FIELD GUIDE FOR EROSION AND SEDIMENT CONTROL

June 2011

Government of Alberta

FIELD GUIDE FOR
EROSION AND SEDIMENT CONTROL
VERSION 2

June 2011

VERSION HISTORY

Version No.	Date	Description
1	May 2003	Updates/Edits/Revisions to Field Guide (March 2003 Paper Publication) for Erosion and Sediment Control for Highways
1a	March 2009	New BMPs added to the Field Guide
2	June 2011	Revision Update to Field Guide for Erosion and Sediment Control

PREFACE

This document provides guidelines for construction, inspection and maintenance of erosion and sediment control structures along highways in Alberta. This document was developed to provide a convenient and handy resource in the field. It is intended primarily for use by field personnel of contractors, consultants and Alberta Transportation staff. It is intended to assist and provide direction in the field implementation of erosion and sediment control structures, but is not intended to preclude application of innovative or alternative designs, or installation requirements specific to a particular site.

For the analysis and design aspects of erosion and sediment control measures, reference should be made to the Alberta Transportation document titled "Erosion and Sediment Control Manual". The contents of this field guide are extracted from the Manual.

A general review of all sections and appendices within the Manual and Field Guide was completed. Major updates from the first edition include:

- Provide a more thorough description of Temporary and Permanent Erosion Control Plan (in the Manual);
- Updating the list of Best Management Practices (BMPs); and
- Added Streambank Applications to the list of BMPs.

Continuing comment is essential to the regular updating of this document and any feedback is welcome. Periodic updates and revisions will be undertaken in response to user feedback, changes in technology, regulatory requirements and many other factors. The most current version of this document will be posted on the Alberta Transportation (AT) website (www.transportation.alberta.ca/686.htm). Inquiries and comments may be sent to the Director of Geotechnical and Materials Services, Technical Standards Branch, Alberta Transportation, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3.

Much appreciation is expressed to all those who have contributed to the development of this document. Special thanks are expressed to EBA, A Tetra Tech Company (EBA) who was given the task of developing and updating the Manual document. Thanks are also expressed to members of the Consulting Engineers of Alberta (CEA), Alberta Roadbuilders and Heavy Construction Association (ARHCA) and staff of Alberta Transportation who were involved with development and updating of the document and review of the draft versions.

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PART I

1.0 INTRODUCTION

Erosion and sedimentation are naturally occurring processes of loosening and transport of soil through the action of wind, water or ice and its subsequent deposition. However, construction activities can result in accelerated rates of erosion and sedimentation where soil surfaces are exposed and initially not re-vegetated. If left uncontrolled, these processes may result in an adverse impact to the environment, such as degradation of surface water quality, damage to adjacent land and degradation of aquatic habitat. Erosion and sediment control techniques are activities or practices, or a combination of practices that are designed to protect an exposed soil surface, to prevent or reduce the release of sediment to environmentally sensitive areas, and to promote revegetation as soon as possible.

Alberta Transportation (AT) and their consultants have used various erosion and sediment control measures on construction sites for many years. The types of measures taken have been based on specific site conditions, generally accepted engineering practice, common sense and judgement exercised by staff.

AT recognized the need for more consistent and standard guidelines for permanent and temporary erosion and sediment control as the department moved toward consultant-designed, contractor-built end-product specification based program delivery. This need was reinforced as contractors began taking more responsibility in environmental protection as per their Environmental Construction Operation (ECO) Plan submissions. Contractors are now required to incorporate erosion and sediment control measures during construction activities and for maintenance of highway infrastructure.

Alberta Transportation has published a document entitled: "Erosion and Sediment Control Manual" (2011). This document provides the design guideline and standard procedures for erosion and sediment control for use by designers, consultants and contractors for the construction and maintenance of highways. The Manual should be referenced for a more detailed understanding of erosion and sediment control issues, and for a greater appreciation of design rationale as well as any clarification in relation to the use of this Field Guide. The most commonly used Best Management Practices (BMPs) have been extracted from the Manual and form the main content of this Field Guide document.

The purpose of this Field Guide is to provide guidance to field personnel (construction contractors, maintenance contractors and AT maintenance field staff) on the application, construction, inspection and maintenance of erosion and sediment control measures. The best management practices (BMPs) presented in this document are considered commonly acceptable baseline practices and are not intended to supercede a design provided by a designer and/or engineer.

In this document, the process of sediment control is synonymous to sedimentation control.

2.0 OBJECTIVES

The objectives of this document are to provide:

- Basic appreciation of regulatory requirements;
- Basic understanding of erosion and sediment control measures;
- Guidelines for selection of common BMPs;
- Guideline for installation, inspection, maintenance and decommissioning of erosion and sediment control structure; and
- Convenient resources for contractors and field staff.

This document is not applicable for instream works.

3.0 REGULATORY REQUIREMENTS

There are a number of federal and provincial acts and regulations governing activities that cause, or can cause harm to the environment, including construction projects that result in erosion and/or sedimentation. Regulatory agencies also publish codes of practice, guidelines and standards that set out requirements for undertaking certain types of activities. Most legislation and other types of regulatory tools make reference to preventing the release of harmful or deleterious substances, including silt, to the environment.

Brief overviews of the major acts are presented in the Manual. More thorough descriptions are provided in the AT Environmental Management System (EMS) Manual at http://www.transportation.alberta.ca/2643.htm.

3.1 Regulating Agencies

The federal Department of Fisheries and Oceans (DFO) collaborates with the provincial department, Alberta Environment, to enforce the relevant federal and provincial regulations to prevent erosion and sediment control damage to the environment.

3.2 Contraventions

Contravention of the regulations includes the following offences:

- Release or deposit of deleterious substance;
- Failure to report the release or deposit; and/or
- Failure to mitigate or remediate.

3.3 Penalties

Penalties for offences may include:

- Fines from $50,000 to $1,000,000;
- 6 months in prison; and/or
- An offender is liable for each day or part of a day that the contravention occurs or continues.

3.4 Release Reporting Requirements

The person responsible for the release of deleterious substances into the environment should report the occurrence as soon as he becomes aware of the occurrence. In the event of a release during construction or during shutdown periods, it is likely that the contractor or the consultant on site would be considered the "person who releases or causes the release" of the substance. However, the owner may also be responsible, if, for example, the owner had failed to supervise their consultant or contractor properly, thereby "permitting" the release through its inaction. In this sense all three parties can be held jointly liable, and all parties must take appropriate and timely actions to minimize the impact to the environment. For highway construction sites, the release of silt and other soils to environmentally sensitive and fish habitat areas must be reported

by contractors. Consultant field personnel and owners are also expected to report the incidents, particularly in the case when the contractor is not on site.

The release must be reported to:

- Alberta Environment and/or Department of Fisheries and Oceans (DFO);
- The owner of the substance;
- Their employer;
- The person having control of the substance; and
- Any other person who may be directly affected by the release.

The release must be reported in person or by telephone and be followed up by a written report within 7 days of the verbal report. Section 4 of the Release Reporting Regulation (Alberta Regulation 117/93) outlines the requirements for a written report. The Director (Alberta Environment) may waive the requirement for a written report.

The reporting should be made by telephone to:

1-800-222-6514

This is a single contact number for Alberta Environment, Environment Canada and Department of Fisheries and Oceans (DFO).

4.0 EROSION AND SEDIMENT CONTROL PROCESS

4.1 Definitions

The process of Erosion and Sedimentation can be described as follows:

- Erosion is the wearing away of soil material by water, wind or ice. In highway construction and maintenance, rainfall and runoff water is considered the primary cause of erosion. Fine sand
- The Sedimentation is the deposition, or settling out, of eroded soil particles previously held in suspension by flowing water.

The process of Erosion Control and Sediment Control can be described as follows:

- Erosion control is the process whereby the potential for erosion is minimized, it is an attempt to stop erosion before it happens; and
- Sediment control is the process whereby the potential for eroded soil being transported and/or deposited beyond the limits of the construction site is minimized.

4.2 Control Measures

Erosion and sediment control measures can be classified into the following categories and best management practices (BMPs).

- Minimum requirements (Planning Strategy)
- Temporary measures
- Permanent measures
- Best management practices (BMPs) and Applications

4.2.1 Minimum requirements (Planning Strategy)

Prior to any site disturbance, the potential for erosion can be greatly reduced by good planning and adopting construction processes that proactively work to reduce the area, type and duration of the disturbance. Various methods of scheduling construction activities can provide the first and best opportunities to help minimize the potential for erosion and sedimentation.

The minimum requirements for an erosion and sediment control strategy are presented in Part II Table 1. However, the minimum requirements are generally not sufficient on their own and temporary or permanent control measures will be required.

