-causing work on windy days.
    - Pave unpaved permanent roads and other trafficked areas.

Maintenance Standards

Respray area as necessary to keep dust to a minimum.

BMP C150: Materials on Hand

Purpose

Keep quantities of erosion prevention and sediment control materials on the project site at all times to be used for regular maintenance and emergency situations such as unexpected heavy rains. Having these materials on-site reduces the time needed to replace existing or implement new BMPs when inspections indicate that existing BMPs are not meeting the Construction SWPPP requirements. In addition, contractors can save money by buying some materials in bulk and storing them at their office or yard.

Conditions of Use

- Construction projects of any size or type can benefit from having materials on hand. A small commercial development project could have a roll of plastic and some gravel available for immediate protection of bare soil and temporary berm construction. A large earthwork project, such as highway construction, might have several tons of straw, several rolls of plastic, flexible

pipe, sandbags, geotextile fabric and steel “T” posts.

- Materials should be stockpiled and readily available before any site clearing, grubbing, or earthwork begins. A large contractor or project proponent could keep a stockpile of materials that are available for use on several projects.
- If storage space at the project site is at a premium, the contractor could maintain the materials at their office or yard. The office or yard must be less than an hour from the project site.

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:

- 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 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 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.

BMP C207: Check Dams

Purpose

Construction of check dams across a swale or ditch reduces the velocity of concentrated flow and dissipates energy at the check dam.

Conditions of Use

Use check dams where temporary or permanent channels are not yet vegetated, channel lining is infeasible, and/or velocity checks are required.

- Check dams may not be placed in streams unless approved by the State Department of Fish and Wildlife.
- Check dams may not be placed in wetlands without approval from a permitting agency.
- Do not place check dams below the expected backwater from any salmonid bearing water between October 1 and May 31 to ensure that there is no loss of high flow refuge habitat for overwintering juvenile salmonids and emergent salmonid fry.

Design and Installation Specifications

- Construct rock check dams from appropriately sized rock. The rock used must be large enough to stay in place given the expected design flow through the channel. The rock must be placed by hand or by mechanical means (do not dump the rock to form the dam) to achieve complete coverage of the ditch or swale and to ensure that the center of the dam is lower than the edges.
- Check dams may also be constructed of either rock or pea-gravel filled bags. Numerous new products are also available for this purpose. They tend to be re-usable, quick and easy to install, effective, and cost efficient.
- Place check dams perpendicular to the flow of water.
- The check dam should form a triangle when viewed from the side. This prevents undercutting as water flows over the face of the check dam rather than falling directly onto the ditch bottom.
- Before installing check dams, impound and bypass upstream water flow away from the work area. Options for bypassing include pumps, siphons, or temporary channels.
- Check dams combined with sumps work more effectively at slowing flow and retaining sediment than a check dam alone. A deep sump should be provided immediately upstream of the check dam.
- In some cases, if carefully located and designed, check dams can remain as permanent installations with very minor regrading. They may be left as either spillways, in which case accumulated sediment would be graded and seeded, or as check dams to prevent further sediment from leaving the site.
- The maximum spacing between check dams shall be such that the downstream toe of the

upstream dam is at the same elevation as the top of the downstream dam.

- Keep the maximum height at 2 feet at the center of the check dam.
- Keep the center of the check dam at least 12 inches lower than the outer edges at natural ground elevation.
- Keep the side slopes of the check dam at 2H:1V or flatter.
- Key the stone into the ditch banks and extend it beyond the abutments a minimum of 18 inches to avoid washouts from overflow around the dam.
- Use filter fabric foundation under a rock or sand bag check dam. If a blanket ditch liner is used, filter fabric is not necessary. A piece of organic or synthetic blanket cut to fit will also work for this purpose.
- In the case of grass-lined ditches and swales, all check dams and accumulated sediment shall be removed when the grass has matured sufficiently to protect the ditch or swale - unless the slope of the swale is greater than 4 percent. The area beneath the check dams shall be seeded and mulched immediately after dam removal.
- Ensure that channel appurtenances, such as culvert entrances below check dams, are not subject to damage or blockage from displaced stones.
- See Figure II-3.16: Rock Check Dam.

Maintenance Standards

Check dams shall be monitored for performance and sediment accumulation during and after each rainfall that produces runoff. Sediment shall be removed when it reaches one half the sump depth.

- Anticipate submergence and deposition above the check dam and erosion from high flows around the edges of the dam.
- If significant erosion occurs between dams, install a protective riprap liner in that portion of the channel. See BMP C202: Riprap Channel Lining.

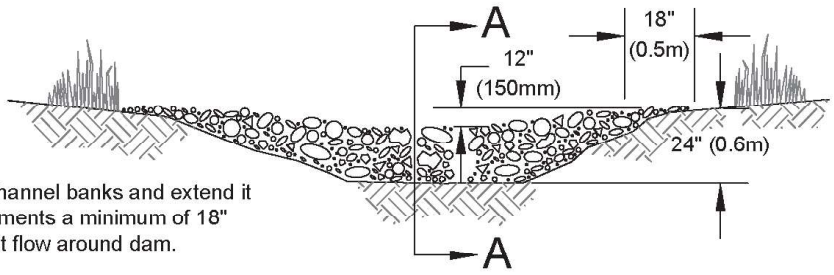
Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

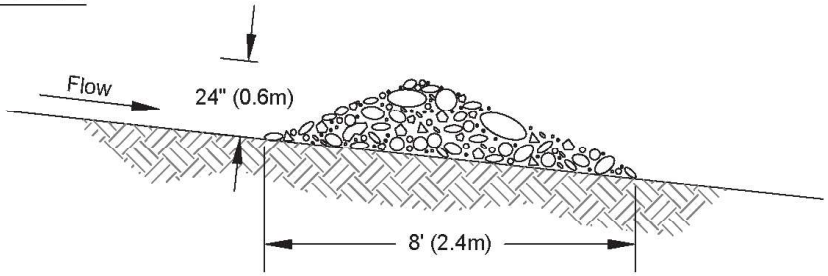
Figure II-3.16: Rock Check Dam

View Looking Upstream

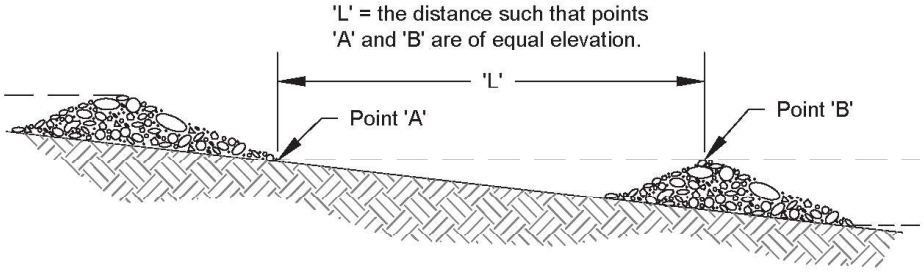


Note:
Key stone into channel banks and extend it beyond the abutments a minimum of 18" (0.5m) to prevent flow around dam.

Section A-A



Spacing Between Check Dams



NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Rock Check Dam

Revised June 2016

and staples.

- In the case of grass-lined ditches and swales, check dams and accumulated sediment shall be removed when the grass has matured sufficiently to protect the ditch or swale unless the slope of the swale is greater than 4 percent. The area beneath the check dams shall be seeded and mulched immediately after dam removal.

Maintenance Standards

- Inspect TSDs for performance and sediment accumulation during and after each rainfall that produces runoff. Remove sediment when it reaches one half the height of the TSD.
- Anticipate submergence and deposition above the TSD and erosion from high flows around the edges of the TSD. Immediately repair any damage or any undercutting of the TSD.

BMP C209: Outlet Protection

Purpose

Outlet protection prevents scour at conveyance outlets and minimizes the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.

Conditions of Use

Use outlet protection at the outlets of all ponds, pipes, ditches, or other conveyances that discharge to a natural or manmade drainage feature such as a stream, wetland, lake, or ditch.

