Stormwater Pollution Prevention Plan

For

Terrestrial Geotechnical Investigations, Pacific International Terminals, Inc. property

Prepared For
Northwest Regional Office
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Bellevue, WA 98008-5452
425-649-7000

Owner	Developer	Operator/Contractor
Pacific International Terminals, Inc.	Pacific International Terminals, Inc.	Pacific International Terminals, Inc.
1131 SW Klickitat Way	1131 SW Klickitat Way	1131 SW Klickitat Way
Seattle, Washington 98134	Seattle, Washington 98134	Seattle, Washington 98134

Project Site Location
Adjacent to the Strait of Georgia, north of Henry Road, south of Aldergrove Road, and west of Kickerville Road near Ferndale in Whatcom County, Washington.

Certified Erosion and Sediment Control Lead
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SWPPP Prepared By
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June 27, 2011
December 31, 2011

Contents

1.0 INTRODUCTION

This Stormwater Pollution Prevention Plan (SWPPP) has been prepared as part of the NPDES stormwater permit requirements for the Terrestrial Geotechnical Investigation and site clearing at property owned by Pacific International Terminals, Inc., near Ferndale, Washington. The Geotechnical Investigation began in early July 2011, but work was stopped because various permits and approvals were determined to be needed.

The study area for the geotechnical investigation is located 18 miles northwest of Bellingham and 10 miles west of Ferndale (**Appendix A: A-1**). The area is approximately 1,200 acres in size. The project site covers portions of Sections 17, 18, and 19 of Township 39 North, Range 1 East, all in unincorporated Whatcom County. The project site is accessible from I-5 via Highway 548 (Grandview Road) west, and left on Kickerville Road.

Roughly rectangular in shape, the study area is bounded by County roads and industrial operations to the north, east, and south, and by the Strait of Georgia to the southwest:

- BP's Cherry Point refinery property is adjacent to the north and west;
- 70 acres owned by BP lie to the northwest;
- Kickerville Road, populated by private residences on approximately 5 acre plats, lies to the east;
- Pastures owned by others lie to the south;
- DNR lands lie to the northeast; and
- The Strait of Georgia lies to the south and southwest.

Investigation activities include advancing approximately 50 boreholes and 19 cone penetration tests (CPTs), creating approximately 22,400 feet of access paths for track-mounted equipment, and performing restoration work.

The purpose of this SWPPP is to describe the proposed activities and all temporary and permanent erosion and sediment control (TESC) measures, pollution prevention measures, inspection/monitoring activities, and recordkeeping that will be implemented during the proposed construction project. The SWPPP will be used and followed prior to receipt of an approval under the State General Stormwater Approval.

The objectives of this SWPPP are to:

1. Identify the appropriate Best Management Practices (BMPs) to be implemented that prevent erosion and sedimentation, and to identify, reduce, eliminate or prevent stormwater contamination and water pollution from construction activity.
2. Provide direction to field efforts so that actions are taken which prevent violations of surface water quality, ground water quality, or sediment management standards.

This SWPPP was prepared following the Ecology SWPPP Template downloaded from the Ecology website on August 9, 2011. The template was prepared based on the requirements set forth in the *Construction Stormwater General Permit* and the *Stormwater Management Manual for Western Washington* (SWMMWW 2005). The report is divided into seven main sections with several appendices that include stormwater related reference materials. The topics presented in the each of the main sections are:

1. Section 1 – INTRODUCTION. This section provides a summary description of the project, and the organization of the SWPPP document.
2. Section 2 – SITE DESCRIPTION. This section provides a detailed description of the existing site conditions, proposed construction activities, and calculated stormwater flow rates for existing conditions and post–construction conditions.
3. Section 3 – CONSTRUCTION BMPs. This section provides a detailed description of the BMPs to be implemented based on the 12 required elements of the SWPPP (SWMMWW 2005).
4. Section 4 – CONSTRUCTION PHASING AND BMP IMPLEMENTATION. This section provides a description of the timing of the BMP implementation in relation to the project schedule.
5. Section 5 – POLLUTION PREVENTION TEAM. This section identifies the appropriate contact names (emergency and non-emergency), monitoring personnel, and the on-site temporary erosion and sedimentation control inspector
6. Section 6 – INSPECTION AND MONITORING. This section provides a description of the inspection and monitoring requirements such as the parameters of concern to be monitored, sample locations, sample frequencies, and sampling methods for all stormwater discharge locations from the site.
7. Section 7 – RECORDKEEPING. This section describes the requirements for documentation of the BMP implementation, site inspections, monitoring results, and

changes to the implementation of certain BMPs due to site factors experienced during construction.

Supporting documentation and standard forms are provided in the following Appendices:

Appendix A – Geotechnical Investigation Temporary Erosion and Sediment Control plan
Appendix B – Construction BMPs
Appendix C – General Permit – *Once Received.*

1.1 EXISTING CONDITIONS

The study area is located on a relatively flat plateau adjacent to the Strait of Georgia in Whatcom County, Washington. The area roughly lies north of Henry Road, south of Aldergrove Road and west of Kickerville Road and covers roughly 1,200 acres.

The property is currently undeveloped, although some portions of the area are used for agriculture, including pastures and hayfields. The only impervious surfaces in the vicinity are rural County roads. Stormwater from these roadways drains to open roadside ditches. No other stormwater facilities, such as catch basins, exist in the vicinity.

Other features in the vicinity include an underground oil pipeline and a Bonneville Power Administration transmission line, which cross the project area approximately north to south. BNSF Railway's Custer Spur line transects the eastern edge of the project area.

Topography of the site is mostly flat. Subsurface conditions consist of reworked glaciomarine drift, clayey glaciomarine drift, Vashon Stade advance outwash, and Cherry Point silt. The glaciomarine drift is typical of normally consolidated silt and clay; the upper portion of the glaciomarine drift is typically stiff from desiccation or partial ice contact loading and grades to medium stiff or soft with depth. The advance outwash and Cherry Point silt are glacially consolidated and dense to very dense/hard.

Stormwater on the property generally infiltrates to soil. Streams and roadside ditches generally have no flows in the summer. During heavy prolonged rainfall, such as in late fall and early winter, soils become saturated and stormwater discharge occurs to wetlands and streams by sheetflow and throughflow. Stormwater also discharges from roadways to roadside ditches.

Because there are no impervious surfaces on the property, no stormwater control systems exist. No new impervious surface results from the geotechnical investigation or restoration of cleared areas.

The southern extent of the project site is adjacent to the Strait of Georgia. There are 7 streams within the project vicinity. Streams 1 (WRIA # 01.0100) and 2 (WRIA # 01.0101) are first order streams and flow into the Strait of Georgia. Streams 3 through 7 flow in County roadside ditches and drain to either Stream 1 or 2. The only fish-bearing stream on site is the lowest reach of Stream 1 south of Henry Road (Type Fs). Nine additional drainages flow in the vicinity and drain to one of the roadside streams or Stream 1 or 2. None of these drainages (Stream 1 north of Henry Road, Stream 2, all other Streams and Ditches) support fish.

Wetlands are found in the project area. Wetlands 1, 4B, 4C, 5B, 7B, 8B, 10B, 11B, 12, 13C, 13F, 13G, and 14 are depressional wetlands. Wetlands 2, 3, 4A, 4D, 4E, 4F, 5A, 5C, 6, 7A, 8A, 9A&C, 10A, and 13D are slope wetlands. Wetlands 11A, 13A, and 13E are riverine wetlands. Most of the wetlands are Class III, with the exception of wetlands in the lower reach of Stream 1 (Class II) and the coastal lagoon (Class I).Wetlands are associated with roadside drainages or to Streams 1 or 2, although there are almost no point discharges from the wetlands.

1.2 PROPOSED CONSTRUCTION ACTIVITIES

The project includes clearing, geotechnical investigation, and restoration activities.

The proposed geotechnical investigation program entails advancing approximately 50 boreholes and 19 cone penetration tests (CPT) to evaluate subsurface soil and groundwater conditions at the site that are critical for design of future development. Boreholes are generally about 8 inches in diameter, and extend between 80 and 130 feet deep. The CPT explorations push a 1.4-inch-diameter rod into the ground to depths up to about 100 feet. No excavation is required for the CPT explorations and the rods are removed immediately upon completion of the exploration. The locations of explorations are scattered throughout the site, but are generally to be in the areas of proposed development as shown in the Geotechnical Investigation Plan.

Access paths were cleared in July 2011. Access paths with exposed soils will be covered using hydroseeding. Site entrances will be stabilized if they are not already stabilized.

Once agency approvals are received the geotechnical investigation will resume. Following completion of geotechnical investigation, cleared access paths will be restored. Restoration of access paths in both upland and wetland areas is planned. In wetland areas, side cast rootwads and some side cast root mats with soil will be moved to the clearings. Plantings appropriate to forested wetlands or shrub areas will be installed. Restoration in upland areas will include planting tree seedlings to accomplish reforestation at a stocking rate of 190 stems per acre by 2014 to meet Department of Natural Resources (DNR) reforestation requirements.

The following summarizes details regarding site areas:

Total site area:	~1,200 acres
Percent impervious area before project:	0.0%
Percent impervious area after project:	0.0%
Disturbed area during investigation:	9.2 acres
Disturbed area that is characterized as impervious (i.e., access roads, staging, parking):	0 acres

2.0 CONSTRUCTION STORMWATER BMPS

2.1 THE 12 BMP ELEMENTS

This SWPPP will be modified whenever there is a change in the design, construction, operation, or maintenance at the geotechnical project site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.

Element #1 – Mark Clearing Limits

Borehole locations were determined and located by survey onsite. Clearing of paths was accomplished by pushing over vegetation in a 17-foot-wide corridor between marked borehole locations.

To avoid wetlands, streams, and buffers and minimize clearing disturbance, access routes were drawn onto base maps and evaluated prior to field work. It was not practicable to locate the proposed geotechnical boreholes with complete avoidance of wetlands because much of the area is wetland and geotechnical data is needed for subsurface conditions in those locations. Wetland boundaries were located in the field with pink “wetland delineation” flagging. However, to the extent feasible, proposed geotechnical boreholes were located outside of wetland and heavily vegetated areas in order to avoid direct vegetation impacts. When a boring hole was located within a wetland, existing roads and pastures and hayfields were used as access routes to the extent possible to minimize vegetation disturbance throughout the property. Only when no other alternative could be identified were access routes placed through forested or shrub vegetated wetland areas.

No further clearing activities are anticipated. However should any be determined to be required, appropriate authorization will be obtained. Clearing limits would be clearly marked with flagging prior to initiation of any future clearing. In addition the following BMPs will be used

- Preserving Natural Vegetation (BMP C101)

Element #2 – Establish Construction Access

Erosion control installation, geotechnical borings, and site restoration will require access from County roads (4 locations) and access from other roads located behind gates that bar public access (approximately 8 locations).

The BMP to be employed at all of these locations is:

- Stabilized Construction Entrance (BMP C105)
- Preserving Native Vegetation (BMP C101)

Entrances will be stabilized using quarry spalls or wood chips placed to prevent tracking of dirt onto County roads. Access from public roads will cross an approximate 100 foot-long strip of quarry spalls or wood chips, where appropriate. Where wetlands are adjacent to entrances, temporary metal plates will be placed to protect soils. Existing native vegetation adjacent to access points will be protected and provide additional soil stabilization near entrances.

If soil materials are tracked onto County Roads, roads will be thoroughly cleaned daily or more frequently during wet weather, to prevent soil materials washing into adjacent roadways. Soil materials will be removed by shovel and disposed of in an appropriate upland location disposal area away from water.

Element #3 – Control Flow Rates

Stormwater will infiltrate or disperse to vegetated areas. The property has no pollution generating impervious surfaces. In addition, most portions of the area, vegetated buffers provide infiltration capacity and protection from sedimentation to roadside ditches. No land conversion occurs as a result of clearing temporary access paths for the geotechnical investigation. The geotechnical investigation will result in no construction of pollution generating impervious surfaces.

The specific BMPs to be used for controlling flow on this project include:

- Interceptor Dike and Swale (C200)

If specific areas are determined to be likely to discharge concentrated stormwater from areas of exposed soils, interception dike and swales would be installed and used to redirect water to preferably vegetated locations that allow sediment trapping and infiltration.

Element #4 – Install Sediment Controls

Stormwater runoff from disturbed areas shall pass through an appropriate sediment removal BMP before leaving the construction site or prior to being discharged to an infiltration facility.

The specific BMPs to be used for controlling sediment on this project include:

- Mats and Blankets (BMP C122)
- Temporary and Permanent Seeding (BMP C120)
- Check Dams (C207)
- Channel Lining (C202)

Soils will be stabilized through revegetation including hydroseeding, seeding, and natural regeneration. Mats and blankets will be used to cover exposed soils in appropriate locations that require additional stabilization such as near ditches or slopes.