4.2.2 Temporary and Permanent Control Measures

- Temporary Measures: Those measures (or BMPs) that are installed for the duration of the construction phase only, and that are removed once permanent measures are installed and/or vegetative cover is established; and

- Permanent Measures: Those measures (or BMPs) incorporated into the overall design to address long-term, post construction erosion and sediment control concerns.

Temporary erosion and sediment control measures should be installed at the start of the construction phase. Additional measures will likely need to be installed throughout the construction phase. Permanent erosion and sediment control measures can be installed during or at the end of the construction phase.

Examples of temporary measures include: topsoiling, seeding, slope texturing, synthetic permeable barrier, mulching, RECP coverings, silt fence, rolls, wattles, straw bale barriers, etc. Examples of permanent measures include: offtake ditch, energy dissipator, berm interceptor, gabion, rock check, sediment pond/basin, etc. Dependent on site conditions, some temporary measures will be retained for a longer duration to render its life span more permanent. Typical streambank stabilization application BMPs which are mostly permanent measures are added in Part II Table 6 and Table 7.

Examples of good practice to be undertaken by the contractor at the beginning of construction phase may include:

1) Silt fence and sediment pond/basin along site perimeter for sediment control;

2) Offtake ditch to intercept and divert surface water runoff from construction area;

3) Proper planning and scheduling for timely implementation of appropriate BMPs.

4.2.3 Best management Practices – Applications to Construction Activities

For grading construction, the types of typical construction activities can be described as follows:

- Preconstruction activities generally include: clearing, grubbing, stripping, borrow excavation, sub-excavation, stockpiling;
- Construction activities generally include: cut slopes, fill slopes, ditches, channels, culverts, haul roads.

The application of the appropriate BMPs for construction activities is important. Most commonly used BMPs are presented in this document. Other BMPs (not commonly used) are described in the Manual document.

- A listing of erosion and sediment control measures (BMPs) is presented in Part II Table 2, according to the appropriate construction activities.
- For impacts from pre-construction phase activities, the potential erosion and sediments concerns are described in Section 4.2.3.1.
- For impacts from construction phase activities, the potential erosion and sediments concerns are described in Section 4.2.3.2.

4.2.3.1 Pre-Construction Activities – Potential Impacts

Erosion impact considerations for various pre-construction phase activities are presented as follows:

Clearing and Grubbing

Clearing and grubbing operations may cause localized soil exposure in areas where roots and stumps have been removed, or in areas subjected to vehicular traffic causing rutting and exposing bare soils.

Stripping

Stripping removes the organic mat above mineral soils which exposes and disturbs the mineral soils, thereby increases the erosion potential.

Borrow Sources

Developing borrow sources may include stripping, clearing, grubbing, and excavating operations. The development of borrow sources and the construction of associated structures (haul roads) may cause soil disturbance, create exposed slopes, and/or alter the natural drainage courses in the vicinity of the borrow source.

Sub-excavation

Sub-excavation to remove unsuitable foundation or construction materials may disturb the exposed soil surface, create exposed slopes, and/or alter the natural drainage courses.

Stockpiles

The creation of stockpiles may disturb the vegetated soil surface, create exposed slopes, and/or alter the natural drainage courses.

4.2.3.2 Construction Activities – Potential Impacts

Erosion control considerations for various construction phase activities are presented as follows:

Cut Slope Construction

Cut slopes may increase the slope angle, remove surface organic cover and disturb the soil surface, create a length of exposed slopes, and/or alter the natural drainage courses.

Embankment Slope Construction

Embankments may create disturbed exposed slopes, create slopes with steep slope angles, and/or alter the natural drainage courses.

Ditch Construction

Where channels or ditch are constructed to direct and transport runoff along or transverse to the highway alignment, the original drainage pattern may be altered and concentrated runoff flows increased which can increase flow velocity and erosion

potential. Ditch construction creates exposed channel slopes which can be candidate erosion sites.

Culvert Installation

Installation of culverts may cause flow concentrations, create cut slopes, disturb slope faces, and create potential scour zones at the culvert inlet and outlet.

Temporary Access Road Construction

Construction of temporary haul roads may alter drainage courses and may include the construction of cut slopes, embankments and ditches, or installation of culverts.

4.2.4 Best Management Practices - Applications to Control Effects

BMPs commonly utilized in Alberta highway construction are presented in Part III. For each BMP, details of its purpose, application, construction considerations, inspection, maintenance, and drawings and figures are provided. The two main effects of applied measures (or BMPs) are to provide erosion control and sediment control, and are described as follows.

4.2.4.1 Best Management Practices (BMPs) for Erosion Control

BMPs for erosion control are various measures that have been proven to work on past construction sites when they were properly planned, constructed and maintained. These measures reduce erosion potential by stabilizing exposed soil or reducing surface runoff flow velocity. There are generally two types of erosion control BMPs that can be used in conjunction with the minimum requirements. They are listed as follows:

- Source Control BMPs for protection of exposed surfaces; and
- Conveyance BMPs for control of runoff.

Protection of Exposed Surfaces BMPs

The protection of exposed surfaces should be the primary goal when selecting appropriate control measures. Cover is the single most effective erosion control BMP for preventing erosion. Cover can include topsoiling in conjunction with one or more of the following: seeding, mulching, hydroseeding, sodding, erosion control blankets, turf reinforcement matting (TRM) riprap, gabion mat, aggregate cover and paving.

An overview of appropriate BMPs for protection of exposed surfaces is presented in Part II Table 3 with their respective advantages and limitations.

Control of Runoff BMPs

During construction it is not always possible or practical to provide surface cover for all disturbed areas. Commonly used methods for protecting exposed ground surfaces include the modification (e.g. roughening, tracking, benching) of slope surfaces, the reduction of slope gradients, controlling flow velocity, diverting flows around the affected area, and providing upstream storage for runoff.

An overview of appropriate BMPs for control of runoff is presented in Part II Table 4 with their respective advantages and limitations.

4.2.4.2 Best Management Practices (BMPs) for Sediment Control

BMPs for sediment control are various measures that have been proven to work on past construction sites when they were properly planned, constructed and maintained. These measures reduce off-site sedimentation potential by promoting sedimentation before surface runoff leaves the construction site. There are generally two types of BMPs that can be used in conjunction with the minimum requirements and an erosion control plan. They are as follows:

- Filtering (and Entrapment) BMPs; and
- Impoundment BMPs.

An overview of appropriate sediment control BMPs is presented in Part II Table 5 with their respective advantages and limitations.

Filtering (and Entrapment) BMPs

Soil particles suspended in runoff can be filtered through porous media consisting of natural or artificial materials such as vegetative strips, stone filters, man-made fiber filters. Filtering is most effective when applied to unconcentrated sheet flow as a linear measure placed perpendicular to the direction of flow. Filtering BMPs are usually employed for sediment control along the crest of stream banks and around the perimeter of regions of high erosion potential. Filtering BMPs can also be effectively applied to concentrated channel flows at stilling basin inlets of permanent or temporary drainage systems and outlets of sedimentation ponds.

Regular inspection is required to determine the effectiveness of the filtering BMP, and to schedule maintenance as required to remove accumulated sediment and unclog the filter.

The most commonly used filtering BMP is silt curtains or fences (BMP #1). Silt fences are more effective for particle sizes of fine to medium sand to coarse silt, depending on the mesh size used, for low flow velocity (<1.0 m^3/sec) and for gentle grade (<3%). This method should only be used when there are small runoff flow rates and volumes. Strawbales (BMP #11 Removed) do not efficiently filter sediments, however, strawbales can be used as temporary drop structures for low flow velocity areas and to trapping sediments.

Impoundment BMPs

The temporary impoundment of sediment-laden surface runoff reduces the flow velocity which provides retention time for soil particles to settle out and accumulate in the impoundment. Normally, the practical soil particles of fine sand to medium silt size (ranging from 0.40 mm to 0.02 mm diameter) are target soils for pragmatic sedimentation at impoundment ponds. However, sedimentation may take a long time if the suspended sediments are clayey or organic.

- Sedimentation basin/trap designed for large runoff area; and

- Temporary filter barriers (e.g. silt fence, synthetic weave barrier, rock check dam) along ditches or the bottom of slopes.

Ideally, impoundment BMPs should be located within the site near the sediment source. Roadside ditches and old drainage channels can also be used as sediment entrapment areas upon installation of permeable or impermeable berms. Sediment traps or basins should be installed at perimeters of construction sites, especially where they are adjoining sensitive environmental areas. Sedimentation traps or basins may be constructed by excavation of an earth dyke and installation of a granular berm as an outlet flow structure.

Regular inspection, maintenance and excess sediment removal will ensure that adequate capacity and drainage is maintained.