Design and Installation Specifications

- The receiving channel at the outlet of a pipe shall be protected from erosion by lining a minimum of 6 feet downstream and extending up the channel sides a minimum of 1–foot above the maximum tailwater elevation, or 1-foot above the crown, whichever is higher. For pipes larger than 18 inches in diameter, the outlet protection lining of the channel shall be four times the diameter of the outlet pipe.
- Standard wingwalls, tapered outlets, and paved channels should also be considered when appropriate for permanent culvert outlet protection (WSDOT, 2015).
- BMP C122: Nets and Blankets or BMP C202: Riprap Channel Lining provide suitable options for lining materials.
- With low flows, BMP C201: Grass-Lined Channels can be an effective alternative for lining material.
- The following guidelines shall be used for outlet protection with riprap:
    - If the discharge velocity at the outlet is less than 5 fps, use 2-inch to 8-inch riprap. Minimum thickness is 1-foot.
    - For 5 to 10 fps discharge velocity at the outlet, use 24-inch to 48-inch riprap. Minimum

thickness is 2 feet.

- For outlets at the base of steep slope pipes (pipe slope greater than 10 percent), use an engineered energy dissipator.
- Filter fabric or erosion control blankets should always be used under riprap to prevent scour and channel erosion. See BMP C122: Nets and Blankets.

- Bank stabilization, bioengineering, and habitat features may be required for disturbed areas. This work may require a Hydraulic Project Approval (HPA) from the Washington State Department of Fish and Wildlife. See I-2.11 Hydraulic Project Approvals.

Maintenance Standards

- Inspect and repair as needed.
- Add rock as needed to maintain the intended function.
- Clean energy dissipator if sediment builds up.

BMP C220: Inlet Protection

Purpose

Inlet protection prevents coarse sediment from entering drainage systems prior to permanent stabilization of the disturbed area.

Conditions of Use

Use inlet protection at inlets that are operational before permanent stabilization of the disturbed areas that contribute runoff to the inlet. Provide protection for all storm drain inlets downslope and within 500 feet of a disturbed or construction area, unless those inlets are preceded by a sediment trapping BMP.

Also consider inlet protection for lawn and yard drains on new home construction. These small and numerous drains coupled with lack of gutters can add significant amounts of sediment into the roof drain system. If possible, delay installing lawn and yard drains until just before landscaping, or cap these drains to prevent sediment from entering the system until completion of landscaping. Provide 18-inches of sod around each finished lawn and yard drain.

Table II-3.10: Storm Drain Inlet Protection lists several options for inlet protection. All of the methods for inlet protection tend to plug and require a high frequency of maintenance. Limit contributing drainage areas for an individual inlet to one acre or less. If possible, provide emergency overflows with additional end-of-pipe treatment where stormwater ponding would cause a hazard.

Maintenance Standards

- Repair any damage immediately.
- Intercept and convey all evident concentrated flows uphill of the silt fence to a sediment trapping BMP.
- Check the uphill side of the silt 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 and 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 geotextile 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 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 BMP C241: Sediment Pond (Temporary) or other sediment trapping BMP. The only circumstance in which overland flow can be treated solely by a vegetated strip, rather than by a sediment trapping BMP, is when the following criteria are met (see Table II-3.12: Contributing Drainage Area for Vegetated Strips):

Table II-3.12: 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 continuous strip of dense vegetation with topsoil for a minimum of a 25-foot length along the flowpath. 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 vegetated 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 vegetated strip, stormwater runoff controls must be installed to reduce the flows entering the vegetated strip, or additional perimeter protection must be installed.

BMP C235: Wattles

Purpose

Wattles are temporary erosion and sediment control barriers consisting of straw, compost, or other material that is wrapped in netting made of natural plant fiber or similar encasing material. They reduce the velocity and can spread the flow of rill and sheet runoff, and can capture and retain sediment.

Conditions of Use

- Wattles shall consist of cylinders of plant material such as weed-free straw, coir, wood chips, excelsior, or wood fiber or shavings encased within netting made of natural plant fibers unaltered by synthetic materials.
- Use wattles:
    - In disturbed areas that require immediate erosion protection.
    - On exposed soils during the period of short construction delays, or over winter months.
    - On slopes requiring stabilization until permanent vegetation can be established.
- The material used dictates the effectiveness period of the wattle. Generally, wattles are effective for one to two seasons.

IV-4 Soil Erosion, Sediment Control, and Landscaping Source Control BMPs

S407 BMPs for Dust Control at Disturbed Land Areas and Unpaved Roadways and Parking Lots

Note: Contact the local air quality authority for appropriate and required BMPs for dust control to implement at your project site. Use the following website to determine the air quality authority for the project site:

https://ecology.wa.gov/About-us/Our-role-in-the-community/Partnerships-committees/Clean-air-agencies

Description of Pollutant Sources: Dust can cause air and water pollution problems particularly at demolition sites and in arid areas where reduced rainfall exposes soil particles to transport by air.

Pollutant Control Approach: Minimize dust generation and apply environmentally friendly and government approved dust suppressant chemicals, if necessary.

Applicable Operational BMPs:

- Sprinkle or wet down soil or dust with water as long as it does not result in a wastewater discharge.
- Use only dust suppressant chemicals that are approved by the local jurisdiction and/or state government approved dust suppressant chemicals such as those listed in *Alternatives to Hazardous Materials: Techniques for Dust Prevention and Suppression* (Ecology, 2016b).
- Avoid excessive and repeated applications of dust suppressant chemicals. Time the application of dust suppressants to avoid or minimize their wash-off by rainfall or human activity such as irrigation.
- Apply stormwater containment to prevent the conveyance of sediment into storm drains or receiving waters.
- Protect inlets/catch basins during application of dust suppressants.
- Ecology prohibits the use of motor oil for dust control. Take care when using lignin derivatives and other high BOD chemicals in areas susceptible to contaminating surface water or ground water.
- Consult with Ecology and the local permitting authority on discharge permit requirements if the dust suppression process results in a wastewater discharge to the ground, ground water, storm drain, or surface water.
- Street gutters, sidewalks, driveways, and other paved surfaces in the immediate area of the activity must be swept regularly to collect and properly dispose of dust, dirt, loose debris, and garbage.

- Install catch basin filter socks on site and in surrounding catch basins to collect sediment and debris. Maintain the filters regularly to prevent plugging.

Recommended Additional Operational BMPs for Roadways and Other Trafficked Areas:

- Consider limiting use of off-road recreational vehicles on dust generating land.
- Consider graveling or paving unpaved permanent roads and other trafficked areas at municipal, commercial, and industrial areas.
- Consider paving or stabilizing shoulders of paved roads with gravel, vegetation, or local government approved chemicals.
- Encourage use of alternate paved routes, if available.
- Vacuum sweep fine dirt and skid control materials from paved roads soon after winter weather ends or when needed.
- Consider using pre-washed traction sand to reduce dust emissions.

Additional Recommended Operational BMPs for Dust Generating Areas:

- Prepare a dust control plan. Helpful references include: *Control of Open Fugitive Dust Sources* (Cowherd et al., 1988) and *Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures* (USEPA, 1992).
- Limit exposure of soil (dust source) as much as feasible.
- Stabilize dust-generating soil by growing and maintaining vegetation, mulching, topsoiling, and/or applying stone, sand, or gravel.
- Apply windbreaks in the soil such as trees, board fences, tarp curtains, bales of hay, etc.

Note: Construction site dust control is covered in BMP C140: Dust Control.