Check dams will be constructed in roadside drainage ditches adjacent to where construction entrances are located. In addition, sediment will be removed from paved areas in and adjacent to construction work areas manually or using mechanical sweepers, as needed, to minimize tracking of sediments on vehicle tires away from the site and to minimize wash-off of sediments from adjacent streets in runoff.

Element #5 – Stabilize Soils

Exposed and unworked soils shall be stabilized with the application of effective BMPs to prevent erosion throughout the life of the project. The specific BMPs for soil stabilization that shall be used on this project include:

- Temporary and Permanent Seeding (BMP C120)
- Mats and Blankets (BMP C122)

Temporary seeding will be applied to all exposed soil in access roads. It will be applied at an application rate of 1,500 pounds per acre of wood fiber mulch, 150 pounds per acre of wet area seed, 200 pounds per acre of 25-5-15 fertilizer, and 15 pounds per acre of tackifier. No water is available onsite for the application and must be obtained in the vicinity of Ferndale. Access

paths will be inspected for excessive rutting prior to hydroseeding and remedied by hand raking, if needed. Irrigation of the hydroseed is not proposed. The seed mixtures are intended to germinate once there is enough natural moisture in the air (e.g., dew, fog, or rain); in the interim, the wood fiber mulch and tackifier control any dust.

Mats will be placed over sensitive areas where vehicle transport is required such as construction entrances that cross drainage ditches, agricultural drainages adjacent to the construction activities, and areas in which rutting may occur.

The project site is located west of the Cascade Mountain Crest. As such, no soils shall remain exposed and unworked for more than 7 days during the dry season (May 1 to September 30) and 2 days during the wet season (October 1 to April 30). Regardless of the time of year, all soils shall be stabilized at the end of the shift before a holiday or weekend if needed based on weather forecasts.

Prior to hydroseeding, access paths are to be inspected for excessive rutting prior to and remedied. Vehicular traffic associated with this action will be restricted to only the access paths and will not extend onto any additional surface areas not already tracked. Use of mats to span across sensitive areas for vehicle transport will be required to prevent additional rutting. Turning of equipment will be limited to avoid additional rutting.

Element #6 – Protect Slopes

The site is fairly level, but where short slopes occur, slopes will be stabilized if bare soils are exposed. One area of slope is the Stream 1 ravine north of Henry Road. In this area and other areas as needed, slope protection will include the following BMPs:

- Temporary and Permanent Seeding (BMP C120)
- Mats and Blankets (BMP C122)
- Preserving Natural Vegetation (C101)

Hydroseeding and/or seeding will be used to stabilize soils. Where additional protection is needed, mats or blankets will be installed to protect soils from washing into stormwater. For the slope adjacent to the Stream 1 ravine, native vegetation will be preserved along the slope.

Element #7 – Protect Drain Inlets

There are no drain inlets located on the project site. There are no storm drain inlets near the site that could potentially receive surface runoff from the construction site. There is no stormwater system on-site as the site is undeveloped and has no impervious surfaces. County stormwater

conveyance on adjacent roadways is comprised of open roadside ditches and no drains have been installed. Non-the-less, the first priority is to keep all paved roads clean of sediment.

Element #8 – Stabilize Channels and Outlets

Any channels located within the cleared areas will be stabilized with one of the following BMPs:

- Temporary and Permanent Seeding (BMP C120)
- Mats and Blankets (BMP C122)
- Preserving Natural Vegetation (BMP C101)
- Grass lined Channels (BMP C201)

Most of the channels adjacent to county roadways are lined with vegetation and this vegetation will be preserved. The established grass-lined channels provide soil stability and filtration capacity to stormwater.

Element #9 – Control Pollutants

Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well organized, and free of debris. All vehicles and other equipment will be inspected regularly to detect any leaks or spills, and to identify maintenance needs to prevent leaks or spills. Spill prevention measures, such as drip pans, will be used when conducting maintenance and repair of vehicles or equipment. In order to perform emergency repairs on site, temporary plastic will be placed beneath and, if raining, over the vehicle. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident.

Chemical storage

Any chemicals stored in the construction areas will conform to the appropriate source control BMPs listed in Volume IV of the Ecology stormwater manual. In Western WA, all chemicals shall have cover, containment, and protection provided on site, per BMP C153 for Material Delivery, Storage and Containment in SWMMWW 2005

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

Solid Waste

Solid waste will be stored in secure, clearly marked containers.

Other

Other BMPs will be administered as necessary to address any additional pollutant sources on site.

Element #10 – Control Dewatering

There will be no dewatering as part of the geotechnical investigation or restoration.

Element #11 – Maintain BMPs

All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with each particular BMPs specifications.

Visual monitoring of the BMPs will be conducted at least once every calendar week and within 24 hours of any stormwater or non-stormwater discharge from the site. If the site becomes inactive, and is temporarily stabilized, the inspection frequency will be reduced to once every month. All temporary erosion and sediment control BMPs shall be removed within 30 days after the final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

Element #12 – Manage the Project

Erosion and sediment control BMPs for this project have been designed based on the following principles:

- Design the project to fit the existing topography, soils, and drainage patterns.
- Emphasize erosion control rather than sediment control.
- Minimize the extent and duration of the area exposed.
- Keep runoff velocities low.
- Retain sediment on site.
- Thoroughly monitor site and maintain all ESC measures.
- No major earthwork.

As this project site is located west of the Cascade Mountain Crest, the project will be managed according to the following key project components:

Phasing of Construction

The construction project is being phased to the extent practicable in order to prevent soil erosion, and, to the maximum extent possible, the transport of sediment from the site during construction.

Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities during each phase of construction, per the Scheduling BMP (C 162).

Seasonal Work Limitations

From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the local permitting authority that silt-laden runoff will be prevented from leaving the site through a combination of the following:

- Site conditions including existing vegetative coverage, slope, soil type, and proximity to receiving waters;
- Limitations on activities and the extent of disturbed areas; and
- Proposed erosion and sediment control measures.

Based on the information provided and/or local weather conditions, the local permitting authority may expand or restrict the seasonal limitation on site disturbance.

The following activities are exempt from the seasonal clearing and grading limitations:

- Routine maintenance and necessary repair of erosion and sediment control BMPs;
- Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil; and
- Activities where there is 100 percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

Coordination with Utilities and Other Jurisdictions

Care has been taken to coordinate with utilities, other construction projects, and the local jurisdiction in preparing this SWPPP and scheduling the construction work.

Inspection and Monitoring

All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. Site inspections shall be conducted by a person who is

knowledgeable in the principles and practices of erosion and sediment control. This person has the necessary skills to:

- Assess the site conditions and construction activities that could impact the quality of stormwater.
- Assess the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.

A Certified Erosion and Sediment Control Lead shall be on-site or on-call at all times. Whenever inspection and/or monitoring reveals that the BMPs identified in this SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, appropriate BMPs or design changes shall be implemented as soon as possible.

Maintaining an Updated Construction SWPPP

This SWPPP shall be retained on-site or within reasonable access to the site.

This SWPPP shall be modified whenever there is a change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.

This SWPPP shall be modified if, during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site.

This SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) days following the inspection.

Site Specific BMPs

Site specific BMPs are shown on the TESC Plan Sheets and Details in Appendix A.

The following notes are included:

- The implementation of these ESC plans and the construction, maintenance, replacement, and upgrading of these ESC facilities is the responsibility of the applicant/contractor until all construction is completed and approved and vegetation/landscaping is established.

- The ESC facilities shown on this plan must be constructed in such a manner as to insure that sediment and sediment laden water do not enter the drainage system, roadways, or violate applicable water standards.
- Stabilized construction entrances shall be installed and maintained for the duration of the project. Additional measures may be required to insure that all paved areas are kept clean for the duration of the project.
- The ESC facilities shown on this plan are the minimum requirements for anticipated site conditions. During the construction period, these ESC facilities shall be upgraded as needed for unexpected storm events and to ensure that sediment and sediment-laden water do not leave the site.
- The ESC facilities shall be inspected daily by the applicant/contractor and maintained as necessary to ensure their continued functioning.
- These site specific plan sheets will be updated as needed.

Alternate BMPs are included in the Stormwater Management Manual for Western Washington: Volume II Construction Stormwater Pollution Prevention as a reference for the onsite inspector in the event the BMP(s) listed above are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in the General NPDES Permit (Appendix C). To avoid potential erosion and sediment control issues that may cause a violation(s) of the NPDES Construction Stormwater permit (as provided in Appendix C), the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs after the first sign that existing BMPs are ineffective or failing.

3.0 CONSTRUCTION PHASING AND BMP IMPLEMENTATION

The project site is located west of the Cascade Mountain Crest. As such, the dry season is considered to be from May 1 to September 30 and the wet season is considered to be from October 1 to April 30.

Construction start date	7/05/2011
Estimate of project completion	To be determined
Cleared access paths start	7/05/2011
Geotechnical investigation start	7/07/2011
Geotechnical investigation stop	7/22/2011
Site inspections and monitoring to be conducted beginning	9/01/2011
Mobilize equipment on-site	8/26/2011
Mobilize and store all ESC and soil stabilization products	8/26/2011
Install stabilized construction entrances	8/26/2011
Temporary erosion control measures	8/29/2011

Wet season starts	10/1/2011
Further geotechnical investigation	To be determined
Begin restoration activities	To be determined
Permanent erosion control measures	To be determined

4.0 POLLUTION PREVENTION TEAM

4.1 ROLES AND RESPONSIBILITIES

The pollution prevention team consists of personnel responsible for implementation of the SWPPP, including the following:

Certified Erosion and Sediment Control Lead (CESCL) – primary contractor contact, responsible for site inspections (BMPs, visual monitoring, sampling, etc.); to be called upon in case of failure of any ESC measures.

Resident Engineer – For projects with engineered structures only (sediment ponds/traps, sand filters, etc.): site representative for the owner that is the project's supervising engineer responsible for inspections and issuing instructions and drawings to the contractor's site supervisor or representative

Emergency Ecology Contact – individual to be contacted at Ecology in case of emergency.

Emergency Owner Contact – individual that is the site owner or representative of the site owner to be contacted in the case of an emergency.

Non-Emergency Ecology Contact – individual that is the site owner or representative of the site owner than can be contacted if required.

Monitoring Personnel – personnel responsible for conducting water quality monitoring; for most sites this person is also the Certified Erosion and Sediment Control Lead.

4.2 TEAM MEMBERS

Names and contact information for those identified as members of the pollution prevention team are provided in the following table.

Title	Name(s)	Phone Number
Certified Erosion and Sediment Control Lead (CESCL)	Al Jeroue, P.E. Pacific International Terminals, Inc.	253.627.0406

Resident Engineer	Al Jeroue, P.E.	253.627.0406
Emergency Ecology Contact	Kurt Baumgarten	360.715.5200
Emergency Owner Contact	Skip Sahlin or	206.654.3510
	Ari Steinberg, Pacific International Terminals, Inc.	206.654.3689
Non-Emergency Ecology Contact	Shawn Hopkins	360.407.6442
Monitoring Personnel	Al Jeroue	253.627.0406

5.0 SITE INSPECTIONS AND MONITORING

Monitoring includes visual inspection, monitoring for water quality parameters of concern, and documentation of the inspection and monitoring findings in a site log book. A site log book will be maintained for all on-site construction activities and will include:

- A record of the implementation of the SWPPP and other permit requirements;
- Site inspections; and,
- Stormwater quality monitoring.

The site monitoring log is bound separately and will be maintained within reasonable access to the site and be made available upon request to Ecology or the local jurisdiction.

5.1 SITE INSPECTION

All BMPs will be inspected, maintained, and repaired as needed to assure continued performance of their intended function. Site inspections will be conducted by a person who is knowledgeable in the principles and practices of erosion and sediment control. The onsite inspector will have the skills to assess the potential for water quality impacts as a result of the type of construction activities occurring on site, and the knowledge of the appropriate and effective ESC measures needed to control the quality of stormwater discharges.

All BMPs will be inspected, maintained, and repaired as needed to assure continued performance of their intended function. The inspector will be a Certified Erosion and Sediment Control Lead (CESCL) per BMP C160. The name and contact information for the CESCL is provided in Section 4 of this SWPPP.

Site inspection will occur in all areas disturbed by construction activities and at all pre-determined sampling points. Stormwater will be examined for the presence of suspended sediment, turbidity, discoloration, and oily sheen. The site inspector will evaluate and document the effectiveness of the installed BMPs and determine if it is necessary to repair or replace any

of the BMPs to improve the quality of stormwater discharges. All maintenance and repairs will be documented in the site log book or forms provided in this document. All new BMPs or design changes will be documented in the SWPPP as soon as possible.