4.2.5 Best Management Practices for Water Management

Water management BMPs are measures which can be implemented on-site or off-site. These are intended to control water and reduce erosion potential by following these general principles:

- Keep clean water clean, by diverting clean water around the site and by conveying clean water from undisturbed areas within the site to natural receiving streams;
- Minimize watercourse disturbance by using existing drainage where possible and by integrating on-site drainage into the project design;
- Design new drainage channels to accommodate design discharges and use natural channel design for watercourse diversions; and
- Anticipate and manage groundwater where applicable.

Commonly used water management BMPs are listed in Part II Table 8, where the applicability of each BMP to each roadway construction site is noted.

5.0 INSPECTION AND MAINTENANCE

At the construction contract phase and before final acceptance of construction contract works, the construction contractor will be responsible for maintenance of the temporary erosion control works installed under the Environmental Construction Operation (ECO) Plan and the consultant will be responsible for the permanent erosion control works installed in accordance with the requirements of the permanent ESC Plan. Joint co-operation efforts by the construction contractor and consultant will be required as construction approaches completion.

The requirement for erosion and sedimentation control measures may extend beyond completion of the construction activities and after final acceptance of the construction contract. As such, continued inspection and maintenance of erosion and sedimentation control measures may be required after the completion of construction.

At the post-construction phase (after final acceptance of the contract works by AT) the Maintenance Contract Inspector (MCI) and AT's Maintenance Contractor will be responsible for continued inspection and maintenance. The respective maintenance responsibilities at the Construction Phase and Post-Construction Phase are described in the Section 5.1 and Figure 5.1.

5.1 Maintenance Responsibilities (from construction phase to maintenance phase)

The maintenance responsibilities at construction phase and post-construction phase are described as follows (a schematic summary is presented in Figure 5.1).

i) Before the issue of Construction Completion Certificate (or Conditional Construction Completion Certificate), the construction contractor is responsible to maintain all erosion and sediment control installations (including winter shutdown or any other shutdown periods).

ii) At and prior to issue of the above Completion Certificate, the consultant shall ensure effective transfer of maintenance responsibility from Construction Contract Phase to Maintenance Contract Phase in the following manner (reference AT Construction Bulletin #12):

   a) It is the consultant's responsibility to indicate suitable maintenance procedures for all erosion control devices remaining in-place following construction completion. If the erosion control device (or BMP) is included in the department's Erosion and Sediment Control Manual, reference can be made to the applicable sections in that Manual document. If the device is not included in the Manual document, the consultant shall provide proper maintenance procedures for that device.

   b) The consultant shall provide this information in the form of a written document or as-built drawings detailing the location of each device and the maintenance procedures required (methods, type of equipment, frequency, etc.) to the department's project sponsor prior to the construction completion inspection.

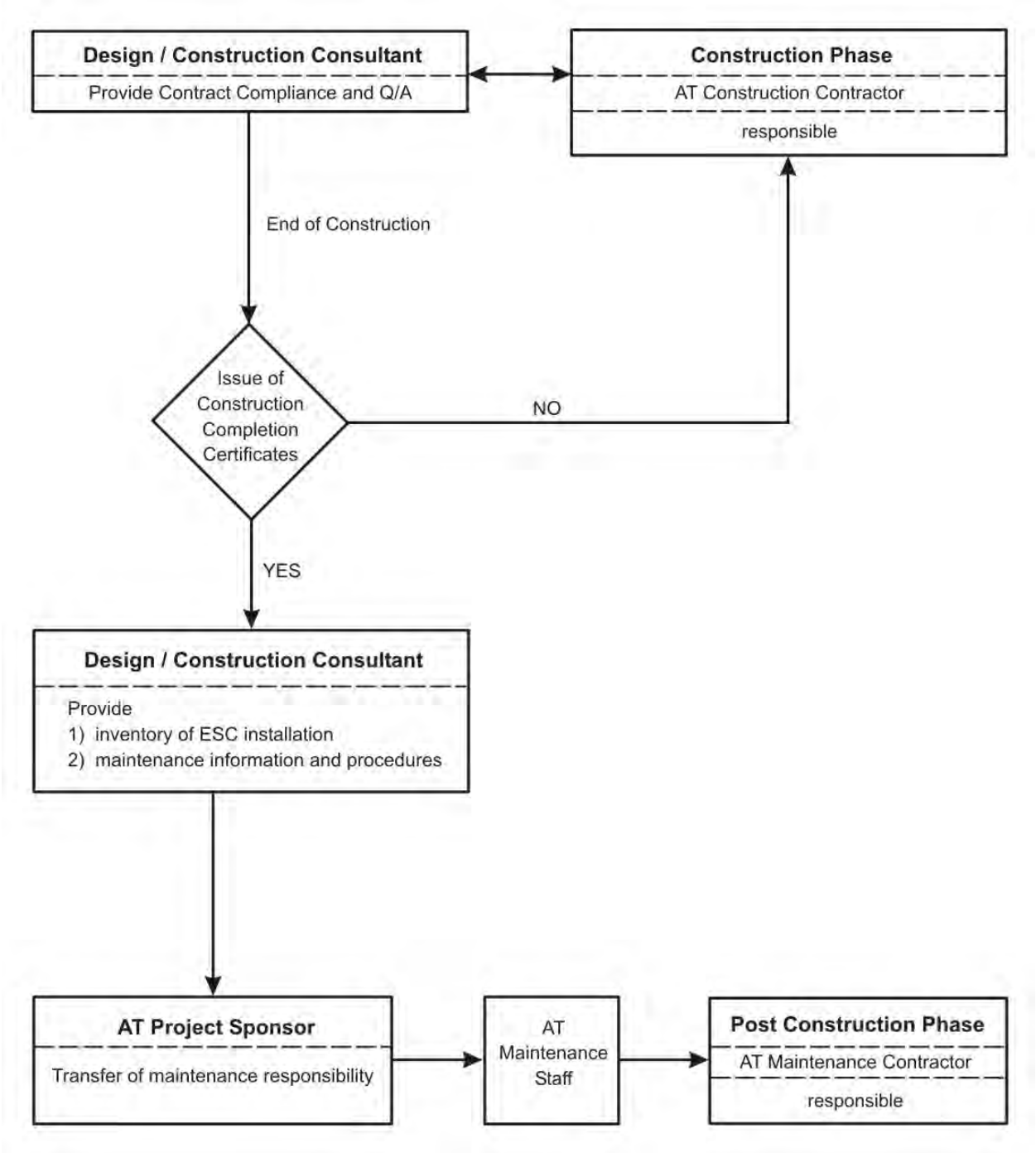

Figure 5.1: Maintenance Responsibilities – Construction Phase & Post Construction Phase - Erosion & Sediment Control (ESC) Installation

5.2 Temporary and Permanent Works

During construction and shutdown intervals, the inspection and maintenance of the erosion and sediment control measures are the responsibility of the contractor or appointed designate.

A schedule of planned inspection and maintenance activities for temporary works is required from the contractor with the submission of the Environmental Construction Operation (ECO) Plan and should be followed. When implemented controls are not sufficient or not working as intended, changes to temporary erosion and sedimentation control plans must be made to ensure continued compliance.

Any similar schedule of planned inspection and maintenance required for permanent erosion and sediment control works under the contract's overall design should be implemented by the contractor as well. The need for changes to the permanent erosion and sedimentation control designs may become evident during the construction phases. The consultant should undertake periodic observations of the performance of the temporary ESC structures and any installed permanent ESC structures and make adjustments to their ESC designs accordingly. The consultant should inform the contractor of his observations and any need for repairs, improvement or upgrades.

Guidelines for inspection and maintenance are provided for individual BMPs presented in Part II of this field guide. Some measures such as straw bale barriers, silt fences and inlet protection devices require periodic replacement and/or removal of accumulated sediment. Sediment basins (traps and ponds) require periodic sediment removal when the storage level is one third to one half full.

All inspections and maintenance works performed on the erosion and sediment control measures should be recorded on the "Inspection and Maintenance Form", presented in Part II Table 9.

5.3 Deactivation of Sediment Control Measures

Inspection and maintenance must continue until the BMP is no longer required, at which time the BMP will have to be properly removed. The following circumstances and conditions for deactivation will signal removal of BMPs:

- Revegetation of bare soil was successful;
- No obvious erosion scour is observed;
- No obvious bedload of silt and sediment laden runoff is observed;
- Inspection and maintenance report indicates satisfactory performance for past 3 years; and
- AT maintenance staff will assess and decide on performance of the structures and requirement for necessary removal.

Deactivation of sediment control measures should occur only after the above circumstances and conditions for deactivation are satisfied. AT maintenance staff must be satisfied that the continued monitoring information indicates permanent erosion

control methods have been successful in reducing the site erosion potential to the point where permanent sedimentation measures are no longer required. In some cases permanent sediment control measures will have been implemented that do not require deactivation. Where applicable, deactivation procedures are provided on the sediment control BMP information sheets. Perimeter control sedimentation control measures should be deactivated last.