S408 BMPs for Dust Control at Manufacturing Areas

Note: Contact the local air quality authority for appropriate and required BMPs for dust control to implement at your project site. Use the following website to determine the air quality authority for the project site:

https://ecology.wa.gov/About-us/Our-role-in-the-community/Partnerships-committees/Clean-air-agencies

Description of Pollutant Sources: Industrial material handling activities can generate considerable amounts of dust that is typically removed using exhaust systems. Mixing cement and concrete products and handling powdered materials can also generate dust. Particulate materials that

- Convey all roof drains to storm drains outside the fueling containment area.
- Convey stormwater collected on the fuel island containment pad to a sanitary sewer system, if approved by the sanitary authority, or to an approved treatment system such as an oil/water separator and a basic treatment BMP. (Basic treatment BMPs are listed in III-1.2 Choosing Your Runoff Treatment BMPs). Discharges from treatment systems to storm drains or surface water or to the ground must not display ongoing or recurring visible sheen and must not contain oil and grease.
- Alternatively, collect stormwater from the fuel island containment pad and hold for proper off-site disposal.
- Approval from the local sewer authority is required for conveyance of any fuel-contaminated stormwater to a sanitary sewer. The discharged stormwater must comply with pretreatment regulations (WAC 173-216-060). These regulations prohibit discharges that could "cause fire or explosion." State and federal pretreatment regulations define an explosive or flammable mixture, based on a flash point determination of the mixture. Stormwater could be conveyed to a sanitary sewer system if it is determined not to be explosive.
- Transfer the fuel from the delivery tank trucks to the fuel storage tank in impervious contained areas and ensure that appropriate overflow protection is used. Alternatively, cover nearby storm drains during the filling process and use drip pans under all hose connections.

Additional BMP for Vehicles 10 feet in height or greater

A roof or canopy may not be feasible at fueling stations that regularly fuel vehicles that are 10 feet in height or greater, particularly at industrial or WSDOT sites. At those types of fueling facilities, the following BMPs apply, as well as the applicable BMPs and fire prevention (UFC requirements) of this BMP for fueling stations:

- If a roof or canopy is impractical, the concrete fueling pad must be equipped with emergency spill control including a shutoff valve for drainage from the fueling area. Maintain the valve in the closed position in the event of a spill. Clean up spills and dispose of materials off-site in accordance with S426 BMPs for Spills of Oil and Hazardous Substances.
- The valve may be opened to convey contaminated stormwater to a sanitary sewer, if approved by the sewer authority, or to oil removal treatment such as an API or CP oil/water separator (see V-13 Oil and Water Separator BMPs), catchbasin insert, or equivalent treatment, and then to a basic treatment BMP (as described in III-1.2 Choosing Your Runoff Treatment BMPs). Discharges from treatment systems to storm sewer or surface water or to the ground must not display ongoing or recurring visible sheen and must not contain a significant amount of oil and grease.

S412 BMPs for Loading and Unloading Areas for Liquid or Solid Material

Description of Pollutant Sources: Operators typically conduct loading/unloading of liquid and solid materials at industrial and commercial facilities at shipping and receiving, outside storage, fueling areas, etc. Materials transferred can include products, raw materials, intermediate products,

waste materials, fuels, scrap metals, etc. Leaks and spills of fuels, oils, powders, organics, heavy metals, salts, acids, alkalis, etc. during transfer may cause stormwater contamination. Spills from hydraulic line breaks are a common problem at loading docks.

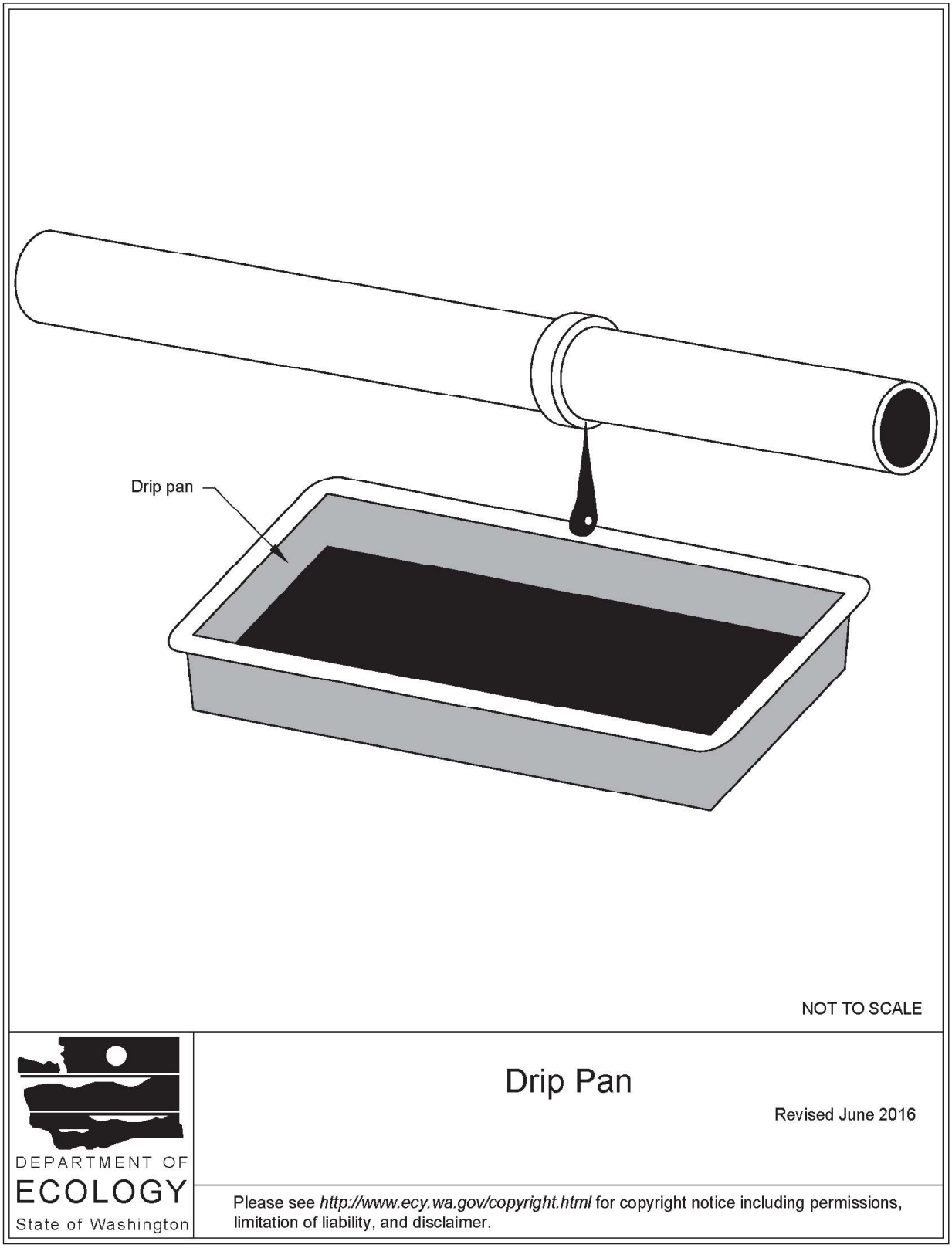
Pollutant Control Approach: Cover and contain the loading/unloading area where necessary to prevent run-on of stormwater and runoff of contaminated stormwater.

Applicable Operational BMPs:

At All Loading/ Unloading Areas

- A significant amount of debris can accumulate at outside, uncovered loading/unloading areas. Sweep these surfaces frequently to remove loose material that could contaminate stormwater. Sweep areas temporarily covered after removal of the containers, logs, or other material covering the ground.
- Place drip pans, or other appropriate temporary containment device, at locations where leaks or spills may occur such as hose connections, hose reels and filler nozzles. Always use drip pans when making and breaking connections (see Figure IV-6.2: Drip Pan). Check loading/unloading equipment such as valves, pumps, flanges, and connections regularly for leaks and repair as needed.

Figure IV-6.2: Drip Pan



S414 BMPs for Maintenance and Repair of Vehicles and Equipment

Description of Pollutant Sources: Pollutant sources include parts/vehicle cleaning, spills/leaks of fuel and other liquids, replacement of liquids, outdoor storage of batteries/liquids/parts, and vehicle parking.

Pollutant Control Approach: Control of leaks and spills of fluids using good housekeeping and cover and containment BMPs.