5.2 SITE INSPECTION FREQUENCY

Site inspections will be conducted at least once a week and within 24 hours following any discharge from the site. For sites with temporary stabilization measures, the site inspection frequency can be reduced to once every month if the site operator has successfully applied for inactive status for the site using the Permit Fee Activity Status Change Form, which can be found at the following web site:
http://www.ecy.wa.gov/programs/wq/permits/permit_fees/ConstructionActivityStatusChangeForm.pdf

5.3 SITE INSPECTION DOCUMENTATION

The site inspector will record each site inspection using the site log inspection forms provided in the site log book and on-line.

5.4 STORMWATER QUALITY MONITORING

When stormwater is observed leaving the property into roadside drainages, samples will be taken of flows leaving the site. Sampling points will generally be located where concentrated flows are observed leaving the property.

Turbidity Sampling

Monitoring requirements for the proposed project will include either turbidity or water transparency sampling to monitor site discharges for water quality compliance with the 2005 Construction Stormwater General Permit. Sampling will be conducted at all discharge points at least once per calendar week. Turbidity or transparency monitoring will follow the analytical methodologies described in Section S4 of the 2005 Construction Stormwater General Permit.

The key benchmark values that require action are 25 nephelometric turbidity units (NTU) for turbidity (equivalent to 32 cm transparency) and 250 NTU for turbidity (equivalent to 6 cm transparency). If the 25 NTU benchmark for turbidity (equivalent to 32 cm transparency) is exceeded, the following steps will be conducted:

1. Ensure all BMPs specified in this SWPPP are installed and functioning as intended.
2. Assess whether additional BMPs should be implemented, and document revisions to the SWPPP as necessary.

3. Sample discharge location daily until the analysis results are less than 25 NTU (turbidity) or greater than 32 cm (transparency).

If the turbidity is greater than 25 NTU (or transparency is less than 32 cm) but less than 250 NTU (transparency greater than 6 cm) for more than 3 days, additional treatment BMPs will be implemented within 24 hours of the third consecutive sample that exceeded the benchmark value. Additional treatment BMPs to be considered will include, but are not limited to, off-site treatment, infiltration, filtration and chemical treatment.

If the 250 NTU benchmark for turbidity (or less than 6 cm transparency) is exceeded at any time, the following steps will be conducted:

1. Notify Ecology by phone within 24 hours of analysis (see Section 5.0 of this SWPPP for contact information).
2. Continue daily sampling until the turbidity is less than 25 NTU (or transparency is greater than 32 cm).
3. Initiate additional treatment BMPs such as off-site treatment, infiltration, filtration and chemical treatment within 24 hours of the first 250 NTU exceedance.
4. Implement additional treatment BMPs as soon as possible, but within 7 days of the first 250 NTU exceedance.
5. Describe inspection results and remedial actions taken in the site log book and in monthly discharge monitoring reports as described in Section 7.0 of this SWPPP.

pH Sampling

No pH sampling is anticipated because no concrete or engineered soils are planned to be installed. However, if concrete or engineer soils are installed Stormwater runoff will be monitored for pH starting on the first day of any activity that includes more than 40 yards of poured or recycled concrete, or after the application of “Engineered Soils” such as, Portland cement treated base, cement kiln dust, or fly ash. This does not include fertilizers. For concrete work, pH monitoring will start the first day concrete is poured and continue until 3 weeks after the last pour. For engineered soils, the pH monitoring period begins when engineered soils are first exposed to precipitation and continue until the area is fully stabilized.

Stormwater samples will be collected daily from all points of discharge from the site and measured for pH using a calibrated pH meter, pH test kit, or wide range pH indicator paper. If the measured pH is 8.5 or greater, the following steps will be conducted:

1. Prevent the high pH water from entering storm drains or surface water.
2. Adjust or neutralize the high pH water if necessary using appropriate technology such as CO_2 sparging (liquid or dry ice).
3. Contact Ecology if chemical treatment other than CO_2 sparging is planned.

6.0 REPORTING AND RECORDKEEPING

6.1 RECORDKEEPING

Site Log Book

A site log book will be maintained for all on-site construction activities and will include:
A record of the implementation of the SWPPP and other permit requirements;

- Site inspections (Ecology's site inspection checklist is included in Appendix D); and,
- Stormwater quality monitoring.

Records Retention

Records of all monitoring information (site log book, inspection reports/checklists, etc.), this Stormwater Pollution Prevention Plan, and any other documentation of compliance with permit requirements will be retained during the life of the construction project and for a minimum of three years following the termination of permit coverage in accordance with permit condition S5.C.

Access to Plans and Records

The SWPPP, General Permit, Notice of Authorization letter, and Site Log Book will be retained on site or within reasonable access to the site and will be made immediately available upon request to Ecology or the local jurisdiction. A copy of this SWPPP will be provided to Ecology within 14 days of receipt of a written request for the SWPPP from Ecology. Any other information requested by Ecology will be submitted within a reasonable time. A copy of the SWPPP or access to the SWPPP will be provided to the public when requested in writing in accordance with permit condition S5.G.

Updating the SWPPP

In accordance with Conditions S3, S4.B, and S9.B.3 of the General Permit, this SWPPP will be modified if the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site or there has been a change in design, construction, operation, or maintenance at the site that has a significant effect on the discharge, or potential for discharge, of pollutants to the waters of the State. The SWPPP will be modified within 7 days

of determination based on inspection(s) that additional or modified BMPs are necessary to correct problems identified, and an updated timeline for BMP implementation will be prepared.

7.0 REPORTING

7.1 DISCHARGE MONITORING REPORTS

Discharge Monitoring Reports (DMRs) will be submitted to Ecology monthly via the WAWebDMR system. If there was no discharge during a given monitoring period, Pacific International Terminals, Inc. shall submit the form as required, with the words “No discharge” entered in the place of monitoring results.

The DMR due date is 15 days following the end of each month.

7.2 NOTIFICATION OF NONCOMPLIANCE

If any of the terms and conditions of the permit are not met, and it causes a threat to human health or the environment, the following steps will be taken in accordance with permit section S5.F:

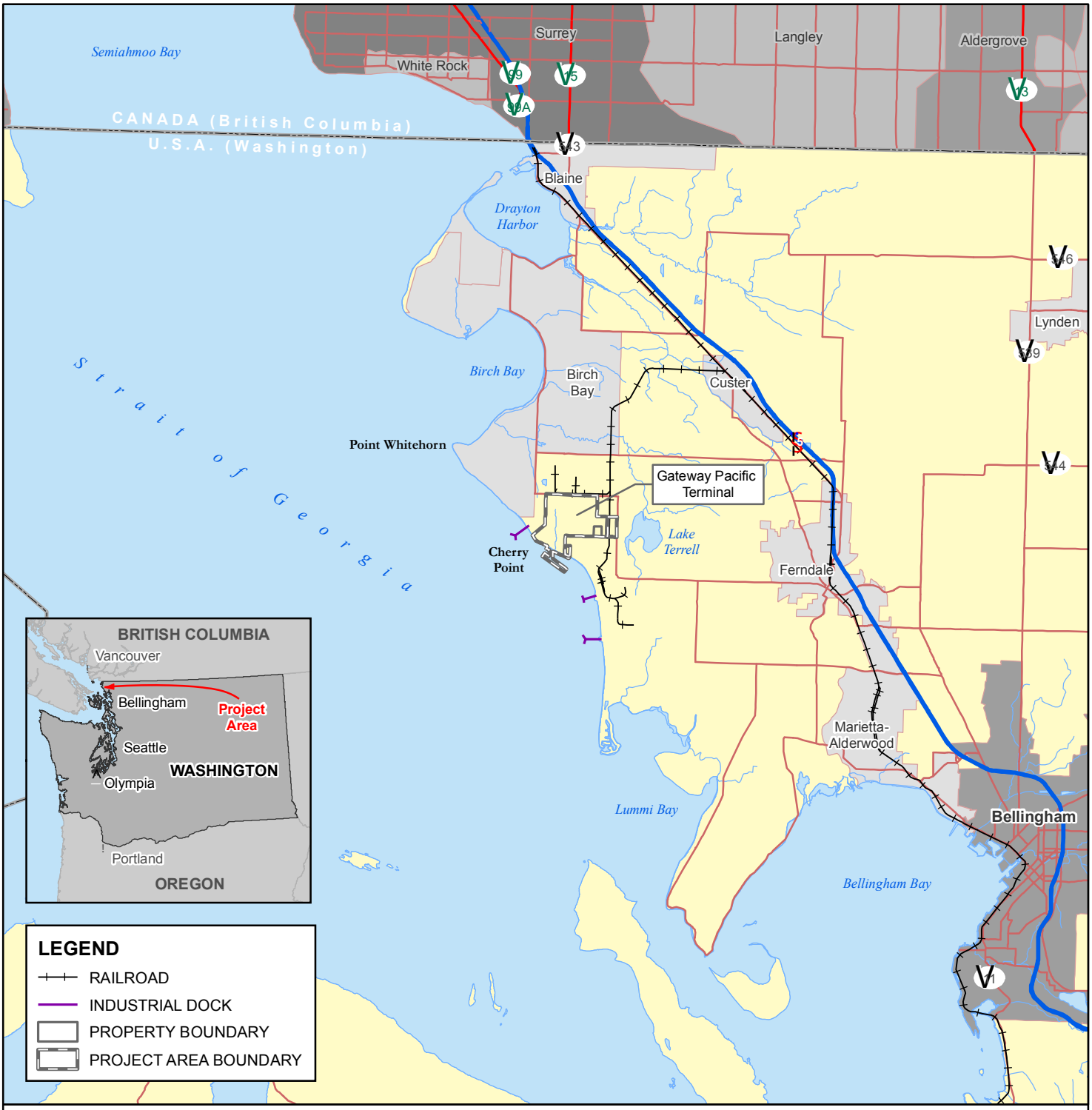
Ecology will be immediately notified of the failure to comply.

Immediate action will be taken to control the noncompliance issue and to correct the problem. If applicable, sampling and analysis of any noncompliance will be repeated immediately and the results submitted to Ecology within five (5) days of becoming aware of the violation.

A detailed written report describing the noncompliance will be submitted to Ecology within five (5) days, unless requested earlier by Ecology.

In accordance with permit condition S2.A, a complete application form will be submitted to Ecology and the appropriate local jurisdiction (if applicable) to be covered by the General Permit.

APPENDIX A – SITE PLAN

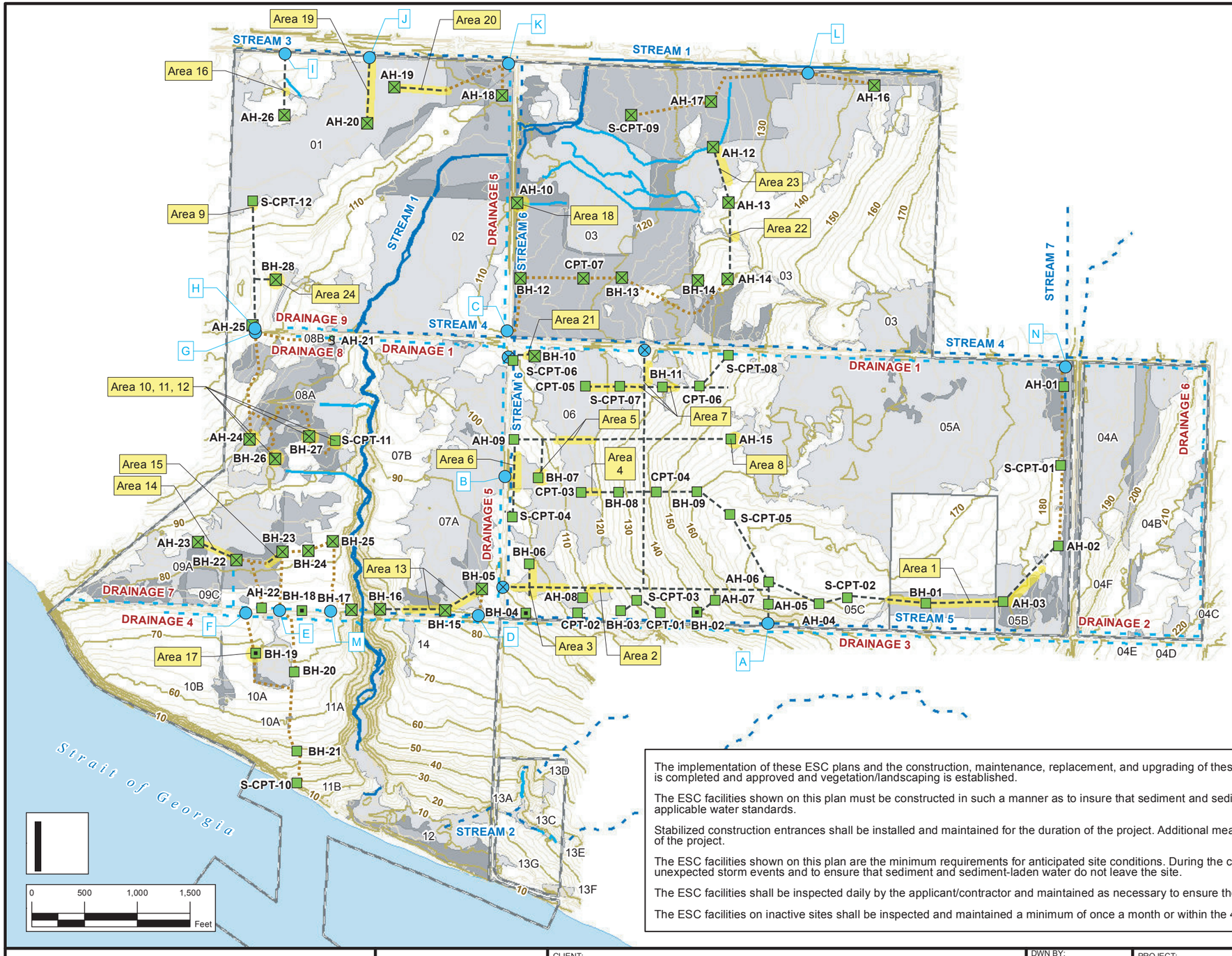


AMEC Earth & Environmental
11810 North Creek Parkway N
Bothell, WA 98011

CLIENT:
PACIFIC INTERNATIONAL TERMINALS, INC.