5.4 Records

The consultant or their designate, must maintain an inspection record of any maintenance, damages or deficiencies of erosion and sediment control measures. The contractor has a responsibility to maintain housekeeping records of their own inspection and maintenance efforts for due diligence; and the records should be made available to AT, AT's consultant and/or his designate. A field inspection and subsequent inspection report must be undertaken every 7 days (or every 2 weeks dependent on BMP types) and following heavy rainstorms or snowmelt events. The same document can be used to record maintenance and repairs undertaken after the inspection. It is the responsibility of the consultant or designate to design and implement the inspection and maintenance record. The record must be signed by the consultant or their designated inspector and must be available for review by AT's inspectors at any time. Upon completion of the construction, the consultant is expected to provide copies of the inspection and maintenance record, including a complete list of what, and where, erosion and sedimentation control structures were installed, and any recommendations for continued inspection and maintenance requirements. This information will be provided to AT operations staff and contracted maintenance forces for incorporation into their work plans.

A copy of the Inspection and Maintenance Form is presented in Part II Table 9. A full size version is presented in the entitled "Erosion and Sediment Control Manual".

PART II

LIST OF TABLES

LIST OF BMPs

Erosion Control

BMP #	BMP Description
13	Rolled Erosion Control Products (RECP)
14	Riprap Armouring
15	Cellular Confinement System (refer to Manual for details)
21	Offtake Ditch
22	Seeding
25	Topsoiling
26	Sodding
34	Slope Texturing
36	**Polyacrylamide (PAM)** (refer to Manual for details)
37	**Compost Blanket**

Sediment Control

BMP #	BMP Description
1	Silt Fence
4	Continuous Perimeter Control Structures (refer to Manual for details)
5	Berm Interceptor
6	Storm Drain Inlet Sediment Barrier
12	Straw Bale Barrier
17	Energy Dissipators
18	Sediment Traps and Basins
19	Slope Drains
20	Groundwater Control (refer to Manual for details)
38	**Rolls** (refer to Manual for details)
38	Wattles (Live Fascine) (refer to Manual for details)

Erosion and Sediment Control

BMP #	BMP Description
2	Gabions
7	Rock Check Dam
10	Synthetic Permeable Barrier
23	Mulching
24a	Hydroseeding (refer to Manual for details)
24b	Hydromulching (refer to Manual for details)
30	Riparian Zone Preservation
31	Pumped Silt Control Systems (refer to Manual for details)
32	Scheduling
33	Stabilized Worksite Entrances
35	**Straw Mulching & Crimping** (refer to Manual for details)

Streambank Stabilization Techniques

BMP #	BMP Description
27a	**Live Staking**
27b	**Brushlayering**
38	**Rolls** (refer to Manual for details)
39	**Brush Mattress** (refer to Manual for details)
40	**Live Siltation** (refer to Manual for details)
41	**Willow Post and Poles** (refer to Manual for details)
42	**Rock Vanes** (refer to Manual for details)
43	**Longitudinal Stone Toe** (refer to Manual for details)
44	**Vegetated Mechanical Stabilized Earth (VMSE)** (refer to Manual for details)
45	**Vegetated Riprap** (refer to Manual for details)

Note:

BMPs not commonly used are not presented in this Field Guide. Details of complete BMPs are contained in the "Erosion and Sediment Control Manual".

New BMP items have been **bolded** in the list.

Users of this manual are cautioned that these BMPs are for guidance only and that a specific site design is required by the engineer or designer.

DRAWING LISTING

BMP #1	Silt Fence
BMP #2a	Gabions (Slope and Bank)
BMP #2b	Gabions (Single Gabion) Drop Structure for Ditch Channel
BMP #2c	Gabions (Double Gabion) "Energy Dissipator" Drop Structure for Ditch Channel
BMP #5	Berm Interceptor
BMP #6a	Storm Drain Drop Inlet Sediment Barrier (Block and Gravel - Option 1)
BMP #6b	Storm Drain Curb Inlet Sediment Barrier (Block and Gravel – Option 2)
BMP #6c	Storm Drain Curb Inlet Sediment Barrier (Sandbags – Option 1)
BMP #6d	Storm Drain Curb and Gutter Sediment Barrier
BMP #6e	Storm Drain Drop Inlet Sediment Barrier (Straw Bale/Gravel Option)
BMP #6f	Storm Drain Drop Inlet Sediment Barrier (Silt Fence – Option)
BMP #7	Rock Check Dam
BMP #10	Synthetic Permeable (ditch) Barriers
BMP #12	Straw Bale Barrier
BMP #13a	Rolled Erosion Control Product (RECP) Channel Installation
BMP #13b	Rolled Erosion Control Product (RECP) Slope Installation
BMP #14a	Riprap Armouring for Slope
BMP #14b	Riprap Armouring for Channel
BMP #17a	Energy Dissipator for Culvert Outlet
BMP #17b	Energy Dissipator for Semi-Circular Trough Drain Terminal Protection for Bridge Headslope
BMP #18b	Typical Sediment Basin (Permeable Rock Berm Outlet Option)
BMP #19a	Slope Drain
BMP #19b	Overside Drain
BMP #21	Offtake Ditch
BMP #22	AT Seed Mixture Zones
BMP #27a	Live Staking
BMP #27b1	Brushlayering with Rock Toe Protection
BMP #27b2	Brushlayering
BMP #27b3	Brushlayering
BMP #33	Temporary Gravel Construction Entrance/Exit
BMP #34a	Surface Roughening
BMP #34b	Grooved or Serrated Slope
BMP #34c	Stepped or Terraced Slope

Part II – Table 1: Planning Strategies and Procedural BMPs for ESC Plans

BMP	Applications				Comments	
	Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
Minimize Exposed Soils	✓	✓	✓	✓	Decreases erosion potential and decreases quantity of erosion and sediment control measures required thus decreasing costs	May require topsoiling/seeding be completed on areas before stripping of new areas
Observe Environmental Timing Restrictions	✓	✓	✓	✓	Minimizes possible negative impacts on fish and wildlife	May affect project schedule
Maximize Work During Favourable Weather	✓	✓	✓	✓	Minimizes volume of work required in less desirable (wet) conditions, thus decreasing potential for erosion and sediment transport	May require additional resources to increase scale of production/construction
Install BMPs Early	✓	✓	✓	✓	Minimizes sediment losses during construction	May cause difficulties with site access or traffic
Avoid Wet Weather Periods	✓	✓	✓	✓	Minimizes erosion potential	Shutdowns may prolong/delay construction activities
Topsoil and Seed Early	✓	✓	✓		Covers exposed soil and reduces erosion potential	
Surface Roughening (Slope Texturing)	✓		✓	✓	Reduces erosion: estimated 12% for a dozer ripping on the contour, 52% for track walking up and down the slope, 54% for sheep's foot rolling, and 76% for imprinting (Mike Harding, 2010)	Equipment may need to be retasked at a slight increase in construction cost
Preserve and Use Existing Drainage Systems	✓	✓	✓	✓	Minimizes exposed soils in drainage system	May affect scheduling of certain construction activities
Control Construction Traffic				✓	Avoids over-trafficking sensitive areas or areas with increased disturbance	Forcing traffic into localized areas may increase disturbance in high-traffic areas
Signage	✓	✓	✓	✓	Clearly labelling sensitive zones or areas not to be disturbed makes workers aware of work restrictions	Increased costs of signs

Part II – Table 1: Planning Strategies and Procedural BMPs for ESC Plans

BMP	Applications				Comments	
	Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
Scheduling of Work	✓	✓	✓	✓	Placement of topsoil and seeding should be scheduled throughout construction phase. New sections should not be stripped far in advance of construction	May require construction to be completed in one area before starting in another.
Stockpile Control				✓	Stockpiles should be located well away from watercourses and environmentally sensitive areas	May result in longer haul distances.
Direct Surface Water Flow Around Site	✓	✓	✓	✓	Keeps surface water from off-site from increasing erosion	Diversion ditches may require erosion and sediment control measures to be implemented.