Applicable Operational BMPs:

- Inspect all incoming vehicles, parts, and equipment stored temporarily outside for leaks.
- Use drip pans or containers under parts or vehicles that drip or that are likely to drip liquids, such as during dismantling of liquid containing parts or removal or transfer of liquids. Inspect drip pans regularly to prevent accumulation of stormwater or other liquids, and dispose of any accumulated liquid appropriately.
- Remove batteries and liquids from vehicles and equipment in designated areas designed to prevent stormwater contamination. Store cracked batteries in a covered non-leaking secondary containment system.
- Remove liquids from vehicles retired for scrap.
- Empty oil and fuel filters before disposal. Provide for proper disposal of used oil and fuel.
- Do not pour/convey washwater, liquid waste, or other pollutants into storm drains or to surface water. Check with the local sanitary sewer authority for approval to convey water to a sanitary sewer.
- Do not connect maintenance and repair shop floor drains to storm drains or to surface water.
- To allow for snowmelt during the winter, install a drainage trench with a sump for particulate collection. Use the drainage trench for draining the snowmelt only. Do not discharge any vehicular or shop pollutants to the trench drain.

Applicable Structural Source Control BMPs:

- Conduct all maintenance and repair of vehicles and equipment in a building, or other covered impervious containment area that is sloped to prevent run-on of uncontaminated stormwater and runoff of contaminated water.
- Operators may conduct maintenance of refrigeration engines in refrigerated trailers in the parking area. Exercise due caution to avoid the release of engine or refrigeration fluids to storm drains or surface water.
- Park large mobile equipment, such as log stackers, in a designated contained area.

Applicable Treatment BMPs:

Convey contaminated stormwater runoff from vehicle staging and maintenance areas to a sanitary sewer, if allowed by the local sewer authority, or to an API or CP oil and water separator followed by a Basic Treatment BMP (See Volume V), applicable filter, or other equivalent oil treatment system.

Note this applicable treatment BMP for contaminated stormwater.

Recommended Additional Operational BMPs:

- Store damaged vehicles inside a building or other covered containment, until successfully removing all liquids.
- Clean parts with aqueous detergent based solutions or non-chlorinated solvents such as kerosene or high flash mineral spirits, and/or use wire brushing or sand blasting whenever practicable. Avoid using toxic liquid cleaners such as methylene chloride, 1,1,1-trichloroethane, trichloroethylene or similar chlorinated solvents. Choose cleaning agents that can be recycled.
- Inspect all BMPs regularly, particularly after a significant storm. Identify and correct deficiencies to ensure that the BMPs are functioning as intended.
- Avoid hosing down work areas. Use dry methods for cleaning leaked fluids.
- Recycle greases, used oil, oil filters, antifreeze, cleaning solutions, automotive batteries, hydraulic fluids, transmission fluids, and engine oils. Contact Ecology's Hazardous Waste & Toxics Reduction Program for recommendations on recycling or disposal of waste materials. (https://ecology.wa.gov/About-us/Get-to-know-us/Our-Programs/Hazardous-Waste-Toxics-Reduction)
- Do not mix dissimilar or incompatible waste liquids stored for recycling.

S418 BMPs for Manufacturing Activities - Outside

Description of Pollutant Sources: Manufacturing pollutant sources include outside process areas, stack emissions, and areas where manufacturing activity has taken place in the past and significant exposed pollutant materials remain.

Pollution Control Approach: Cover and contain outside manufacturing and prevent stormwater run-on and contamination, where feasible.

Applicable Operational BMP:

- Sweep paved areas regularly, as needed, to prevent contamination of stormwater.
- Alter the activity by eliminating or minimizing the contamination of stormwater.

Applicable Structural Source Control BMPs:

- Enclose the activity (see Figure IV-7.1: Enclose the Activity). If possible, enclose the manufacturing activity in a building.
- Cover the activity and connect floor drains to a sanitary sewer, if approved by the local sewer

Recommended Operational BMPs:

- When selecting utility poles for a specific location, consider the potential environmental effects of the pole or poles during storage, handling, and end-use, as well as its cost, safety, efficacy, and expected life. Use wood products treated with chemical preservatives made in accordance with generally accepted industry standards such as the American Wood Preservers Association Standards (see http://www.awpa.com/standards/). Consider alternative materials or technologies if placing poles in or near an environmentally sensitive area, such as a wetland or a drinking water well. Alternative technologies include poles constructed with material (s) other than wood such as fiberglass composites, metal, or concrete. Consider other technologies and materials, such as sleeves or caissons for wood poles, when they are determined to be practicable and available.
- As soon as practicable remove all litter from wire cutting/replacing operations.
- Implement temporary erosion and sediment control in areas cleared of trees and vegetation and during the construction of new roads.

S416 BMPs for Maintenance of Roadside Ditches

Description of Pollutant Sources: Common road debris including eroded soil, oils, vegetative particles, and heavy metals can be sources of stormwater pollutants.

Pollutant Control Approach: Maintain roadside ditches to preserve the condition and capacity for which they were originally constructed, and to minimize bare or thinly vegetated ground surfaces. Maintenance practices should provide for erosion and sediment control (see S411 BMPs for Landscaping and Lawn / Vegetation Management).

Additional Regulations: Note that work in wet areas may be regulated by local, state, or federal regulations that impose additional obligations on the responsible party. Check with the appropriate authorities prior to beginning work in those areas.

Applicable Operational BMPs:

- Inspect roadside ditches regularly to identify sediment accumulations and localized erosion.
- Clean ditches on a regular basis, as needed. Keep ditches free of rubbish and debris.
- Vegetation in ditches often prevents erosion and cleanses runoff waters. Remove vegetation only when flow is blocked or excess sediments have accumulated. Conduct ditch maintenance (seeding, fertilizer application, harvesting) in late spring and/or early fall, where possible. This allows re-establishment of vegetative cover by the next wet season thereby minimizing erosion of the ditch as well as making the ditch effective as a biofilter.
- Do not apply fertilizer unless needed to maintain vegetative growth.
- In the area between the edge of the pavement and the bottom of the ditch, commonly known as the “bare earth zone,” use grass vegetation, wherever possible. Establish vegetation from the edge of the pavement, if possible, or at least from the top of the slope of the ditch.
- Maintain diversion ditches on top of cut slopes constructed to prevent slope erosion by

intercepting surface drainage to retain their diversion shape and capability.

- Use temporary erosion and sediment control measures or re-vegetate as necessary to prevent erosion during ditch reshaping.
- Do not leave ditch cleanings on the roadway surfaces. Sweep, collect, and dispose of dirt and debris remaining on the pavement at the completion of ditch cleaning operations as described below:
    - Consider screening roadside ditch cleanings, not contaminated by spills or other releases and not associated with a stormwater treatment system such as a bioswale, to remove litter. Separate screenings into soil and vegetative matter (leaves, grass, needles, branches, etc.) categories. Compost or dispose of the vegetative matter in a municipal waste landfill. Consult with the jurisdictional health department to discuss use or disposal options for the soil portion. For more information, see Appendix IV-B: Management of Street Waste Solids and Liquids.
    - Roadside ditch cleanings contaminated by spills or other releases known or suspected to contain dangerous waste must be handled following the Dangerous Waste Regulations (Chapter 173 303 WAC). If testing determines materials are not dangerous waste but contaminants are present, consult with the jurisdictional health department for disposal options.
- Examine culverts on a regular basis for scour or sedimentation at the inlet and outlet, and repair as necessary. Give priority to those culverts conveying perennial and/or salmon-bearing streams and culverts near streams in areas of high sediment load, such as those near subdivisions during construction. Maintain trash racks to avoid damage, blockage, or erosion of culverts.

Recommended Treatment BMPs:

Install biofiltration swales and filter strips (see V-7 Biofiltration BMPs) to treat roadside runoff wherever practicable and use engineered topsoils wherever necessary to maintain adequate vegetation. These systems can improve infiltration and stormwater pollutant control upstream of roadside ditches.

S417 BMPs for Maintenance of Stormwater Drainage and Treatment Systems

Description of Pollutant Sources: Facilities include roadside catch basins on arterials and within residential areas, conveyance systems, detention facilities such as ponds and vaults, oil/water separators, biofilters, settling basins, infiltration systems, and all other types of stormwater treatment systems presented in Volume V. Oil and grease, hydrocarbons, debris, heavy metals, sediments and contaminated water are found in catch basins, oil and water separators, settling basins, etc.