PROJECT: GATEWAY PACIFIC TERMINAL GEOTECHNICAL INVESTIGATION	DWN BY: SD	DATUM: NAD83	DATE: AUGUST 2011
TITLE: VICINITY MAP	CHK'D BY: CS	REV. NO.: 1	PROJECT NO.: 091515338C-07-03
	PROJECTION: WA SP North, Ft.	SCALE: 1 inch=3 miles	Appendix A : A-1

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-07-03 - Geotechnical Investigation\Critical_Areas_Report\Figure 1 - Vicinity Map.mxd



LEGEND

- VEHICLE ACCESS POINT - CONSTRUCTION ENTRANCETO BE STABILIZED, IF NOT ALREADY STABILIZED
- NO VEHICLE ACCESS
- BOREHOLE COMPLETED (37)
- BOREHOLE NOT COMPLETE (31)
- BOREHOLE IN PROGRESS (4)
- APPROXIMATE OPEN FIELD BOREHOLE ACCESS**
- AS-BUILT BOREHOLE ACCESS* - ALL CLEARED ACCESS ROUTES TO BE HYDROSEEDED
- APPROXIMATE DRAINAGE
- SURVEYED DRAINAGE
- APPROXIMATE STREAM COURSE
- SURVEYED STREAM COURSE
- CURRENT ELEVATION CONTOUR (10 ft. interval, NAVD88 datum)
- CURRENT ELEVATION CONTOUR (2 ft. interval, NAVD88 datum)
- FRESHWATER EMERGENT WETLAND (PEM)
- FRESHWATER FORESTED WETLAND (PFO)
- FRESHWATER SHRUB WETLAND (PSS)
- WETLAND IMPACT AREA
- PROPERTY BOUNDARY
- PROJECT AREA BOUNDARY

The implementation of these ESC plans and the construction, maintenance, replacement, and upgrading of these ESC facilities is the responsibility of the applicant/contractor until all construction is completed and approved and vegetation/landscaping is established.

The ESC facilities shown on this plan must be constructed in such a manner as to insure that sediment and sediment laden water do not enter the drainage system, roadways, or violate applicable water standards.

Stabilized construction entrances shall be installed and maintained for the duration of the project. Additional measures may be required to insure that all paved areas are kept clean for the duration of the project.

The ESC facilities shown on this plan are the minimum requirements for anticipated site conditions. During the construction period, these ESC facilities shall be upgraded as needed for unexpected storm events and to ensure that sediment and sediment-laden water do not leave the site.

The ESC facilities shall be inspected daily by the applicant/contractor and maintained as necessary to ensure their continued functioning.

The ESC facilities on inactive sites shall be inspected and maintained a minimum of once a month or within the 48 hours following a major storm event.

* THIS LINE DEPICTS LOCATIONS WHERE TREES AND SHRUBS WERE REMOVED TO ALLOW ACCESS FOR GEOTECHNICAL INVESTIGATION.

** ACCESS PATHS THROUGH OPEN FIELDS THAT INVOLVED NO CLEARING OR BLADING. PATHS SHOWN AS APPROXIMATE, AS THE TRUCKS ACCESSING THE DRILLING POINTS VARIED THEIR PATHS OVER THESE SECTIONS SO AS TO MINIMIZE VEGETATION IMPACTS AND AVOID RUTTING THE SOIL.

Pacific International Terminals
A Carrix Enterprise

CLIENT: PACIFIC INTERNATIONAL TERMINALS, INC.

AMEC Earth & Environmental
11810 North Creek Parkway N
Bothell, WA 98011

DWN BY: SD
CHK'D BY: KD
DATUM: NAD83
PROJECTION: WA SP North, Ft.
SCALE: 1 inch = 1,000 feet

PROJECT: PROPOSED GATEWAY PACIFIC TERMINAL

TITLE: GEOTECHNICAL INVESTIGATION
ACCESS CLEARING: TEMPORARY EROSION AND SEDIMENT CONTROL

DATE: 25th AUGUST 2011
PROJECT NO.: 091515338C-13-07
REV. NO.: 1
APPENDIX A: A-2

K:\AMEC US OFFICES\KIRKLAND\15338-0\15338C\T-07-03 - Geotechnical Investigation\SWPPP\Figure 2 - Geotechnical Investigation Access Clearing Temporary Erosion and Sediment Control.mxd

APPENDIX B – CONSTRUCTION BMPS

- Preserving Natural Vegetation (BMP C101)
- Buffer Zones (BMP C102)
- Stabilized Construction Entrance (BMP C105)
- Temporary and Permanent Seeding (BMP C120)
- Interceptor Dike and Swale (C200)
- Mats and Blankets (BMP C122)
- Check Dams (C207)
- Channel Lining (C202)
- Grass lined Channels (BMP C201)

4.1 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 watercourses or swales, and on building sites in wooded areas.
- As required by local governments.

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 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. A tile

system protects a tree from a raised grade. 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.

  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 madronna 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 lopers 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

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

Conditions of Use

Natural buffer zones are used along streams, wetlands and other bodies of water that need protection from erosion and sedimentation. Vegetative buffer zones can be used to protect natural swales and can be incorporated into the natural landscaping of an area.

Critical-areas buffer zones should not be used 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.

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. Steel construction fencing is the most effective method in protecting 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 from burying and smothering.
- 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.

BMP C103: High Visibility Plastic or Metal Fence

Purpose

Fencing is intended to: (1) restrict clearing to approved limits; (2) prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed; (3) limit construction traffic to designated construction entrances or roads; and, (4) protect areas where marking with survey tape may not provide adequate protection.

Conditions of Use

To establish clearing limits, plastic 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.
- 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 Entrance

Purpose

Construction entrances are stabilized to reduce the amount of sediment transported onto paved roads by vehicles or equipment by constructing a stabilized pad of quarry spalls at entrances to construction sites.

Conditions of Use

Construction entrances shall be stabilized wherever traffic will be leaving a construction site and traveling on paved roads or other paved areas within 1,000 feet of the site.

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

Design and Installation Specifications

- See Figure 4.2 for details. Note: the 100' minimum length of the entrance shall be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (100').
- A separation geotextile shall be placed under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet the following standards:

Grab Tensile Strength (ASTM D4751)	200 psi min.
Grab Tensile Elongation (ASTM D4632)	30% max.
Mullen Burst Strength (ASTM D3786-80a)	400 psi min.
AOS (ASTM D4751)	20-45 (U.S. standard sieve size)

- Consider early installation of the first lift of asphalt in areas that will paved; this can be used as a stabilized entrance. Also consider the installation of excess concrete as a stabilized entrance. During large concrete pours, excess concrete is often available for this purpose.
- Hog fuel (wood-based mulch) may be substituted for or combined with quarry spalls in areas that will not be used for permanent roads. Hog fuel is generally less effective at stabilizing construction entrances and should be used only at sites where the amount of traffic is very limited. Hog fuel is not recommended for entrance stabilization in urban areas. The effectiveness of hog fuel is highly variable and it generally requires more maintenance than quarry spalls. The inspector may at any time require the use of quarry spalls if the hog fuel is not preventing sediment from being tracked onto pavement or if the hog fuel is being carried onto pavement. Hog fuel is prohibited in permanent roadbeds because organics in the subgrade soils cause degradation of the subgrade support over time.
- Fencing (see BMPs C103 and C104) shall be installed as necessary to restrict traffic to the construction entrance.

- Whenever possible, the entrance shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.

Maintenance Standards

- Quarry spalls (or hog fuel) shall be added if the pad is no longer in accordance with the specifications.
- If the entrance is not preventing sediment from being tracked onto pavement, then alternative measures to keep the streets free of sediment shall be used. This may include street sweeping, an increase in the dimensions of the entrance, or the installation of a wheel wash.
- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be removed or stabilized on site. The pavement shall not be cleaned by washing down the street, except when 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 shall be considered. The sediment would then be washed into the sump where it can be controlled.
- Any quarry spalls that are loosened from the pad, which end up on the roadway shall be removed immediately.
- If vehicles are entering or exiting the site at points other than the construction entrance(s), fencing (see BMPs C103 and C104) shall be installed to control traffic.
- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

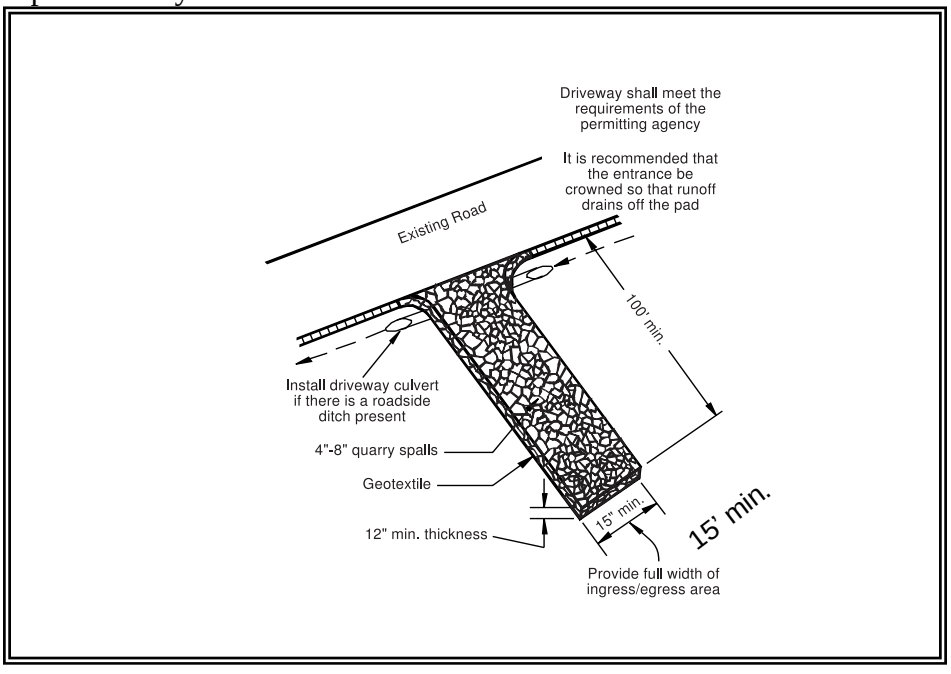


Figure 4.2 – Stabilized Construction Entrance

BMP C107: Construction Road/Parking Area Stabilization

Purpose

Stabilizing subdivision roads, parking areas, and other onsite vehicle transportation routes immediately after grading reduces erosion caused by construction traffic or runoff.

Conditions of Use

- Roads or parking areas shall be stabilized wherever they are constructed, whether permanent or temporary, for use by construction traffic.
- Fencing (see BMPs C103 and C104) shall be installed, if necessary, to limit the access of vehicles to only those roads and parking areas that are stabilized.