Part II - Table 2: Application for BMPs Based on Construction Activities

BMP Name		Construction Activity								
		Clearing and Grubbing	Stripping	Borrow Pits	Stockpiles	Cut Slopes	Fill Slopes	Ditches/Channels	Culverts	Temporary Haul Roads
1.	Silt Fence	✓	✓	✓	✓	✓	✓		✓	✓
2.	Gabions							✓	✓	
4.	Continuous Perimeter Control Structures	✓	✓	✓	✓	✓	✓			✓
5.	Berm Interceptor	✓	✓	✓	✓	✓	✓			✓
6.	Storm Drain Inlet							✓	✓	
7.	Rock Check							✓		
10.	Synthetic Permeable Barrier							✓		
12.	Straw Bale Barrier			✓	✓	✓	✓			✓
13.	Rolled Erosion Control Products (RECP)				✓	✓	✓	✓		
14.	Riprap Armouring							✓	✓	
15.	Cellular Confinement System					✓	✓	✓		
17.	Energy Dissipators							✓	✓	
18.	Sediment Traps and Basins		✓					✓		
19.	Slope Drains					✓	✓			
20.	Groundwater Control			✓		✓	✓			
21.	Offtake Ditches		✓	✓	✓	✓	✓			
22.	Seeding			✓	✓	✓	✓	✓		
23.	Mulching			✓	✓	✓	✓	✓		
35	Straw Mulching and Crimping (Straw Anchoring)			✓		✓	✓			
24a.	Hydroseeding			✓	✓	✓	✓	✓		
24b.	Hydromulching			✓	✓	✓	✓	✓		
25.	Topsoiling			✓	✓	✓	✓	✓		
26.	Sodding			✓	✓	✓	✓	✓		
27a.	Live Staking					✓	✓	✓		
30.	Riparian Zone Preservation	✓	✓	✓	✓	✓	✓	✓	✓	✓
31.	Pumped Silt Control Systems							✓	✓	
32.	Scheduling	✓	✓	✓	✓	✓	✓	✓	✓	✓

BMP Name		Construction Activity								
		Clearing and Grubbing	Stripping	Borrow Pits	Stockpiles	Cut Slopes	Fill Slopes	Ditches/Channels	Culverts	Temporary Haul Roads
33.	Stabilized Worksite Entrances	✓	✓	✓	✓	✓	✓	✓	✓	✓
34.	Slope Texturing			✓	✓	✓	✓			✓
36.	Polyacrylamide (PAM)			✓		✓	✓	✓		
37.	Compost Blanket				✓	✓	✓			✓
38.	Rolls (Fibre)			✓	✓	✓	✓			

Part II - Table 3: Erosion Control Measures – Source Control

BMP #	BMP Name	Applications				Comments	
		Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
25	Topsoiling	✓	✓	✓	✓	Placing topsoil provides excellent medium for vegetation root structure development, organic content promotes plant growth, reuse organics (topsoil or peat) stripped from the site at start of grading; absorbs raindrop energy to minimize erosion potential	Cannot be effective without seeding and allowing time for plant growth; not appropriate for slopes steeper than 2H:1V (steep slopes will require soil covering over topsoil and specialized design); dry topsoil susceptible to wind erosion, susceptible to erosion prior to establishment of vegetation
22	Seeding	✓	✓	✓	✓	Inexpensive and relatively effective erosion control measure, effectiveness increases with time as vegetation develops, aesthetically pleasing, enhances terrestrial and aquatic habitat	Must be applied over prepared surface (topsoiled), grasses may require periodic maintenance (mowing), uncut dry grass may be a fire hazard, seeding for steep slopes may be difficult, seasonal limitations on seeding effectiveness may not coincide with construction schedule, freshly seeded areas are susceptible to runoff erosion until vegetation is established, reseeding may be required for areas of low growth
23	Mulching	✓	✓	✓	✓	Used alone to protect exposed areas for short periods, protects soil from rainsplash erosion, preserves soil moisture and protects germinating seed from temperature extremes, relatively inexpensive measure of promoting plant growth and slope protection	Application of mulch on steep slopes may be difficult, may require additional specialized equipment. May deplete available nitrogen. Nitrogen rich fertilizer may need to be added

Part II - Table 3: Erosion Control Measures – Source Control

BMP #	BMP Name	Applications				Comments	
		Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
24a 24b	Hydroseeding / Hydromulching	✓	✓	✓	✓	Economical and effective on large areas, mulch tackifier may be used to provide immediate protection until seed germination and vegetation is established, allows revegetation of steep slopes where conventional seeding/mulching techniques are very difficult, relatively efficient operation, also provides wind erosion control	Site must be accessible to hydroseeding / hydromulching equipment (usually mounted on trucks with a maximum hose range of approximately 150 m), may require subsequent application in areas of low growth as part of maintenance program
26	Sodding	✓	✓	✓	✓	Provides immediate vegetation and protection, instant buffer strip and/or soft channel lining, can be used on steep slopes, relatively easy to install, may be repaired if damaged, aesthetically pleasing	Expensive, labour intensive to install, sod may not be readily available in all areas of the province, relatively short 'shelf-life' (sod can't be stored on-site for excessive periods of time)
14	Riprap Armouring	✓	✓			Most applicable as channel lining with geotextile underlay, used for soils where vegetation not easily established, effective for high velocities or concentrations, permits infiltration, dissipates energy of flow from culvert inlets/outlets, easy to install and repair, very durable and virtually maintenance free	Expensive, may require heavy equipment to transport and place rock, may not be feasible in areas of the province where rock is not readily available, may be labour intensive to install; generally thickness of riprap is higher when compared to gabion mattress
13	Rolled Erosion Control Products (RECP)	✓	✓			Provides a protective covering to bare soil or topsoiled surface where need of erosion protection is high, can be more uniform and longer lasting than mulch, wide range of commercially available products	RECP use is labour intensive to install, temporary blankets may require removal prior to restarting construction activities, RECP not suitable for rocky slopes, proper site preparation is required to seat RECP onto soil correctly; high performance is tied to successful vegetation growth

Part II - Table 3: Erosion Control Measures – Source Control

BMP #	BMP Name	Applications				Comments	
		Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
15	Cellular Confinement System	✓	✓			Lightweight cellular system and easily installed, uses locally available soils for fill to reduce costs	Not commonly used in Alberta highway construction, expensive, installation is labour intensive (hand installation), not suitable for slopes steeper than 1H:1V
27a	Live Staking	✓		✓		Establishes vegetative cover and root mat, reduces flow velocities on vegetative surface, traps sediment laden runoff, aesthetically pleasing once established, grows stronger with time as root structure develops, usually has deeper root structure than grass	Expensive, may be labour intensive to install, not commonly used in Alberta highway construction projects, revegetated areas are subject to erosion until plants are established, plants may be damaged by wildlife, watering is usually required until plants are established
30	Riparian Zone Preservation	✓	✓	✓	✓	Preserve a native vegetation buffer to filter and slow runoff before entering sensitive (high risk) areas, most effective natural sediment control measure, slows runoff velocity, filters sediment from runoff, reduces volume of runoff on slopes	Freshly planted vegetation for newly created riparian zones requires substantial periods of time before they are as effective as established vegetation at controlling sediment
32	Scheduling	✓	✓	✓	✓	Identifies protection issues and plans for efficient, orderly construction of BMPs; minimizes bare soil exposure and erosion hazard; allows early installation of perimeter control for sediment entrapment; and early installation of runoff control measures	
34	Slope Texturing	✓			✓	Roughens slope surface to reduce erosion potential and sediment yield; suitable for clayey soils	Additional cost; not suitable for silty and sandy soils; not practical for slope length <8 m for dozer operation up/down slope

Part II - Table 3: Erosion Control Measures – Source Control

BMP #	BMP Name	Applications				Comments	
		Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
36	Polyacrylamide (PAM)	✓	✓		✓	Increase cohesion of soil particles, thus enhancing terrestrial and aquatic habitat and improving water quality	Not for application to surface waters. Not commonly used in highway construction projects and may be expensive. Treatment area must be accessible to spray equipment. Temporary measure only. Performance decreases due to exposure to UV light and time
35	Straw Mulching & Crimping (Straw Anchoring)	✓			✓	Economical method of promoting plant growth and slope protection	Availability of straw. "Punching" of straw does not work on sandy soils. Application of straw by hand is labour intensive. If using straw blowers, treatment area must be accessible to trucks
37	Compost Blanket	✓		✓	✓	Economical. Appropriate on slopes 2H:1V to level surface	Application on steep slopes may be difficult. Treatment area should be accessible to blower trucks

Part II - Table 4: Erosion Control Measures – Runoff Control

BMP #	BMP Name	Applications				Comments	
		Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
34	Slope Texturing	✓		✓	✓	Contouring and roughening (tracking) of slope face reduces runoff velocity and increases infiltration rates; collects sediment; holds water, seed and mulch better than smooth surfaces; promotes development of vegetation, provides reduction in soil erosion compared with untracked slopes	May increase grading costs, may cause sloughing in sensitive (wet) soils, tracking may compact soil, provides limited erosion control and should not be used as primary control measure
21	Offtake Ditch	✓		✓	✓	Collects and diverts sheet flow or runoff water at the top of a slope to reduce downslope erosion, incorporated with permanent project drainage systems	Channel must be sized appropriately to accommodate anticipated flow volumes and velocities, lining may be required, may require design by qualified personnel, must be graded to minimize ponding
17	Energy Dissipator	✓	✓			Slows runoff velocity and dissipates flow energy to non-erosive level in relatively short distances, permits sediment collection from runoff	Small diameter rocks/stones can be dislodged; grouted riprap armouring may breakup due to hydrostatic pressures, frost heaves, or settlement; may be expensive, may be labour intensive to install; may require design by qualified personnel
19	Slope (Down) Drains	✓				Directs surface water runoff into drain pipe or lined channel instead of flowing over and eroding exposed soils of slope face	Must be sized appropriately to accommodate anticipated flows, erosion can occur at inlet/outlet if protection is not incorporated into design, slope drain pipe must be anchored to slope