Pollutant Control Approach: Provide maintenance and cleaning of debris, sediments, and other pollutants from stormwater collection, conveyance, and treatment systems to maintain proper operation.

Applicable Operational BMPs:

Maintain stormwater treatment facilities per the operations and maintenance (O&M) procedures presented in Appendix V-A: BMP Maintenance Tables in addition to the following BMPs:

- Inspect and clean treatment BMPs, conveyance systems, and catch basins as needed, and determine necessary O&M improvements.
- Promptly repair any deterioration threatening the structural integrity of stormwater facilities. These include replacement of clean-out gates, catch basin lids, and rock in emergency spillways.
- Ensure adequacy of storm sewer capacities and prevent heavy sediment discharges to the sewer system.
- Regularly remove debris and sludge from BMPs used for peak-rate control, treatment, etc. and discharge to a sanitary sewer if approved by the sewer authority, or truck to an appropriate local or state government approved disposal site.
- Clean catch basins when the depth of deposits reaches 60 percent of the sump depth as measured from the bottom of basin to the invert of the lowest pipe into or out of the basin. However, in no case should there be less than six inches clearance from the debris surface to the invert of the lowest pipe. Some catch basins (for example, WSDOT's *Catch Basin Type 1L* (WSDOT, 2011)) may have as little as 12 inches sediment storage below the invert. These catch basins need frequent inspection and cleaning to prevent scouring. Where these catch basins are part of a stormwater collection and treatment system, the system owner/operator may choose to concentrate maintenance efforts on downstream control devices as part of a systems approach.
- Properly dispose of all solids, polluted material, and stagnant water collected through system cleaning. Do not decant water back into the drainage system from eductor trucks or vacuum equipment since there may be residual contaminants in the cleaning equipment. Do not jet material downstream into the public drainage system.
- Clean woody debris in a catch basin as frequently as needed to ensure proper operation of the catch basin.
- Post warning signs; “Dump No Waste - Drains to Ground Water,” “Streams,” “Lakes,” or emboss on or adjacent to all storm drain inlets where possible.
- Disposal of sediments and liquids from the catch basins must comply with Appendix IV-B: Management of Street Waste Solids and Liquids.

S421 BMPs for Parking and Storage of Vehicles and Equipment

Description of Pollutant Sources: Public and commercial parking lots such as retail store, fleet vehicle (including rent-a-car lots and car dealerships), equipment sale and rental parking lots, and

V-11 Miscellaneous LID BMPs

V-11.1 Introduction to Miscellaneous LID BMPs

BMPs in this chapter have been grouped because they have the following in common:

- They employ Low Impact Development (LID) Principles
- They cannot be used to meet I-3.4.6 MR6: Runoff Treatment
- They cannot, by themselves, be used to meet the Flow Control Performance Standard or the LID Performance Standard.
    - Some of the BMPs in this chapter do allow for some amount of Flow Control credit. See the guidance for each individual BMP for details.
- The design methods for each BMP in this chapter are unique. They do not have strong enough design similarities to other BMPs in this volume to place them in the other BMP categories identified in this volume.

BMP T5.13: Post-Construction Soil Quality and Depth

Purpose and Definition

Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition. These functions are largely lost when development strips away native soil and vegetation and replaces it with minimal topsoil and sod. Not only are these important stormwater functions lost, but such landscapes themselves become pollution generating pervious surfaces due to increased use of pesticides, fertilizers and other landscaping and household/industrial chemicals, the concentration of pet wastes, and pollutants that accompany roadside litter.

Establishing soil quality and depth regains greater stormwater functions in the post development landscape, provides increased treatment of pollutants and sediments that result from development and habitation, and minimizes the need for some landscaping chemicals, thus reducing pollution through prevention.

Applications and Limitations

Establishing a minimum soil quality and depth is not the same as preservation of naturally occurring soil and vegetation. However, establishing a minimum soil quality and depth will provide improved on-site management of stormwater flow and water quality.

Soil organic matter can be attained through numerous materials such as compost, composted woody material, biosolids, and forest product residuals. It is important that the materials used to

meet this BMP be appropriate and beneficial to the plant cover to be established. Likewise, it is important that imported topsoils improve soil conditions and do not have an excessive percent of clay fines.

This BMP can be considered infeasible on till soil slopes greater than 33 percent.

Design Guidelines

Soil Retention

Retain, in an undisturbed state, the duff layer and native topsoil to the maximum extent practicable. In any areas requiring grading, remove and stockpile the duff layer and topsoil on site in a designated, controlled area, not adjacent to public resources and critical areas, to be reapplied to other portions of the site where feasible.

Soil Quality

All areas subject to clearing and grading that have not been covered by impervious surface, incorporated into a drainage facility or engineered as structural fill or slope shall, at project completion, demonstrate the following:

1. A topsoil layer with a minimum organic matter content of 10% dry weight in planting beds, and 5% organic matter content in turf areas, and a pH from 6.0 to 8.0 or matching the pH of the undisturbed soil. The topsoil layer shall have a minimum depth of eight inches except where tree roots limit the depth of incorporation of amendments needed to meet the criteria. Subsoils below the topsoil layer should be scarified at least 4 inches with some incorporation of the upper material to avoid stratified layers, where feasible.
2. Mulch planting beds with 2 inches of organic material.
3. Use compost and other materials that meet the following organic content requirements:
    a. The organic content for "pre-approved" amendment rates can be met only using compost meeting the compost specification for BMP T7.30: Bioretention, with the exception that the compost may have up to 35% biosolids or manure.

       The compost must also have an organic matter content of 40% to 65%, and a carbon to nitrogen ratio below 25:1.

       The carbon to nitrogen ratio may be as high as 35:1 for plantings composed entirely of plants native to the Puget Sound Lowlands region.

    b. Calculated amendment rates may be met through use of composted material meeting (a.) above; or other organic materials amended to meet the carbon to nitrogen ratio requirements, and not exceeding the contaminant limits identified in Table 220-B, Testing Parameters, in WAC 173-350-220.

The resulting soil should be conducive to the type of vegetation to be established.

Implementation Options

The soil quality design guidelines listed above can be met by using one of the methods listed below:

1. Leave undisturbed native vegetation and soil, and protect from compaction during construction.
2. Amend existing site topsoil or subsoil either at default "pre-approved" rates, or at custom calculated rates based on tests of the soil and amendment.
3. Stockpile existing topsoil during grading, and replace it prior to planting. Stockpiled topsoil must also be amended if needed to meet the organic matter or depth requirements, either at a default "pre-approved" rate or at a custom calculated rate.
4. Import topsoil mix of sufficient organic content and depth to meet the requirements.

More than one method may be used on different portions of the same site. Soil that already meets the depth and organic matter quality standards, and is not compacted, does not need to be amended.

Planning/Permitting/Inspection/Verification Guidelines & Procedures

Local governments are encouraged to adopt guidelines and procedures similar to those recommended in *Building Soil: Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington* (Stenn et al., 2016).