Design and Installation Specifications

- On areas that will receive asphalt as part of the project, install the first lift as soon as possible.
- A 6-inch depth of 2- to 4-inch crushed rock, gravel base, or crushed surfacing base course shall be applied immediately after grading or utility installation. A 4-inch course of asphalt treated base (ATB) may also be used, or the road/parking area may be paved. It may also be possible to use cement or calcium chloride for soil stabilization. If cement or cement kiln dust is used for roadbase stabilization, pH monitoring and BMPs are necessary to evaluate and minimize the effects on stormwater. If the area will not be used for permanent roads, parking areas, or structures, a 6-inch depth of hog fuel may also be used, but this is likely to require more maintenance. Whenever possible, construction roads and parking areas shall be placed on a firm, compacted subgrade.
- Temporary road gradients shall not exceed 15 percent. Roadways shall be carefully graded to drain. Drainage ditches shall be provided on each side of the roadway in the case of a crowned section, or on one side in the case of a super-elevated section. Drainage ditches shall be directed to a sediment control BMP.
- Rather than relying on ditches, it may also be possible to grade the road so that runoff sheet-flows into a heavily vegetated area with a well-developed topsoil. Landscaped areas are not adequate. If this area has at least 50 feet of vegetation, then it is generally preferable to use the vegetation to treat runoff, rather than a sediment pond or trap. The 50 feet shall not include wetlands. If runoff is allowed to sheetflow through adjacent vegetated areas, it is vital to design the roadways and parking areas so that no concentrated runoff is created.
- Storm drain inlets shall be protected to prevent sediment-laden water entering the storm drain system (see BMP C220).

Maintenance Standards

- Inspect stabilized areas regularly, especially after large storm events.
- Crushed rock, gravel base, hog fuel, 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.

BMP C120: Temporary and Permanent Seeding

Purpose

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

Conditions of Use

- Seeding may be used throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days.
- Channels that will be vegetated should be installed before major earthwork and hydroseeded with a Bonded Fiber Matrix. The vegetation should be well established (i.e., 75 percent cover) before water is allowed to flow in the ditch. With channels that will have high flows, erosion control blankets should be installed over the hydroseed. If vegetation cannot be established from seed before water is allowed in the ditch, sod should be installed in the bottom of the ditch over hydromulch and blankets.
- Retention/detention ponds should be seeded as required.
- Mulch is required at all times because it protects seeds from heat, moisture loss, and transport due to runoff.
- All disturbed areas shall be reviewed in late August to early September and all seeding should be completed by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.
- At final site stabilization, all disturbed areas not otherwise vegetated or stabilized shall be seeded and mulched. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions or geotextiles) which will prevent erosion.

Design and Installation Specifications

- Seeding should be done during those seasons most conducive to growth and will vary with the climate conditions of the region. Local experience should be used to determine the appropriate seeding periods.
- The optimum seeding windows for western Washington are April 1 through June 30 and September 1 through October 1. Seeding that occurs between July 1 and August 30 will require irrigation until 75 percent grass cover is established. Seeding that occurs between October 1 and March 30 will require a mulch or plastic cover until 75 percent grass cover is established.
- To prevent seed from being washed away, confirm that all required surface water control measures have been installed.

- The seedbed should be firm and rough. All soil should be roughened no matter what the slope. If compaction is required for engineering purposes, slopes must be track walked before seeding. Backblading or smoothing of slopes greater than 4:1 is not allowed if they are to be seeded.
- New and more effective restoration-based landscape practices rely on deeper incorporation than that provided by a simple single-pass rototilling treatment. Wherever practical the subgrade should be initially ripped 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 the rototilling process should be done in multiple lifts, or the prepared soil system shall be prepared properly and then placed to achieve the specified depth.
- Organic matter is the most appropriate form of "fertilizer" because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form. A natural system typically releases 2-10 percent of its nutrients annually. Chemical fertilizers have since been formulated to simulate what organic matter does naturally.
- In general, 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer can be used at a rate of 90 pounds per acre. Slow-release fertilizers should always be used because they are more efficient and have fewer environmental impacts. It is recommended that areas being seeded for final landscaping conduct soil tests to determine the exact type and quantity of fertilizer needed. This will prevent the over-application of fertilizer. Fertilizer should not be added to the hydromulch machine and agitated more than 20 minutes before it is to be used. If agitated too much, the slow-release coating is destroyed.
- There are numerous products available on the market 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 is a good source of long-term, slow-release, available nitrogen.
- Hydroseed applications shall include a minimum of 1,500 pounds per acre of mulch with 3 percent tackifier. Mulch may be made up of 100 percent: cottonseed meal; fibers made of wood, recycled cellulose, hemp, and kenaf; compost; or blends of these. Tackifier shall be plant-based, such as guar or alpha plantago, or chemical-based such as polyacrylamide or polymers. Any mulch or tackifier product used shall be installed per manufacturer's instructions. Generally, mulches come in 40-50 pound bags. Seed and fertilizer are added at time of application.

- Mulch is always required for seeding. Mulch can be applied on top of the seed or simultaneously by hydroseeding.
- On steep slopes, Bonded Fiber Matrix (BFM) or Mechanically Bonded Fiber Matrix (MBFM) products should be used. BFM/MBFM products are applied at a minimum rate of 3,000 pounds per acre of mulch with approximately 10 percent tackifier. Application is made so that a minimum of 95 percent soil coverage is achieved. Numerous products are available commercially and should be installed per manufacturer's instructions. Most products require 24-36 hours to cure before a rainfall and cannot be installed on wet or saturated soils. Generally, these products come in 40-50 pound bags and include all necessary ingredients except for seed and fertilizer.

BFMs and MBFMs have some advantages over blankets:

- No surface preparation required;
- Can be installed via helicopter in remote areas;
- On slopes steeper than 2.5:1, blanket installers may need to be roped and harnessed for safety;
- They are at least $1,000 per acre cheaper installed.

In most cases, the shear strength of blankets is not a factor when used on slopes, only when used in channels. BFMs and MBFMs are good alternatives to blankets in most situations where vegetation establishment is the goal.

- 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. One way to overcome this is to increase seed quantities by up to 50 percent.
- Vegetation establishment can also be enhanced by dividing the hydromulch operation into two phases:
    1. Phase 1- Install all seed and fertilizer with 25-30 percent mulch and tackifier onto soil in the first lift;
    2. Phase 2- Install the rest of the mulch and tackifier over the first lift.

An alternative is to install the mulch, seed, fertilizer, and tackifier in one lift. Then, spread or blow straw over the top of the hydromulch at a rate of about 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:

1. Irrigation
2. Reapplication of mulch
3. Repair of failed slope surfaces

This technique works with standard hydromulch (1,500 pounds per acre minimum) and BFM/MBFMs (3,000 pounds per acre minimum).

- Areas to be permanently landscaped shall provide a healthy topsoil that reduces the need for fertilizers, improves overall topsoil quality, provides for better vegetal health and vitality, improves hydrologic characteristics, and reduces the need for irrigation. This can be accomplished in a number of ways:

  Recent research has shown that the best method to improve till soils is to amend these soils with compost. The optimum mixture is approximately two parts soil to one part compost. This equates to 4 inches of compost mixed to a depth of 12 inches in till soils. Increasing the concentration of compost beyond this level can have negative effects on vegetal health, while decreasing the concentrations can reduce the benefits of amended soils. Please note: The compost should meet specifications for Grade A quality compost in Ecology Publication 94-038.

  Other soils, such as gravel or cobble outwash soils, may require different approaches. Organics and fines easily migrate through the loose structure of these soils. Therefore, the importation of at least 6 inches of quality topsoil, underlain by some type of filter fabric to prevent the migration of fines, may be more appropriate for these soils.

  Areas that already have good topsoil, such as undisturbed areas, do not require soil amendments.

- Areas that will be seeded only and not landscaped may need compost or meal-based mulch included in the hydroseed in order to establish vegetation. Native topsoil should be re-installed on the disturbed soil surface before application.
- Seed that is installed as a temporary measure may be installed by hand if it will be covered by straw, mulch, or topsoil. Seed that is installed as a permanent measure may be installed by hand on small areas (usually less than 1 acre) that will be covered with mulch, topsoil, or erosion blankets. The seed mixes listed below include recommended mixes for both temporary and permanent seeding. These mixes, with the exception of the wetland mix, shall be applied at a rate of 120 pounds per acre. This rate can be reduced if soil amendments or slow-release fertilizers are used. Local suppliers or the local conservation district should be consulted for their recommendations because the appropriate mix depends on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic. Alternative seed mixes approved by the local authority may be used.

Table 4.1 represents the standard mix for those areas where just a temporary vegetative cover is required.

Table 4.1
Temporary Erosion Control Seed Mix

	% Weight	% Purity	% Germination
Chewings or annual blue grass *Festuca rubra var. commutata* or *Poa anna*	40	98	90
Perennial rye - *Lolium perenne*	50	98	90
Redtop or colonial bentgrass *Agrostis alba* or *Agrostis tenuis*	5	92	85
White dutch clover *Trifolium repens*	5	98	90

Table 4.2 provides just one recommended possibility for landscaping seed.

Table 4.2
Landscaping Seed Mix

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

This turf seed mix in Table 4.3 is for dry situations where there is no need for much water. The advantage is that this mix requires very little maintenance.

Table 4.3
Low-Growing Turf Seed Mix

	% Weight	% Purity	% Germination
Dwarf tall fescue (several varieties) *Festuca arundinacea var.*	45	98	90
Dwarf perennial rye (Barclay) *Lolium perenne var. barclay*	30	98	90
Red fescue *Festuca rubra*	20	98	90
Colonial bentgrass *Agrostis tenuis*	5	98	90

Table 4.4 presents a mix recommended for bioswales and other intermittently wet areas.

Table 4.4
Bioswale Seed Mix*

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

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

The seed mix shown in Table 4.5 is a recommended low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Other mixes may be appropriate, depending on the soil type and hydrology of the area. Recent research suggests that bentgrass (agrostis sp.) should be emphasized in wet-area seed mixes. Apply this mixture at a rate of 60 pounds per acre.

Table 4.5
Wet Area Seed Mix*

	% Weight	% Purity	% Germination
Tall or meadow fescue *Festuca arundinacea* or *Festuca elatior*	60-70	98	90
Seaside/Creeping bentgrass *Agrostis palustris*	10-15	98	85
Meadow foxtail *Alepocurus pratensis*	10-15	90	80
Alsike clover *Trifolium hybridum*	1-6	98	90
Redtop bentgrass *Agrostis alba*	1-6	92	85

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

The meadow seed mix in Table 4.6 is recommended for areas that will be maintained infrequently or not at all and 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. The appropriateness of clover in the mix may need to be considered, as this can be a fairly invasive species. If the soil is amended, the addition of clover may not be necessary.

Table 4.6
Meadow Seed Mix

	% Weight	% Purity	% Germination
Redtop or Oregon bentgrass *Agrostis alba* or *Agrostis oregonensis*	20	92	85
Red fescue *Festuca rubra*	70	98	90
White dutch clover *Trifolium repens*	10	98	90

Maintenance Standards

- Any seeded areas that fail to establish at least 80 percent cover (100 percent cover for areas that receive sheet or concentrated flows) shall be reseeded. If reseeding is ineffective, an alternate method, such as sodding, mulching, or nets/blankets, shall be used. If winter weather prevents adequate grass growth, this time limit may be relaxed at the discretion of the local authority when sensitive areas would otherwise be protected.

- After adequate cover is achieved, any areas that experience erosion shall be reseeded and protected by mulch. If the erosion problem is drainage related, the problem shall be fixed and the eroded area reseeded and protected by mulch.
- Seeded areas shall be supplied with adequate moisture, but not watered to the extent that it causes runoff.

BMP C122: Nets and Blankets

Purpose

Erosion control nets and blankets are intended to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become well established. In addition, some nets and blankets can be used to permanently reinforce turf to protect drainage ways during high flows. Nets (commonly called matting) are strands of material woven into an open, but high-tensile strength net (for example, coconut fiber matting). Blankets are strands of material that are not tightly woven, but instead form a layer of interlocking fibers, typically held together by a biodegradable or photodegradable netting (for example, excelsior or straw blankets). They generally have lower tensile strength than nets, but cover the ground more completely. Coir (coconut fiber) fabric comes as both nets and blankets.

Conditions of Use

Erosion control nets and blankets should be used:

- To aid permanent vegetated stabilization of slopes 2H:1V or greater and with more than 10 feet of vertical relief.
- For drainage ditches and swales (highly recommended). The application of appropriate netting or blanket to drainage ditches and swales can protect bare soil from channelized runoff while vegetation is established. Nets and blankets also can capture a great deal of sediment due to their open, porous structure. Synthetic nets and blankets can be used to permanently stabilize channels and may provide a cost-effective, environmentally preferable alternative to riprap. 100 percent synthetic blankets manufactured for use in ditches may be easily reused as temporary ditch liners.