Part II - Table 4: Erosion Control Measures – Runoff Control

BMP #	BMP Name	Applications				Comments	
		Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
2	Gabions		✓			Relatively maintenance free, permanent drop structure, long lasting, may be less expensive than riprap, allows smaller diameter rock/stones to be used, relatively flexible, commercially available products, commonly used in Alberta highway construction projects; suitable for resisting high flow velocity	Construction may be labour intensive (hand installation), extra costs associated with gabion basket materials
7	Rock Check Dam		✓		✓	Permanent drop structure with some filtering capability, cheaper than gabion or armouring entire channel, easily constructed, commonly used in Alberta highway construction projects	Can be expensive in areas of limited rock source, not appropriate for channels draining areas larger than 10 ha, requires maintenance after high flow storm events, can fail if water undermines or outflanks structure
10	Synthetic Permeable Barriers		✓			Reusable/moveable, reduces flow velocities and dissipates flow energy; retains some sediments; used as grade breaks in conjunction with sturdy permanent drop structures along steep grades	Not to be used as check structures, must be installed by hand in conjunction with RECP, become brittle in winter and are easily damaged by construction equipment or recreational vehicles, only partially effective in retaining some sediment
20	Groundwater Control (Subsurface Drain)	✓				Relief of subsurface groundwater seepage and winter ice build-up; lowers groundwater table to minimize piping erosion; enhances slope stability performance	Requires design by a qualified person; can be a slope instability issue

Part II - Table 4: Erosion Control Measures – Runoff Control

BMP #	BMP Name	Applications				Comments	
		Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
38 28	Rolls (Fibre) Wattles	✓				Function well in freeze-thaw conditions, low cost solution to sheet flow and rill erosion on slopes, low to medium cost flow retarder and silt trap, can be used on slopes too steep for silt fences or straw bale barriers, biodegradable	Labour intensive to install (hand installation), designed for slope surfaces with low flow velocities, designed for short slope lengths with a maximum slope of 2H:1V, not currently widely used on Alberta highway construction projects
4	Continuous Perimeter Control Structures	✓		✓	✓	Economical, no trenching required, flexible with continuous contact with ground. Appropriate on slopes 2H:1V to level surface	Application on steep slopes may be difficult. Treatment area should be accessible to blower trucks if installing compost berm

Part II - Table 5: Sediment Control Measures

	BMP Name	BMP #	Applications				Comments	
			Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
Filtering and Entrapment	Riparian Zone Preservation	30	✓	✓	✓	✓	Preserve a native vegetation buffer to filter and slow runoff before entering sensitive areas, most effective natural sediment control measure	Freshly planted vegetation for newly created riparian zones requires substantial periods of time before they are as effective as established vegetation at controlling sediment
	Straw Bale Barrier	12	✓		✓	✓	Relatively inexpensive if bales are locally available, biodegradable, cheaper and easier to install than other barriers	Short service life due to biodegradation, straw bales may not be readily available in all areas of the province, maximum barrier height of one straw bale, require extensive maintenance after high flow storm events, require proper keying and staking
	Rolls (Fibre) Wattles	38 28	✓				Function well in freeze-thaw conditions, low cost solution to sheet flow and rill erosion on slopes, low to medium cost flow retarder and silt trap, can be used on slopes too steep for silt fences or straw bale barriers, biodegradable	Labour intensive to install (hand installation), designed for slope surfaces with low flow velocities, designed for short slope lengths with a maximum slope of 2H:1V, not widely used on Alberta highway construction projects
	Pumped Silt Control Systems (Silt Bags)	31		✓			Filter bag is lightweight and portable, simple set up and disposal, sediment-laden water is pumped into this filter bag, different aperture opening sizes (AOS) available from several manufacturers; normally for emergency use only	May be expensive, requires special design, not usually used in Alberta highway construction projects, requires a pump and power source for pump, suitable for only short periods of time and small volumes of sediment laden water, can only remove particles larger than aperture opening size (AOS)

Part II - Table 5: Sediment Control Measures

	BMP Name	BMP #	Applications				Comments	
			Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
	Silt Fence	1	✓		✓	✓	Economical, most commonly used sediment control measure allows water to pond and settle out coarse grained sediment, more effective than straw bale barriers	May fail under high runoff events, applicable for sheet flow erosion only, limited to locations where adequate space is available to pond collected runoff, sediment build up needs to be removed on a regular basis, damage to silt fence may occur during sediment removal, usable life of approximately one year
Filtering and Entrapment	Berm Interceptor	5	✓		✓	✓	Easy to construct, relatively inexpensive as local soil and material is used	Geotechnical design required for fill heights in excess of 3 m, may not be suitable for all soil types or sites; riprap spillway and/or permeable outlet may be required
	Gabions	2		✓			Relatively maintenance free, permanent drop structure, long lasting (robust), may be less expensive and thickness than riprap, allows smaller diameter rock/stones to be used, relatively flexible, commercially available products, commonly used in Alberta highway construction projects; suitable for resisting high flow velocity	Construction may be labour intensive (hand installation), extra costs associated with gabion basket materials
	Rock Check Dam	7		✓		✓	Permanent drop structure with some filtering capability, cheaper than gabion and armouring entire channel, easily constructed, commonly used in Alberta highway construction projects	Can be expensive in areas of limited rock source, not appropriate for channels draining large areas, requires extensive maintenance after high flow storm events, susceptible to failure if water undermines or outflanks structure

Part II - Table 5: Sediment Control Measures

BMP Name		BMP #	Applications				Comments	
			Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
Filtering and Entrapment	Synthetic Permeable Barriers	10		✓			Reusable/moveable, reduces flow velocities and dissipates flow energy; retains some sediments; used as grade breaks in conjunction with sturdy permanent drop structures along steep grades	Partially effective as check dam structure, must be installed by hand in conjunction with RECP, become brittle in winter and are easily damaged by construction equipment or recreational vehicles, only partially effective in retaining some sediment, primarily used for reducing flow velocities and energy dissipation
	Continuous Perimeter Control Structures	4	✓		✓	✓	Temporary measure; divert and intercept sheet or overland flow to form pond and allow sedimentation; no trenching	Require specialized continuous berm machine to manufacture earth-filled geotextile berm on site; sandy/gravel soil is preferable fill material
	Storm Drain Inlet/Sediment Barrier	6			✓		Temporary measure; easy to install and remove	Limited sediment entrapment capacity; requires regular clean-out maintenance
	Compost Blanket	37	✓		✓	✓	Economical. Appropriate on slopes 2H:1V slope or flatter	Application on steep slopes may be difficult. Treatment area should be accessible to blower trucks
All BMPs	Scheduling	32	✓	✓	✓	✓	Identifies protection issues and plans for efficient, orderly construction of BMPs; early installation of perimeter control for sediment entrapment; early dimension planning of sediment control measures	

Part II - Table 5: Sediment Control Measures

BMP Name		BMP #	Applications				Comments	
			Slopes	Ditches and Channels	Large Flat Surface Areas	Borrow and Stockpile Area	Advantages	Limitations
Impoundment	Sediment Traps/Basins	18		✓		✓	May be constructed of a variety of materials, collects sediment laden runoff and reduces velocity of flow and deposition of sediment, can be cleaned and expanded as needed, capable of handling large volumes of sediment laden runoff	"Last resort" measure. Normally requires 250 m^3/ha storage volume per area of exposed soil, Can require large areas of land, requires periodic maintenance to remove sediment build up, requires design by qualified personnel, usually requires 'back-up' control measures in case pond/basin overflows