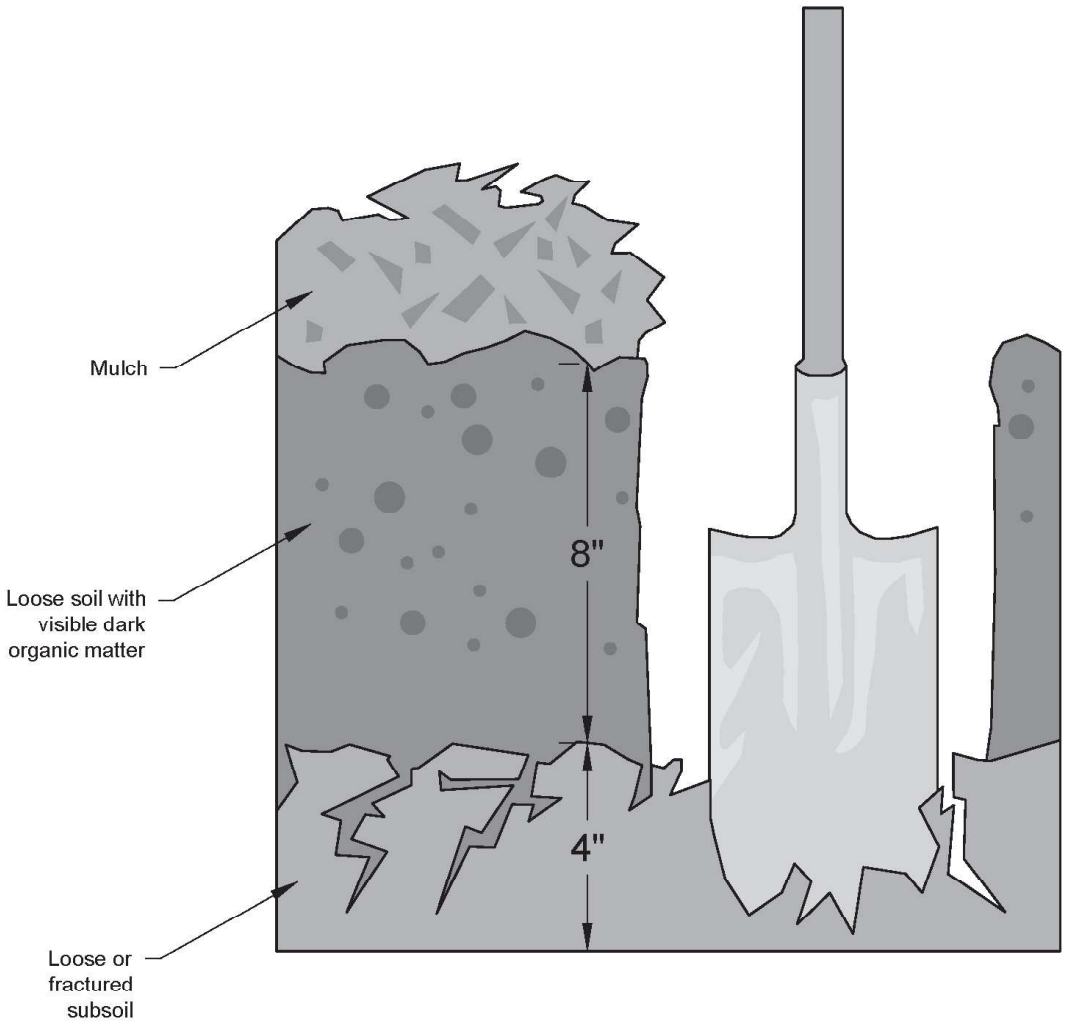
Maintenance

- Establish soil quality and depth toward the end of construction and once established, protect from compaction, such as from large machinery use, and from erosion.
- Plant vegetation and mulch the amended soil area after installation.
- Leave plant debris or its equivalent on the soil surface to replenish organic matter.
- Reduce and adjust, where possible, the use of irrigation, fertilizers, herbicides and pesticides, rather than continuing to implement formerly established practices.

Runoff Model Representation

All areas meeting the soil quality and depth design criteria may be entered into approved runoff models as "Pasture" rather than "Lawn/Landscaping".

Figure V-11.1: Planting Bed Cross-Section



Reprinted from *Guidelines and Resources For Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington*, 2010, Washington Organic Recycling Council

NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Planting Bed Cross-Section

Revised June 2016

BMP T5.30: Full Dispersion

Purpose and Definition

This BMP allows for "fully dispersing" runoff from impervious surfaces and cleared areas of Project Sites into areas preserved as forest, native vegetation, or cleared area.

Ecology accepts Full Dispersion as meeting I-3.4.5 MR5: On-Site Stormwater Management, I-3.4.6 MR6: Runoff Treatment, and I-3.4.7 MR7: Flow Control. Sites that can fully disperse are not required to provide additional Runoff Treatment or Flow Control BMPs. Hard surfaces that are not fully dispersed should be partially dispersed to the maximum extent practicable.

Applications and Limitations

The site (or area of the site) that is applying full dispersion per this BMP must be laid out to allow the runoff from the impervious (or cleared) surface to fully disperse into the preserved dispersion area. (i.e. Have full access to and not be intercepted by pipe(s), ditch(es), stream(s), river(s), pond(s), lake (s), or wetland(s)).

Projects that successfully apply this BMP on all or a portion of their site will decrease effective impervious surfaces, and may avoid triggering the TDA Thresholds in I-3.4.7 MR7: Flow Control.

A site (or an area of a site) that applies full dispersion per this BMP consists of the following elements:

- **An impervious (or cleared) area**. The impervious (or cleared) area is the area that the design is mitigating for by using this BMP.
- **A flow spreader.** Runoff from the impervious (or cleared) area may need to be routed through a flow spreader (see V-1.4.2 Flow Spreaders), depending on the site layout and type of impervious surface, as further described below.
- **A dispersion area.** This area defines the limits of the Full Dispersion BMP. The impervious (or cleared) area must disperse into the preserved dispersion area.
    - The dispersion area must be forest, native vegetation, or a cleared area depending on the site type. Details are provided below for what amount of vegetation the dispersion area must contain based on site type.
    - If the dispersion area must be preserved as forest or native vegetation, it may be a previously cleared area that has been replanted in accordance with Native Vegetation Landscape Specifications (below).
    - The dispersion area should be situated to minimize the clearing of existing forest cover, to maximize the preservation of wetlands (though the wetland area and any streams and lakes do not count as part of the dispersion area), and to buffer stream corridors.
    - The dispersion area should be placed in a separate tract or protected through recorded easements for individual lots.
    - The dispersion area should be shown on all property maps and should be clearly

marked during clearing and construction on the site.

- All trees within the dispersion area at the time of permit application shall be retained, aside from:
  - dangerous or diseased trees, and
  - approved timber harvest activities regulated under WAC Title 222. Class IV General Forest Practices that are conversions from timberland to other uses are not acceptable for the preserved area.
- The dispersion area may be used for passive recreation and related facilities, including pedestrian and bicycle trails, nature viewing areas, fishing and camping areas, and other similar activities that do not require permanent structures. Cleared areas and areas of compacted soil associated with these areas and facilities must not exceed eight percent of the dispersion area.
- The dispersion area may contain utilities and utility easements, but not septic systems. For the purpose of this BMP, utilities are defined as potable and wastewater underground piping, underground wiring, and power and telephone poles.
- The dispersion area is not allowed in critical area buffers or on slopes steeper than 20%. Dispersion areas proposed on slopes steeper than 15% or within 50 feet of a geologically hazardous area (RCW 36.70A.030(5)) must be approved by a geotechnical engineer or engineering geologist.
- For sites with on-site sewage disposal systems, the discharge of runoff from the dispersion area must be located downslope of the primary and reserve drainfield areas. This requirement may be waived by the permitting jurisdiction if site topography clearly prevents discharged flows from intersecting the drainfield.

- **A flow path through the dispersion area.** The length of the flow path from the impervious (or cleared) area through the dispersion area varies based on the site layout and type of impervious surface, as further described below. Regardless of the site layout and type of impervious surface, the flow path must meet the following criteria:
  - The slope of the flow path must be no steeper than 15% for any 20-foot reach of the flow path. Slopes up to 20% are allowed where flow spreaders are located upstream of the dispersion area and at sites where vegetation can be established.
  - The flow paths from adjacent flow spreaders must be sufficiently spaced to prevent overlap of flows in the flow path areas.

The dispersion of runoff must not create flooding or erosion impacts.

Minimum Design Requirements for Residential Projects

Rural single family residential developments should use this BMP wherever possible to minimize effective impervious surfaces.

Full Dispersion from Impervious Surfaces in Residential Projects

Impervious surfaces within residential projects may be "fully dispersed" if they are within a TDA that is less than 10% impervious. If the TDA has more than 10% impervious area, the design may still fully disperse up to 10% of the TDA's area. The impervious areas that are beyond the 10% cannot drain to the dispersion area, and are subject to the thresholds in I-3.4.6 MR6: Runoff Treatment and I-3.4.7 MR7: Flow Control.