Disadvantages of blankets include:

- Surface preparation required;
- On slopes steeper than 2.5:1, blanket installers may need to be roped and harnessed for safety;
- They cost at least $4,000-6,000 per acre installed.

Advantages of blankets include:

- Can be installed without mobilizing special equipment;
- Can be installed by anyone with minimal training;
- Can be installed in stages or phases as the project progresses;
- Seed and fertilizer can be hand-placed by the installers as they progress down the slope;
- Can be installed in any weather;
- There are numerous types of blankets that can be designed with various parameters in mind. Those parameters include: fiber blend, mesh strength, longevity, biodegradability, cost, and availability.

Design and Installation Specifications

- See Figure 4.4 and Figure 4.5 for typical orientation and installation of blankets used in channels and as slope protection. Note: these are typical only; all blankets must be installed per manufacturer's installation instructions.
- Installation is critical to the effectiveness of these products. If good ground contact is not achieved, runoff can concentrate under the product, resulting in significant erosion.
- Installation of Blankets on Slopes:
    1. Complete final grade and track walk up and down the slope.
    2. Install hydromulch with seed and fertilizer.
    3. Dig a small trench, approximately 12 inches wide by 6 inches deep along the top of the slope.
    4. Install the leading edge of the blanket into the small trench and staple approximately every 18 inches. NOTE: Staples are metal,"U"-shaped, and a minimum of 6 inches long. Longer staples are used in sandy soils. Biodegradable stakes are also available.
    5. Roll the blanket slowly down the slope as installer walks backwards. NOTE: The blanket rests against the installer's legs. Staples are installed as the blanket is unrolled. It is critical that the proper staple pattern is used for the blanket being installed. The blanket is not to be allowed to roll down the slope on its own as this stretches the blanket making it impossible to maintain soil contact. In addition, no one is allowed to walk on the blanket after it is in place.
    6. If the blanket is not long enough to cover the entire slope length, the trailing edge of the upper blanket should overlap the leading edge of the lower blanket and be stapled. On steeper slopes, this overlap should be installed in a small trench, stapled, and covered with soil.
- With the variety of products available, it is impossible to cover all the details of appropriate use and installation. Therefore, it is critical that the design engineer consults the manufacturer's information and that a site visit takes place in order to insure that the product specified is appropriate. Information is also available at the following web sites:
    1. WSDOT: http://www.wsdot.wa.gov/eesc/environmental/
    2. Texas Transportation Institute: http://www.dot.state.tx.us/insdtdot/orgchart/cmd/erosion/contents.htm

- Jute matting must be used in conjunction with mulch (BMP C121). Excelsior, woven straw blankets and coir (coconut fiber) blankets may be installed without mulch. There are many other types of erosion control nets and blankets on the market that may be appropriate in certain circumstances.
- In general, most nets (e.g., jute matting) require mulch in order to prevent erosion because they have a fairly open structure. Blankets typically do not require mulch because they usually provide complete protection of the surface.
- Extremely steep, unstable, wet, or rocky slopes are often appropriate candidates for use of synthetic blankets, as are riverbanks, beaches and other high-energy environments. If synthetic blankets are used, the soil should be hydromulched first.
- 100 percent biodegradable blankets are available for use in sensitive areas. These organic blankets are usually held together with a paper or fiber mesh and stitching which may last up to a year.
- Most netting used with blankets is photodegradable, meaning they break down under sunlight (not UV stabilized). However, this process can take months or years even under bright sun. Once vegetation is established, sunlight does not reach the mesh. It is not uncommon to find non-degraded netting still in place several years after installation. This can be a problem if maintenance requires the use of mowers or ditch cleaning equipment. In addition, birds and small animals can become trapped in the netting.

Maintenance Standards

- Good contact with the ground must be maintained, and erosion must not occur beneath the net or blanket.
- Any areas of the net or blanket that are damaged or not in close contact with the ground shall be repaired and stapled.
- If erosion occurs due to poorly controlled drainage, the problem shall be fixed and the eroded area protected.

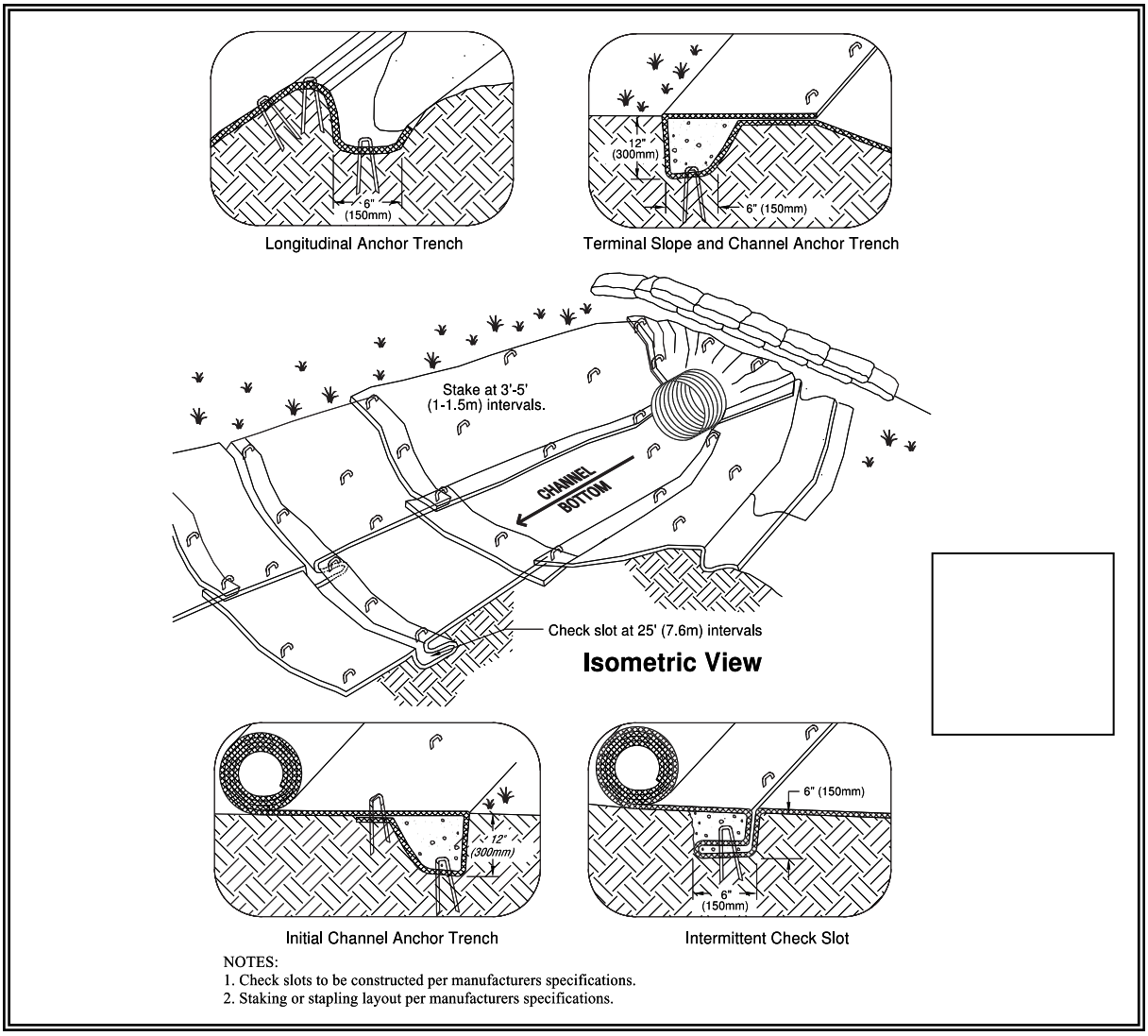


Figure 4.4 – Channel Installation

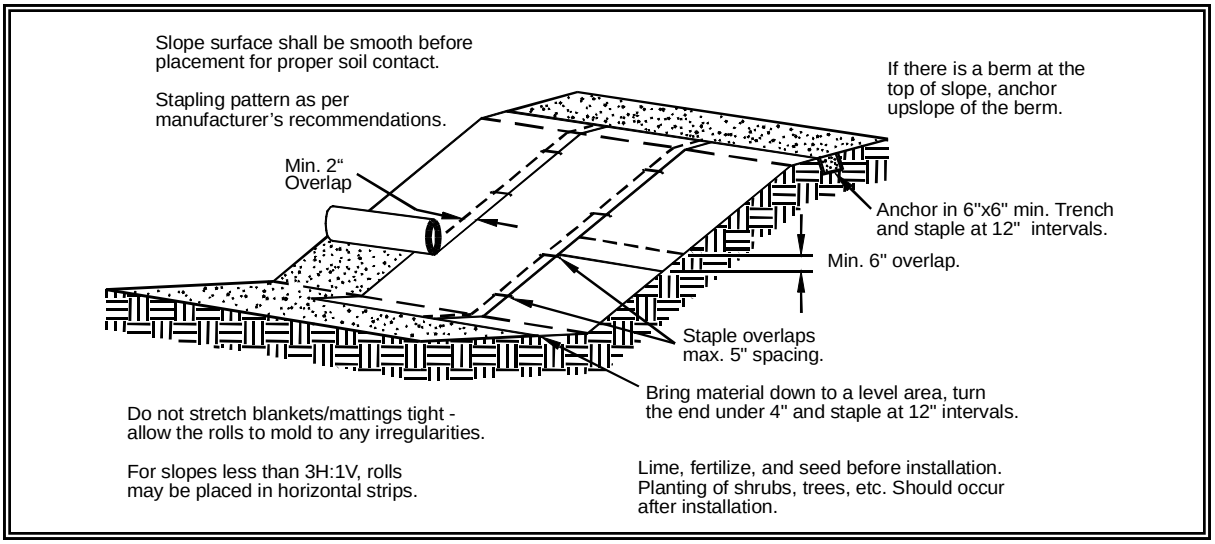


Figure 4.5 – Slope Installation

4.2 Runoff Conveyance and Treatment BMPs

BMP C200: Interceptor Dike and Swale

Purpose

Provide a ridge of compacted soil, or a ridge with an upslope swale, at the top or base of a disturbed slope or along the perimeter of a disturbed construction area to convey stormwater. Use the dike and/or swale to intercept the runoff from unprotected areas and direct it to areas where erosion can be controlled. This can prevent storm runoff from entering the work area or sediment-laden runoff from leaving the construction site.

Conditions of Use

Where the runoff from an exposed site or disturbed slope must be conveyed to an erosion control facility which can safely convey the stormwater.

- Locate upslope of a construction site to prevent runoff from entering disturbed area.
- When placed horizontally across a disturbed slope, it reduces the amount and velocity of runoff flowing down the slope.
- Locate downslope to collect runoff from a disturbed area and direct it to a sediment basin.

Design and Installation Specifications

- Dike and/or swale and channel must be stabilized with temporary or permanent vegetation or other channel protection during construction.
- Channel requires a positive grade for drainage; steeper grades require channel protection and check dams.
- Review construction for areas where overtopping may occur.
- Can be used at top of new fill before vegetation is established.
- May be used as a permanent diversion channel to carry the runoff.
- Sub-basin tributary area should be one acre or less.
- Design capacity for the peak flow from a 10-year, 24-hour storm, assuming a Type 1A rainfall distribution, for temporary facilities. Alternatively, use 1.6 times the 10-year, 1-hour flow indicated by an approved continuous runoff model. For facilities that will also serve on a permanent basis, consult the local government's drainage requirements.

Interceptor dikes shall meet the following criteria:

Top Width	2 feet minimum.
Height	1.5 feet minimum on berm.
Side Slope	2:1 or flatter.
Grade	Depends on topography, however, dike system minimum is 0.5%, maximum is 1%.
Compaction	Minimum of 90 percent ASTM D698 standard proctor.

Horizontal Spacing of Interceptor Dikes:

Average Slope	Slope Percent	Flowpath Length
20H:1V or less	3-5%	300 feet
(10 to 20)H:1V	5-10%	200 feet
(4 to 10)H:1V	10-25%	100 feet
(2 to 4)H:1V	25-50%	50 feet

Stabilization depends on velocity and reach

Slopes <5% Seed and mulch applied within 5 days of dike construction (*see BMP C121, Mulching*).

Slopes 5 - 40% Dependent on runoff velocities and dike materials. Stabilization should be done immediately using either sod or riprap or other measures to avoid erosion.

- The upslope side of the dike shall provide positive drainage to the dike outlet. No erosion shall occur at the outlet. Provide energy dissipation measures as necessary. Sediment-laden runoff must be released through a sediment trapping facility.
- Minimize construction traffic over temporary dikes. Use temporary cross culverts for channel crossing.