PART II - Table 6: Surface Water Management BMPs for ESC Plans

Name	Slopes	Natural Channels	Drainage Channels	Pipes and Culverts	Large Flat Surface	Borrow / Stockpile	Comments	Temporary	Permanent
Divert Clean Water Around the Site	✓	✓	✓	✓	✓	✓	Clean water drainage from upstream areas should be diverted around the construction site wherever practical, to reduce the quantity of water that must be managed on site. This can be done using ditches, berms, pipes or culverts	✓	
Keep Clean Water on the Site Clean	✓	✓	✓	✓	✓	✓	Clean water drainage from undisturbed areas within the construction site should be collected and allowed to discharge to receiving streams without being mixed with runoff from disturbed areas	✓	
Use Existing Drainage		✓	✓	✓			Existing watercourses tend to be well-vegetated and have natural rates of erosion. Discharges from the construction site containing natural levels of sediment should be conveyed to existing, undisturbed watercourses. Care should be taken to ensure that peak flows in the existing watercourse should not be increased significantly	✓	
Integrate New Drainage into the Project Design		✓	✓	✓			If it is necessary to construct new ditches, pipes or culverts for on-site surface water management, integrating these with the project design will prevent future disturbance due to removal of temporary measures	✓	✓
Keep Drainage Areas Small	✓	✓	✓	✓	✓	✓	Smaller drainage areas generally require less complex erosion control measures and smaller drainage channels, so they are preferred if local topography permits. By discharging from a number of small discharge points rather than a few large ones, the size of sediment control measures is reduced and the magnitude of effects from a potential failure is reduced	✓	✓
Design Drainage Channels Appropriately		✓	✓				Drainage channels should be designed with appropriate depths, slopes, cross-sections and linings (armoured or vegetated). Natural channel design is recommended for watercourse diversions.	✓	✓
Manage Shallow Groundwater	✓					✓	Slopes, excavations and areas around retaining walls may be sensitive to piping failure or erosion due to high porewater pressures. These can be managed by temporary dewatering or by incorporating permanent drains to reduce porewater pressures. Gravel blankets can also be installed to protect the ground surface. Dewatering wells, if properly screened, may produce clean water and be suitable for direct discharge to receiving streams.	✓	✓

Source: Transportation Association of Canada, 2005

PART II - Table 7: BMPs for Streambank Applications

BMP #	BMP Name	Category	Also Known As
38.	Rolls (Fibre)	Bank Armour and Protection	Coir Rolls and Coir Mats
27a.	Live Staking	River Training	Live Staking
27b.	Brushlayering	River Training	Live Brushlayering
39.	Brush Mattress	Bank Armour and Protection	Live Brush Mattress, Brush Mat
40.	Live Siltation	River Training	Vertical Brushlayering
41.	Willow Posts & Poles	River Training	Pole Planting, Dormant Live Posts
42.	Rock Vanes	River Training	Rock Vanes, Upstream Angled Spurs
43.	Longitudinal Stone Toe	River Training	Longitudinal Peaked Stone Toe Protection (LPSTP), Stone Toe, Rock Toe, Stone Toe Buttress, Weighted Riprap Toe, Longitudinal Fill Stone Toe Protection (LFSTP)
44.	Vegetated Mechanically Stabilized Earth (VMSE)	River Training	Vegetated Geogrids, Brushlayering with Soil Wraps, Vegetated Geofabric Wrapped Soil
45.	Vegetated Riprap	Bank Armour and Protection	Vegetated Rock Revetment, Vegetated Rock Slope Protection (VRSP), Face Planting, Joint Planting

Note: Adapted from E-SenSS Software, 2005, Salix Applied Earthcare

PART II - Table 8: BMPs for Streambank Applications Based on Erosion Process

	BMP 38 Roll (Fibre)	BMP 27a Live Staking	BMP 27b Brushlayering	BMP 39 Brush Mattress	BMP 40 Live Siltation	BMP 41 Willow Posts & Poles	BMP 42 Rock Vanes	BMP 43 Longitudinal Stone Toe	BMP 44 VMSE	BMP 45 Vegetated Riprap
Erosion Process										
Toe erosion with upper bank failure	✓				✓		✓	✓		✓
Scour of middle and upper banks by currents		✓	✓	✓	✓	✓	✓		✓	✓
Local scour	✓	✓	✓	✓	✓	✓	✓			✓
Erosion of local lenses or layers of non-cohesive sediment	✓	✓	✓	✓	✓	✓			✓	✓
Erosion by overbank runoff			✓							
General Bed Degradation										
Headcutting										
Piping										
Erosion by navigation waves	✓	✓			✓	✓				✓
Erosion by wind waves	✓	✓			✓	✓				✓
Erosion by ice and debris gouging	✓							✓		✓
General bank instability or susceptibility to mass slope failure		✓	✓					✓	✓	
Spatial Application										
Instream							✓			
Toe	✓			✓	✓		✓	✓		✓
Midbank		✓	✓	✓		✓			✓	✓
Top of bank				✓						✓
Hydrologic / Geomorphic Setting										
Resistive	✓			✓				✓	✓	✓
Redirective							✓			
Continuous				✓	✓			✓	✓	✓
Discontinuous							✓		✓	
Outer Bend	✓			✓	✓		✓	✓	✓	✓
Inner Bend				✓					✓	
Incision								✓		
Lateral Migration	✓						✓			✓
Aggradation					✓		✓			
Complexity										
Low					✓	✓		✓		
Moderate	✓	✓	✓	✓			✓			✓
High									✓	

Note: Adapted from E-SenSS Software, 2005, Salix Applied Earthcare

PART II – Table 9: INSPECTION AND MAINTENANCE FORM

AT Contract Number: ______________________ Contractors on Site: ______________________
Construction Site Location: ______________________ Construction Activities on Site: ______________________
Heavy Equipment on Site: ______________________ Current Weather: ______________________
Date: ____________ mm of rain in last week: ________ Weather Forecast: ______________________
Date of Last Inspection: ____________ mm of rain in last 24 hours: ________ ______________________

Type of Measure (BMP)	Location on Construction Site	Intended Function	Sediment Levels	General Condition	General Performance	Maintenance Required	Type of Maintenance Required	Site Manager Notified	Date Repairs to be Completed By
			0 – 1/4 - 1/2 – 3/4 Full not applicable	poor fair good	poor fair good	yes no		yes no	
			0 – 1/4 - 1/2 – 3/4 Full not applicable	poor fair good	poor fair good	yes no		yes no	
			0 – 1/4 - 1/2 – 3/4 Full not applicable	poor fair good	poor fair good	yes no		yes no	
			0 – 1/4 - 1/2 – 3/4 Full not applicable	poor fair good	poor fair good	yes no		yes no	
			0 – 1/4 - 1/2 – 3/4 Full not applicable	poor fair good	poor fair good	yes no		yes no	
			0 – 1/4 - 1/2 – 3/4 Full not applicable	poor fair good	poor fair good	yes no		yes no	
			0 – 1/4 - 1/2 – 3/4 Full not applicable	poor fair good	poor fair good	yes no		yes no	
			0 – 1/4 - 1/2 – 3/4 Full not applicable	poor fair good	poor fair good	yes no		yes no	
Notes:									

Inspectors Signature: ______________________ Inspectors Name: ______________________

Copies to: AT Designated Inspector: ______________________ Contractors Site Designate: ______________________ ESC Plan Designer: ______________________

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BEST MANAGEMENT PRACTICES (BMPs)
Details

Silt Fence Sediment Control	B.M.P. #1

Description and Purpose

- Permeable fabric barriers installed vertically on support posts along contours to collect sediment laden sheet flow runoff
- Causes water to pond allowing sediment to settle out as water filters through fabric
- Entraps and minimizes coarse sediment from sheet flow or overland flow from entering waterbodies
- Perimeter control for sediment transport and deposition

Applications

- Temporary measure
- Used at bottom of cut or fill slopes to collect sediment laden runoff
- Used along streams (or channels) banks
- Used around stockpiles
- Midslope grade-break (using "J-hook" or "smile" pattern to effect ponding, filtering and sedimentation)

Construction

- Two methods of installation are commonly used
  - Trench method
  - Mechanical (slicing) installation method (e.g. Tommy Silt Fence Machine or equivalent)
- Trench Method
  - Select location of silt fence (usually along contours)
  - Drive support posts a minimum of 0.3 m into ground, spaced a maximum of 2 m apart
  - Excavate trench approximately 0.15 m deep by 0.15 m wide for entire length of fence along upstream side of posts
  - Attach the wire mesh or snow fencing, if used as reinforcement, to upstream side of posts with staples
  - Extend filter fabric to base of trench and attach over wire mesh or snow fence, if used, on upstream side of posts
  - Backfill and compact soil in trench, being careful not to damage fence

- Mechanical Installation Method
  - Select location of silt fence (usually along contours)
  - Use mechanical installation machine to embed the fabric a minimum of 0.15 m into the ground. One mechanical installation method is by slicing (with special equipment) the geotextile fabric embeds into the ground without excavation and backfill. There is only minor disturbance of the ground. Tamping of ground is required for compaction.
  - Drive support posts a minimum of 0.3 m into ground, spaced a maximum of 2 m apart
  - Attach the wire mesh or snow fencing, if used as reinforcement to silt fence fabric, to upstream side of posts with staples
  - Extend filter fabric to base of trench and attach over wire mesh or snow fence, if used, on upstream side of posts