The lawn and landscaping areas associated with the impervious area being mitigated may be dispersed into the dispersion area. The lawn and landscaped area must comply with BMP T5.13: Post-Construction Soil Quality and Depth.

The dispersion area must be preserved as forest or native vegetation.

The dispersion area shall have a minimum area 6.5 times the area of the impervious surface draining to it.

The flow path from the impervious surface through the area preserved as forest or native vegetation must be at least 100 feet in length, or 25 feet for sheet flow from lawn and landscaping areas associated with the impervious area being mitigated.

The following additional guidelines must be followed for the following types of impervious surfaces within residential projects:

- **Full dispersion from roof surfaces:** Runoff from roof surfaces must either:
    - Provide dispersion BMPs as described in BMP T5.10B: Downspout Dispersion Systems prior to the runoff entering the dispersion area. The dispersion area and flow path must meet the criteria described in this BMP.

      or
    - Combine the roof runoff with the road runoff, and follow the guidance for full dispersion from roadway surfaces (below).
- **Full dispersion from driveway surfaces:** Runoff from driveway surfaces must either:
    - Provide dispersion BMPs as described in BMP T5.11: Concentrated Flow Dispersion and BMP T5.12: Sheet Flow Dispersion prior to the runoff entering the dispersion area. The dispersion area and flow path must meet the criteria described in this BMP.

      or
    - Combine the driveway runoff with the road runoff, and follow the guidance for full dispersion from roadway surfaces (below).
- **Full Dispersion from Roadway Surfaces:** Runoff from roadway surfaces comply with all of the following requirements:
    - The road section shall be designed to minimize collection and concentration of roadway runoff. Sheet flow over roadway fill slopes (i.e., where roadway subgrade is above adjacent right-of-way) should be used wherever possible to avoid concentration.

- When it is necessary to collect and concentrate runoff from the roadway and adjacent upstream areas (e.g., in a ditch on a cut slope), concentrated flows shall be incrementally discharged from the ditch via cross culverts or at the ends of cut sections. These incremental discharges of newly concentrated flows shall not exceed 0.5 cfs at any one discharge point from a ditch for the 100-year runoff event. Where flows at a particular ditch discharge point were already concentrated under existing site conditions (e.g., in a natural channel that crosses the roadway alignment), the 0.5-cfs limit would be in addition to the existing concentrated peak flows.
- Ditch discharge points with up to 0.2 cfs discharge for the peak 100-year flow shall use rock pads or dispersion trenches to disperse flows into the dispersion area. Ditch discharge points with between 0.2 and 0.5 cfs discharge for the 100-year peak flow shall use dispersion trenches to disperse flows into the dispersion area. See V-1.4.3 Outfall Systems for details on rock pads and dispersion trenches.
    - Dispersion trenches shall be designed to accept surface flows (free discharge) from a pipe, culvert, or ditch end, shall be aligned perpendicular to the flowpath, and shall have a minimum 2 feet by 2 cross section, 50 feet in length, filled with 3/4-inch to 1 1/2-inch washed rock, and provided with a level notched grade board. Manifolds may be used to split flows up to 2 cfs discharge for the 100-year peak flow between up to 4 trenches. Dispersion trenches shall have a minimum spacing of 50 feet between centerlines.
- Where the Local Plan Approval Authority determines there is a potential for significant adverse impacts downstream (e.g., erosive steep slopes or existing downstream drainage problems), dispersion of runoff from roadway surfaces may not be allowed, or other measures may be required.

Full Dispersion from Cleared Areas in Residential Projects

The runoff from cleared areas of residential projects that are comprised of bare soil, non-native landscaping, lawn, and/or pasture is "fully dispersed" if it meets all of the following criteria:

- Cleared areas must comply with BMP T5.13: Post-Construction Soil Quality and Depth.
- The dispersion area must be preserved as forest or native vegetation.
- The flow path through the cleared area (and leading to the dispersion area) must not be greater than 25 feet.
- If the cleared area has a width of up to 25 feet:
    - The minimum flow path length from the cleared area through the dispersion area must be at least 25 feet.
- If the cleared area has a width of 25 to 250 feet:
    - The minimum flow path length from the cleared area through the dispersion area must be 25 feet, plus an additional 1 foot for every 3 feet of width of the cleared area (beyond the initial 25 feet) up to a maximum width of 250 feet.

- The topography of the cleared area must be such that runoff will not concentrate prior to discharge to the dispersion area.
- The width of the dispersion area must equal the width of the cleared area.

Minimum Design Requirements for Public Road Projects

These criteria apply to the construction of public roads not within the context of residential, commercial, or industrial site development. They will likely only be implementable on roads outside of the urban growth areas where roadside areas are not planned for urban density development.

Full dispersion can be applied to public road projects that meet the following requirements:

- The dispersion area must be outside of the urban growth area; or if inside the urban growth area, in legally protected areas (easements, conservation tracts, public parks).
- If the dispersion area is outside urban growth areas, legal agreements should be reached with the owner(s) of the property(ies) that contain the dispersion area.
- An agreement with the property owner(s) is advised for any dispersion areas that represent a continuation of past practice. If not a continuation of past practice, an agreement should be reached with the property owner.

Full Dispersion by Sheet Flow from Uncollected, Unconcentrated Runoff into the Dispersion Area

The runoff from public road projects that sheet flow into the dispersion area is "fully dispersed" if it meets all of the following criteria:

- The dispersion area must be preserved as forest or native vegetation.
- Depth to the average annual maximum ground water elevation should be at least 3 feet.
- The flow path through any impervious area leading to the dispersion area must not be greater than 75 feet.
- The flow path through any pervious area leading to the dispersion area must not be greater than 150 feet. Pervious flow paths include up-gradient road side slopes that run onto the road and down-gradient road side slopes that precede the dispersion area.
- The width of the dispersion area should be equivalent to the width of impervious surface sheet flowing into it.
- Flow path length through the dispersion area:
    - For outwash soils: The following criteria apply to sites (or areas of sites) with outwash soils (Type A – sands and sandy gravels, possibly some Type B – loamy sands). The outwash soils must have an initial saturated hydraulic conductivity rate of 4 inches per hour or greater. The saturated hydraulic conductivity must be based on a Pilot Infiltration Test or the Soil Grain Size Analysis method as identified in V-5.4 Determining the Design Infiltration Rate of the Native Soils, or another method as allowed by the local government.

        - If the impervious area has a flow path length of up to 20 feet, the flow path length through the dispersion area must be at least 10 feet.
        - If the impervious area has a flow path length greater than 20 feet, the flow path length through the dispersion area must be 10 feet, plus an additional 0.25 feet for every 1 foot of impervious flow path length beyond the initial 20 feet.
    - For other soils: The following criteria apply to sites (or areas of sites) with soils other than those described in the bullet above (Types C and D and some Type B not meeting the criterion described in the bullet above).
        - For every 1 foot of flow path length across the impervious surface, the flow path length through the dispersion area must be 6.5 feet.
        - The minimum flow path length through the dispersion area is 100 feet.
- The lateral slope of the impervious area should be less than 8%.
- Road side slopes must be less than 25%. Road side slopes do not count as part of the dispersion area unless native vegetation is re-established and slopes are less than 15%. Road shoulders that are paved or graveled to withstand occasional vehicle loading count as impervious surface.
- Longitudinal slope of road should be ≤ 5%.
- The average longitudinal (parallel to road) slope of dispersion area should be less than or equal to 15%.
- The average lateral slope of dispersion area should be less than or equal to 15%.

Full Dispersion of Channelized (Collected and Re-dispersed) Stormwater into the Dispersion Area

The runoff from public road projects that is collected and re-dispersed is "fully dispersed" if it meets all of the following criteria:

- The dispersion area may be either:
    - preserved as forest or native vegetation, or
    - cleared land. This cleared land option may only be used if the site is outside of the Urban Growth Area and does not have a natural or man-made drainage system.
- Depth to the average annual maximum ground water elevation should be at least three feet.
- Channelized flow must be re-dispersed to produce the longest possible flow path.
- Flows must be evenly dispersed across the dispersion area.
- Ditch discharge points with up to 0.2 cfs discharge for the peak 100-year flow shall use rock pads or dispersion trenches to disperse flows into the dispersion area. Ditch discharge points with between 0.2 and 0.5 cfs discharge for the 100-year peak flow shall use dispersion trenches to disperse flows into the dispersion area. See V-1.4.3 Outfall Systems for details on

rock pads and dispersion trenches.