Interceptor swales shall meet the following criteria:

Bottom Width	2 feet minimum; the bottom shall be level.
Depth	1-foot minimum.
Side Slope	2:1 or flatter.
Grade	Maximum 5 percent, with positive drainage to a suitable outlet (such as a sediment pond).
Stabilization	Seed as per *BMP C120, Temporary and Permanent Seeding*, or *BMP C202, Channel Lining*, 12 inches thick of riprap pressed into the bank and extending at least 8 inches vertical from the bottom.

- Inspect diversion dikes and interceptor swales once a week and after every rainfall. Immediately remove sediment from the flow area.
- Damage caused by construction traffic or other activity must be repaired before the end of each working day.

Check outlets and make timely repairs as needed to avoid gully formation. When the area below the temporary diversion dike is permanently stabilized, remove the dike and fill and stabilize the channel to blend with the natural surface.

BMP C201: Grass-Lined Channels

Purpose

To provide a channel with a vegetative lining for conveyance of runoff. See Figure 4.7 for typical grass-lined channels.

Conditions of Use

This practice applies to construction sites where concentrated runoff needs to be contained to prevent erosion or flooding.

- When a vegetative lining can provide sufficient stability for the channel cross section and at lower velocities of water (normally dependent on grade). This means that the channel slopes are generally less than 5 percent and space is available for a relatively large cross section.
- Typical uses include roadside ditches, channels at property boundaries, outlets for diversions, and other channels and drainage ditches in low areas.
- Channels that will be vegetated should be installed before major earthwork and hydroseeded with a bonded fiber matrix (BFM). The vegetation should be well established (i.e., 75 percent cover) before water is allowed to flow in the ditch. With channels that will have high flows, erosion control blankets should be installed over the hydroseed. If vegetation cannot be established from seed before water is allowed in the ditch, sod should be installed in the bottom of the ditch in lieu of hydromulch and blankets.

Design and Installation Specifications

Locate the channel where it can conform to the topography and other features such as roads.

- Locate them to use natural drainage systems to the greatest extent possible.
- Avoid sharp changes in alignment or bends and changes in grade.
- Do not reshape the landscape to fit the drainage channel.
- The maximum design velocity shall be based on soil conditions, type of vegetation, and method of revegetation, but at no times shall velocity exceed 5 feet/second. The channel shall not be overtopped by the peak runoff from a 10-year, 24-hour storm, assuming a Type 1A rainfall distribution." Alternatively, use 1.6 times the 10-year, 1-hour flow indicated by an approved continuous runoff model to determine a flow rate which the channel must contain.
- Where the grass-lined channel will also function as a permanent stormwater conveyance facility, consultant the drainage conveyance requirements of the local government with jurisdiction.
- An **established** grass or vegetated lining is required before the channel can be used to convey stormwater, unless stabilized with nets or blankets.

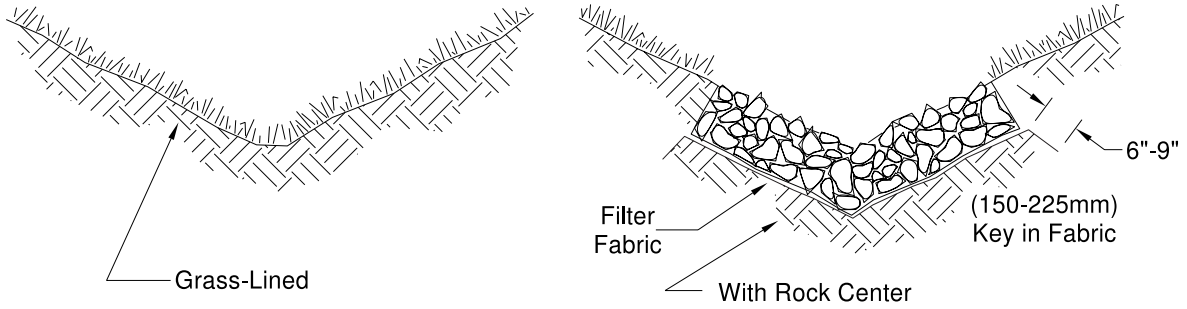
- If design velocity of a channel to be vegetated by seeding exceeds 2 ft/sec, a temporary channel liner is required. Geotextile or special mulch protection such as fiberglass roving or straw and netting provide stability until the vegetation is fully established. See Figure 4.9.
- Check dams shall be 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.
- If vegetation is established by sodding, the permissible velocity for established vegetation may be used and no temporary liner is needed.
- Do not subject grass-lined channel to sedimentation from disturbed areas. Use sediment-trapping BMPs upstream of the channel.
- **V-shaped grass channels** generally apply where the quantity of water is small, such as in short reaches along roadsides. The V-shaped cross section is least desirable because it is difficult to stabilize the bottom where velocities may be high.
- **Trapezoidal grass channels** are used where runoff volumes are large and slope is low so that velocities are nonerosive to vegetated linings. (Note: it is difficult to construct small parabolic shaped channels.)
- Subsurface drainage, or riprap channel bottoms, may be necessary on sites that are subject to prolonged wet conditions due to long duration flows or a high water table.
- Provide outlet protection at culvert ends and at channel intersections.
- Grass channels, at a minimum, should carry peak runoff for temporary construction drainage facilities from the 10-year, 24-hour storm without eroding. Where flood hazard exists, increase the capacity according to the potential damage.
- Grassed channel side slopes generally are constructed 3:1 or flatter to aid in the establishment of vegetation and for maintenance.
- Construct channels a minimum of 0.2 foot larger around the periphery to allow for soil bulking during seedbed preparations and sod buildup.

Maintenance Standards

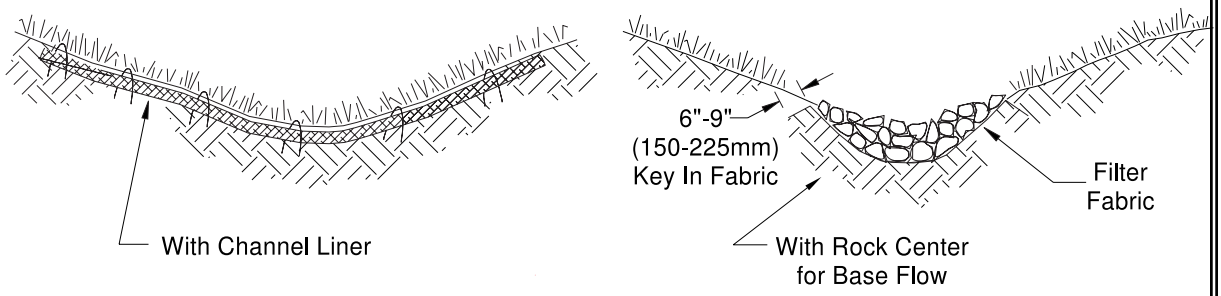
During the establishment period, check grass-lined channels after every rainfall.

- After grass is established, periodically check the channel; check it after every heavy rainfall event. Immediately make repairs.
- It is particularly important to check the channel outlet and all road crossings for bank stability and evidence of piping or scour holes.
- Remove all significant sediment accumulations to maintain the designed carrying capacity. Keep the grass in a healthy, vigorous condition at all times, since it is the primary erosion protection for the channel.

Typical V-Shaped Channel Cross-section



Typical Parabolic Channel Cross-Section



Typical Trapezoidal Channel Cross-Section

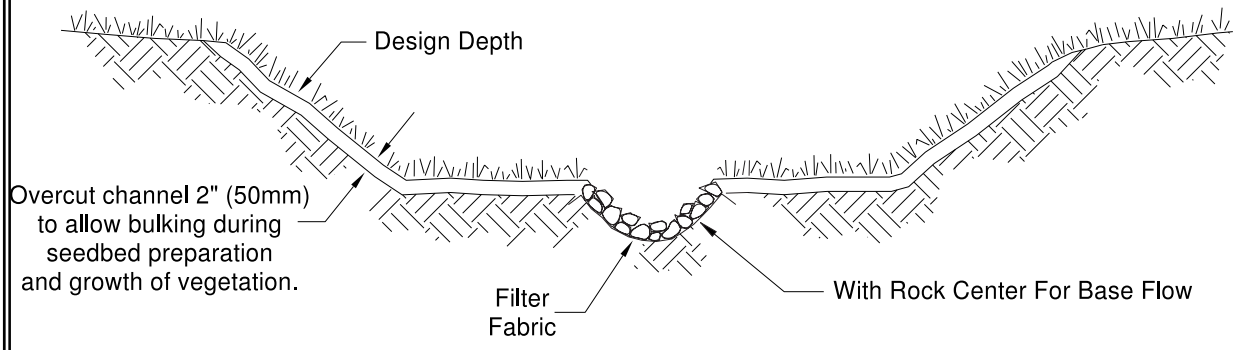
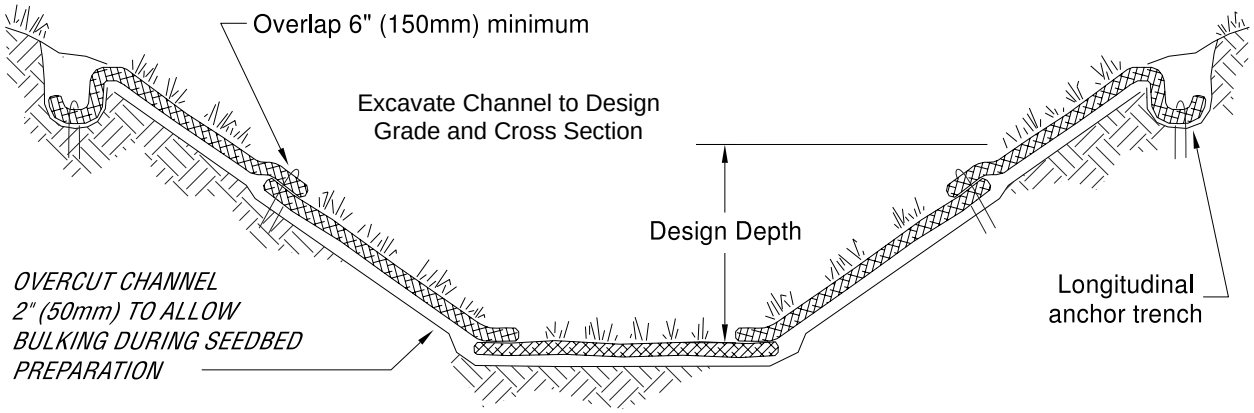
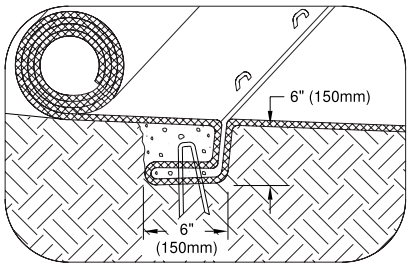


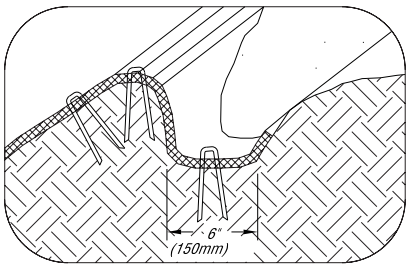
Figure 4.8 – Typical Grass-Lined Channels



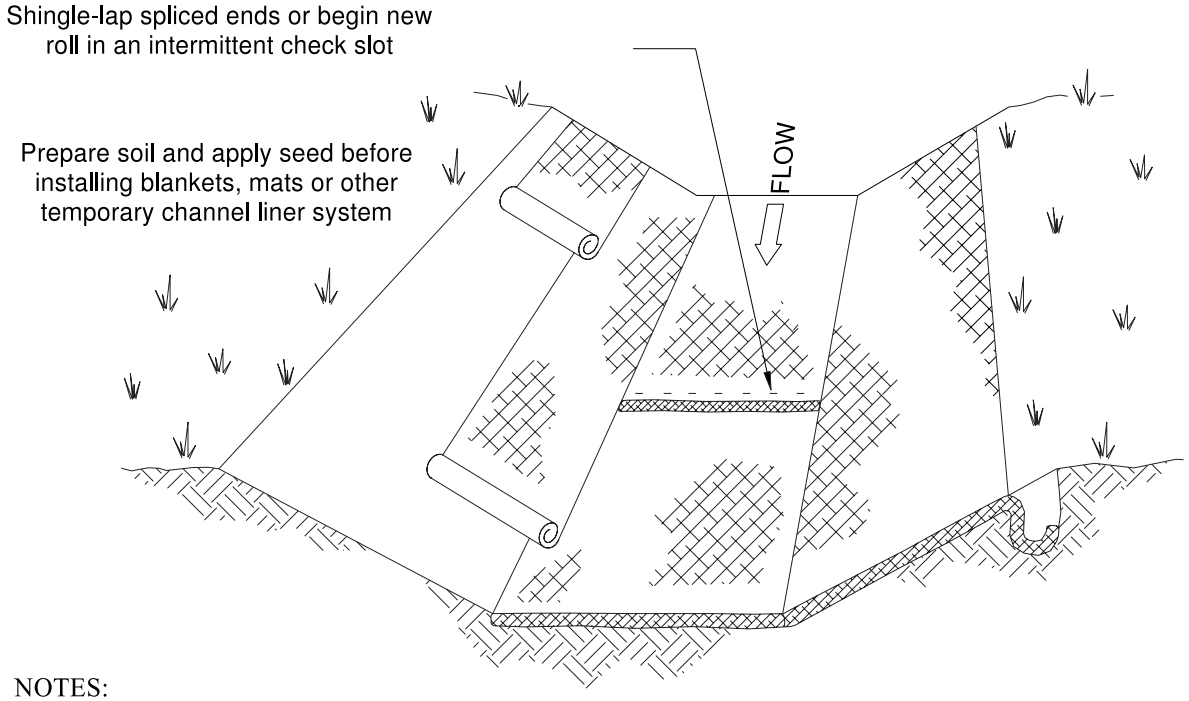


Intermittent Check Slot

TYPICAL INSTALLATION WITH EROSION CONTROL BLANKETS OR TURF REINFORCEMENT MATS



Longitudinal Anchor Trench



NOTES:
1. Design velocities exceeding 2 ft/sec (0.5m/sec) require temporary blankets, mats or similar liners to protect seed and soil until vegetation becomes established.
2. Grass-lined channels with design velocities exceeding 6 ft/sec (2m/sec) should include turf reinforcement mats.