    - Dispersion trenches shall be designed to accept surface flows (free discharge) from a pipe, culvert, or ditch end, shall be aligned perpendicular to the flowpath, and shall have a minimum 2 feet by 2 cross section, 50 feet in length, filled with 3/4-inch to 1 1/2-inch washed rock, and provided with a level notched grade board. Manifolds may be used to split flows up to 2 cfs discharge for the 100-year peak flow between up to 4 trenches. Dispersion trenches shall have a minimum spacing of 50 feet between centerlines.

- Approved energy dissipation techniques may be used.
- Limited to on-site (associated with the road) flows.
- The width of the dispersion area should be equivalent to length of the road from which runoff is collected.
- The average longitudinal and lateral slopes of the dispersion area should be ≤ 8%.
- The slope of any flowpath segment within the dispersion area must be no steeper than 15% for any 20-foot reach of the flowpath segment.
- Flow path length through the dispersion area:
    - For outwash soils: The following criteria apply to sites (or areas of sites) with outwash soils (Type A – sands and sandy gravels, possibly some Type B – loamy sands) that have an initial saturated hydraulic conductivity rate of 4 inches per hour or greater. The saturated hydraulic conductivity must be based on field results using procedures (Pilot Infiltration Test or Soil Grain Size Analysis Method) identified in V-5.4 Determining the Design Infiltration Rate of the Native Soils, or another method as allowed by the local government.
        - The dispersion area should be at least ½ of the impervious drainage area.
    - For other soils: The following criteria apply to sites (or areas of sites) with soils other than those described in the bullet above (Types C and D and some Type B not meeting the criterion in the bullet above).
        - For every 1 foot of flow path length across the impervious surface, the flow path length through the dispersion area must be 6.5 feet.
        - The minimum flow path length through the dispersion area is 100 feet.

Full Dispersion by Engineered Dispersion

The runoff from public road projects is "fully dispersed" if it meets all of the following criteria:

- Stormwater can be dispersed via sheet flow or via collection and re-dispersion in accordance with the techniques for Full Dispersion of Channelized (Collected and Re-dispersed) Storm-water into the Dispersion Area (above).
- The dispersion area should be planted with native trees and shrubs.
- For outwash soils: The following criteria apply to sites (or areas of sites) with outwash soils

(Type A – sands and sandy gravels, possibly some Type B – loamy sands) that have an initial saturated hydraulic conductivity rate of 4 inches per hour or greater. The saturated hydraulic conductivity must be based on field results using procedures (Pilot Infiltration Test or Soil Grain Size Analysis Method) identified in V-5.4 Determining the Design Infiltration Rate of the Native Soils, or another method as allowed by the local government.

    - The dispersion area must be compost amended in accordance with guidelines in BMP T5.13: Post-Construction Soil Quality and Depth. The guidance document *Building Soil: Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington* (Stenn et al., 2016) can be used, or an approved equivalent soil quality and depth specification approved by Ecology.
    - If the impervious area has a flow path length of up to 20 feet, the flow path length through the dispersion area must be at least 10 feet.
    - If the impervious area has a flow path length greater than 20 feet, the flow path length through the dispersion area must be 10 feet, plus an additional 0.25 feet for every 1 foot of impervious flow path length beyond the initial 20 feet.

- For other soils: The following criteria apply to sites (or areas of sites) with soils other than those described in the bullet above (Types C and D and some Type B not meeting the criterion in the bullet above).
- If the dispersion area has Type C or D soils, it
    - The dispersion area must be compost-amended following guidelines in BMP T5.13: Post-Construction Soil Quality and Depth. The guidance document *Building Soil: Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington* (Stenn et al., 2016) can be used, or an approved equivalent soil quality and depth specification approved by Ecology.
    - The dispersion area must have be 6.5 times the area of the surface(s) draining to it.
- The average longitudinal (parallel to road) slope of the dispersion area should be ≤ 15%.
- The average lateral slope of the dispersion area should be ≤ 15%.
- The depth to the average annual maximum ground water elevation should be at least three feet.

Native Vegetation Landscape Specifications

These specifications may be used in situations where an applicant wishes to convert a previously developed surface to a native vegetation landscape for purposes of meeting full dispersion requirements or code requirements for forest retention. Native vegetation landscape is intended to have the soil, vegetation, and runoff characteristics approaching that of natural forestland.

Conversion of a developed surface to native vegetation landscape requires the removal of impervious surface, de-compaction of soils, and the planting of native trees, shrubs, and ground cover in compost-amended soil according to all of the following specifications:

1. Existing impervious surface and any underlying base course (e.g., crushed rock, gravel) must be completely removed from the conversion area(s).
2. Underlying soils must be broken up to a depth of 18 inches. This can be accomplished by excavation or ripping with either a backhoe equipped with a bucket with teeth, or a ripper towed behind a tractor.
3. At least 4 inches of well-decomposed compost must be tilled into the broken up soil as deeply as possible. The finished surface should be gently undulating and must be only lightly compacted.
4. The area of native vegetated landscape must be planted with native species trees, shrubs, and ground cover. Species must be selected as appropriate for site shade and moisture conditions, and in accordance with the following requirements:
    a. Trees: a minimum of two species of trees must be planted, one of which is a conifer. Conifer and other tree species must cover the entire landscape area at a spacing recommended by a professional landscaper or in accordance with local requirements.
    b. Shrubs: a minimum of two species of shrubs should be planted. Space plants to cover the entire landscape area, excluding points where trees are planted.
    c. Groundcover: a minimum of two species of ground cover should be planted. Space plants so as to cover the entire landscape area, excluding points where trees or shrubs are planted.

    For landscape areas larger than 10,000 square feet, planting a greater variety of species than the minimum suggested above is strongly encouraged. For example, an acre could easily accommodate three tree species, three species of shrubs, and two or three species of groundcover.
5. At least 4 inches of hog fuel or other suitable mulch must be placed between plants as mulch for weed control. It is also possible to mulch the entire area before planting; however, an 18-inch diameter circle must be cleared for each plant when it is planted in the underlying amended soil. *Note: Plants and their root systems that come in contact with hog fuel or raw bark have a poor chance of survival.*
6. Plantings must be watered consistently once per week during the dry season for the first two years.
7. The plantings must be well established on at least 90% of the converted area. A minimum of 90% plant survival is required after 3 years.

Conversion of an area that was under cultivation to native vegetation landscape requires a different treatment. Elimination of cultivated plants, grasses and weeds is required before planting and will be required on an on-going basis until native plants are well-established. The soil should be tilled to a depth of 18 inches. A minimum of 8 inches of soil having an organic content of 6 to 12 percent is required, or a four inch layer of compost may be placed on the surface before planting, or 4 inches of

clean wood chips may be tilled into the soil, as recommended by a landscape architect or forester. After soil preparation is complete, continue with steps 4 through 7 above. Placing 4 inches of compost on the surface may be substituted for the hog fuel or mulch. For large areas where frequent watering is not practical, bare-root stock may be substituted at a variable spacing from 10 to 12 feet o.c. (with an average of 360 trees per acre) to allow for natural groupings and 4 to 6 feet o.c. for shrubs. Allowable bare-root stock types are 1-1, 2-1, P-1 and P-2. Live stakes at 4 feet o.c. may be substituted for willow and red-osier dogwood in wet areas.

Runoff Model Representation

Areas that are fully dispersed do not have to use approved runoff models to demonstrate compliance. They are presumed to fully meet the Runoff Treatment and Flow Control requirements in I-3.4.6 MR6: Runoff Treatment and I-3.4.7 MR7: Flow Control.