Figure 4.9 – Temporary Channel Liners

BMP C202: Channel Lining

Purpose

To protect erodible channels by providing a channel liner using either blankets or riprap.

Conditions of Use

When natural soils or vegetated stabilized soils in a channel are not adequat to prevent channel erosion.

- When a permanent ditch or pipe system is to be installed and a temporary measure is needed.
- In almost all cases, synthetic and organic coconut blankets are more effective than riprap for protecting channels from erosion. Blankets can be used with and without vegetation. Blanketed channels can be designed to handle any expected flow and longevity requirement. Some synthetic blankets have a predicted life span of 50 years or more, even in sunlight.
- Other reasons why blankets are better than rock include the availability of blankets over rock. In many areas of the state, rock is not easily obtainable or is very expensive to haul to a site. Blankets can be delivered anywhere. Rock requires the use of dump trucks to haul and heavy equipment to place. Blankets usually only require laborers with hand tools, and sometimes a backhoe.
- The Federal Highway Administration recommends not using flexible liners whenever the slope exceeds 10 percent or the shear stress exceeds 8 lbs/ft^2.

Design and Installation Specifications

See BMP C122 for information on blankets.

Since riprap is used where erosion potential is high, construction must be sequenced so that the riprap is put in place with the minimum possible delay.

- Disturbance of areas where riprap is to be placed should be undertaken only when final preparation and placement of the riprap can follow immediately behind the initial disturbance. Where riprap is used for outlet protection, the riprap should be placed before or in conjunction with the construction of the pipe or channel so that it is in place when the pipe or channel begins to operate.
- The designer, after determining the riprap size that will be stable under the flow conditions, shall consider that size to be a minimum size and then, based on riprap gradations actually available in the area, select the size or sizes that equal or exceed the minimum size. The possibility of drainage structure damage by children shall be considered in selecting a riprap size, especially if there is nearby water or a gully in which to toss the stones.
- Stone for riprap shall consist of field stone or quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or

weathering and it shall be suitable in all respects for the purpose intended.

- Rubble concrete may be used provided it has a density of at least 150 pounds per cubic foot, and otherwise meets the requirement of this standard and specification.
- A lining of engineering filter fabric (geotextile) shall be placed between the riprap and the underlying soil surface to prevent soil movement into or through the riprap. The geotextile should be keyed in at the top of the bank.
- Filter fabric shall not be used on slopes greater than 1-1/2:1 as slippage may occur. It should be used in conjunction with a layer of coarse aggregate (granular filter blanket) when the riprap to be placed is 12 inches and larger.

BMP C207: Check Dams

Purpose

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

Conditions of Use

Where temporary channels or permanent channels are not yet vegetated, channel lining is infeasible, and 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.
- Check dams shall not be placed 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

Whatever material is used, the dam should form a triangle when viewed from the side. This prevents undercutting as water flows over the face of the dam rather than falling directly onto the ditch bottom.

Check dams in association with sumps work more effectively at slowing flow and retaining sediment than just 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.
- Check dams can 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.
- Check dams should be placed perpendicular to the flow of water.
- The maximum spacing between the dams shall be such that the 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 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 2:1 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, this is not necessary. A piece of organic or synthetic blanket cut to fit will also work for this purpose.
- Rock check dams shall be constructed of appropriately sized rock. The rock must be placed by hand or by mechanical means (no dumping of rock to form dam) to achieve complete coverage of the ditch or swale and to ensure that the center of the dam is lower than the edges. The rock used must be large enough to stay in place given the expected design flow through the channel.
- 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. Figure 4.13 depicts a typical rock check dam.

Maintenance Standards

Check dams shall be monitored for performance and sediment accumulation during and after each runoff producing rainfall. 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.

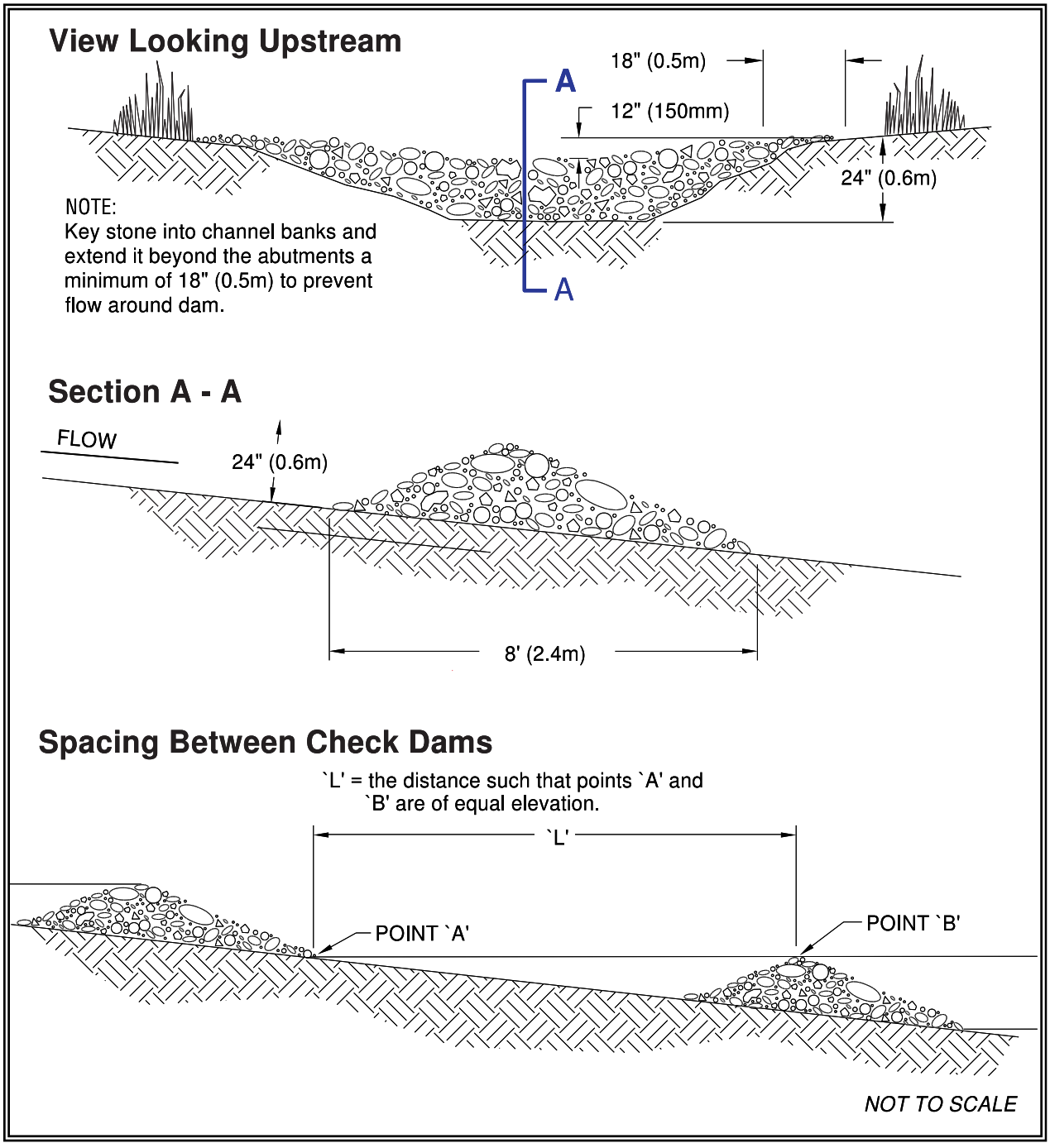


Figure 4.13 – Check Dams

APPENDIX C – GENERAL PERMIT (TO BE ADDED WHEN RECEIVED)

APPENDIX D – ECOLOGY SITE INSPECTION CHECKLIST

Construction Stormwater
SITE INSPECTION CHECKLIST

Project_____ Permit No._____ Inspector_____ Date_____ Time_____

Site BMPs	Overall Condition	Need Repair?	Comments/Observations
Clearing Limits			
●*Buffer Zones around sensitive areas*	G F P	Y N	
●	G F P	Y N	
●	G F P	Y N	
Construction Access/Roads			
●*Stabilized site entrance*	G F P	Y N	
●*Stabilized roads/parking area*	G F P	Y N	
●	G F P	Y N	
Control Flow Rates			
●*Swale*	G F P	Y N	
●*Dike*	G F P	Y N	
●*Sediment pond*	G F P	Y N	
●*Sediment trap*	G F P	Y N	
●	G F P	Y N	
●	G F P	Y N	
Install Sediment Controls			
●*Sediment pond/trap*	G F P	Y N	
●*Silt fence*	G F P	Y N	
●*Straw bale barriers*	G F P	Y N	
●	G F P	Y N	
●	G F P	Y N	
●	G F P	Y N	
Preserve Vegetation/Stabilize Soils			
●*Nets and blankets*	G F P	Y N	
●*Mulch*	G F P	Y N	
●*Seeding*	G F P	Y N	
●	G F P	Y N	
●	G F P	Y N	
Protect Slopes			
●*Terrace*	G F P	Y N	
●*Pipe slope drains*	G F P	Y N	
●	G F P	Y N	
●	G F P	Y N	
Protect Drain Inlets			
●*Inserts*	G F P	Y N	
●	G F P	Y N	
●	G F P	Y N	
Stabilize Channels and Outlets			
●*Conveyance channels*	G F P	Y N	
●*Energy dissipators*	G F P	Y N	
●	G F P	Y N	
Control Pollutants			
●*Chemical Storage Area covered*	G F P	Y N	
●*Concrete handling*	G F P	Y N	
●	G F P	Y N	
Control De-watering			
●	G F P	Y N	

G=Good F=Fair P=Poor Y=Yes N=No

Excerpt from *How to do Stormwater Monitoring,* Publication # 06-10-020

Construction Stormwater
SITE INSPECTION CHECKLIST

Project_____ Permit No._____ Inspector_____ Date_____ Time_____

Will existing BMPs need to be modified or removed, or other BMPs installed? YES NO
IF YES, list the action items to be completed on the following table:

Actions to be Completed	Date Completed/ Initials
1.	
2.	
3.	
4.	
5.	
6.	

Describe current weather conditions

Approximate amount of precipitation since last inspection: _____ inches
and precipitation in the past 24 hours*: _____inches
**based on an on-site rain gauge or local weather data.*

Describe discharging stormwater, if present. Note the presence of suspended sediment, "cloudiness", discoloration, or oil sheen.

Was water quality sampling part of this inspection? YES NO
If yes, record results below (attach separate sheet, if necessary):

Parameter:	Method (circle one)	Result	Units
Turbidity	tube, meter, laboratory		NTU (cm, if tube used)
pH	paper, kit, meter		pH standard units

Is the site in compliance with the SWPPP and the permit requirements? YES NO
If no, indicate tasks necessary to bring site into compliance on the "Actions to be Completed" table above, and include dates each job WILL BE COMPLETED.
If no, has the non-compliance been reported to Dept. of Ecology? YES NO
If no, should the SWPPP be modified: YES NO

Sign the following certification:
"I certify that this report is true, accurate, and complete, to the best of my knowledge and belief."

Inspection completed on:_____ by: (print+signature)_____

Title/Qualification of Inspector:_____

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