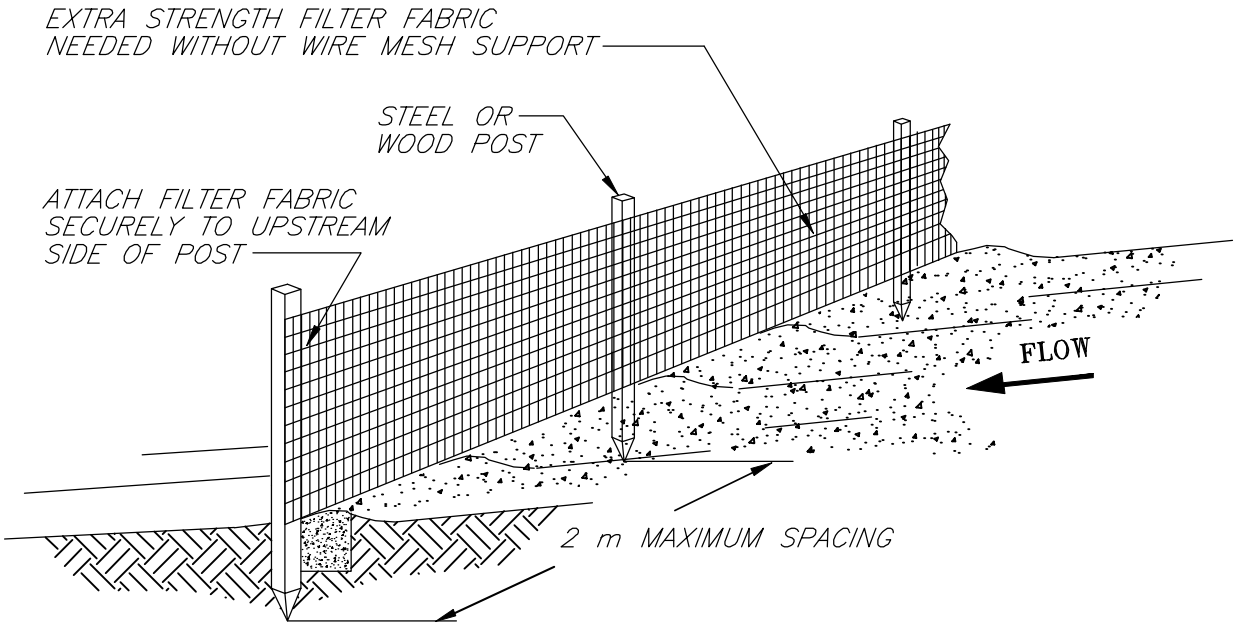
Construction Considerations

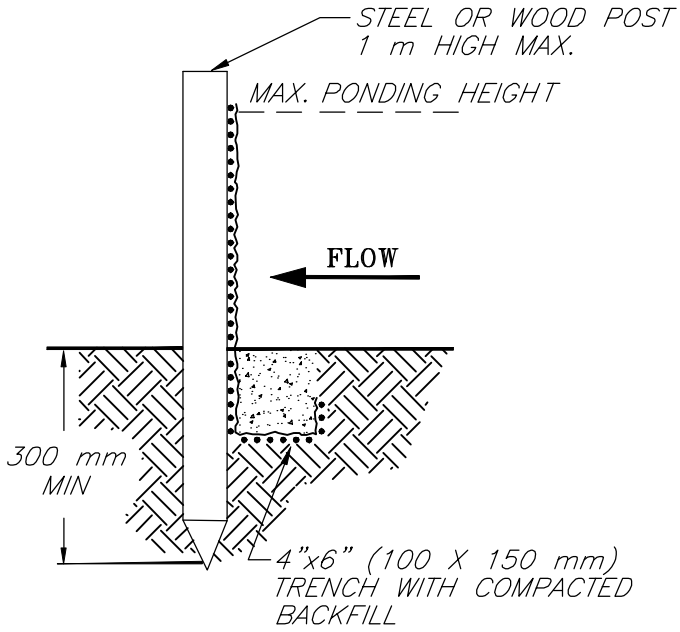
- Site Selection
  - Size of drainage area should be no greater than 0.1 ha per 30 m length of silt fence
  - Maximum flow path length above silt fence should be no greater than 30 m
  - Maximum slope gradient above the silt fence should be no greater than 2H:1V
- Fence should be placed on contour to produce proper ponding
- Fence should be placed far enough away from toe of slope to provide adequate ponding area (minimum of 1.8 m away from toe of slope is recommended)
- Ends of fence should be angled upslope to collect runoff
- Fence should not extend more than 0.6 m above grade
- Posts can be wood or metal material dependent on design and ground conditions
- Posts should be placed on downstream side of fence
- Posts should not be spaced greater than 2 m apart
- Wire mesh or standard snow fencing may be placed between the posts and fabric barrier to provide additional strength and support reinforcement
- Geotextile should be cut from a continuous roll to avoid joints (if joints are necessary, the wrapping of fabric around the fence post and a minimum overlap of 0.2 m with staples should be used to attach the fabric to the post)

- Fence (and wire mesh or snow fence, if used) should be attached to posts with heavy duty staples, tie wires, or hog rings
- Fence (and wire mesh or snow fence, if used) should be dug into a trench at least 0.15 m deep to prevent undercutting of fence by runoff
- Trench backfill should be compacted
- Long runs of silt fence are more prone to failure than short runs
  - Maximum length of each section of silt fence should be 40 m
  - Silt fence should be installed in 'J' hook or 'smile' configuration, with maximum length of 40 m, along contours allowing an escape path for ponded water (minimizes overtopping of silt fence structure)

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Repair undercut fences and repair or replace split, torn, slumping or weathered fabric immediately
- Sediment build up should be removed once it accumulates to a depth of 0.2 m
- Remove fence after vegetation is established
- Deactivate fabric by cutting-off top portion of fabric above ground; bottom trenched-in portion of fence fabric can be left in-ground thus minimizing ground disturbance





TRENCH METHOD DETAIL

NOTES:

1. SILT FENCE SHALL BE PLACED ON SLOPE CONTOURS TO MAXIMIZE PONDING EFFICIENCY.
2. INSPECT AND REPAIR FENCE DAILY AND AFTER EACH STORM EVENT AND REMOVE SEDIMENT WHEN ACCUMULATED SILT REACHES 200 mm.
3. REMOVED SEDIMENT SHALL BE DEPOSITED TO AN AREA WILL NOT CONTRIBUTE SEDIMENT OFF-SITE.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

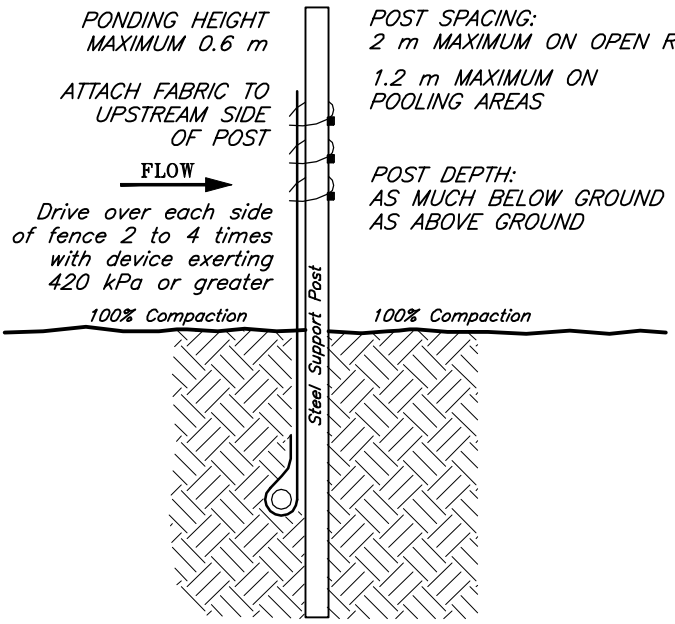
NOT TO SCALE

SILT FENCE

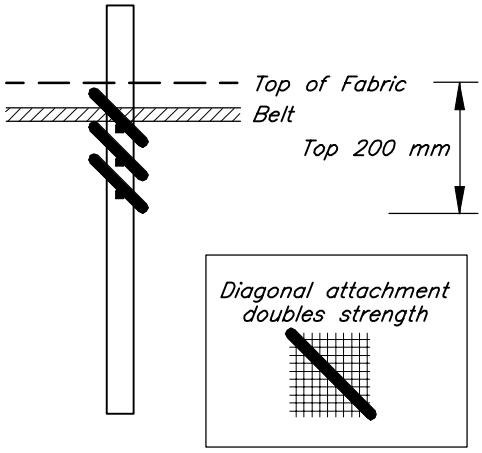
(TRENCH METHOD)

FILE: SILTFENC

Government of Alberta ■
Transportation



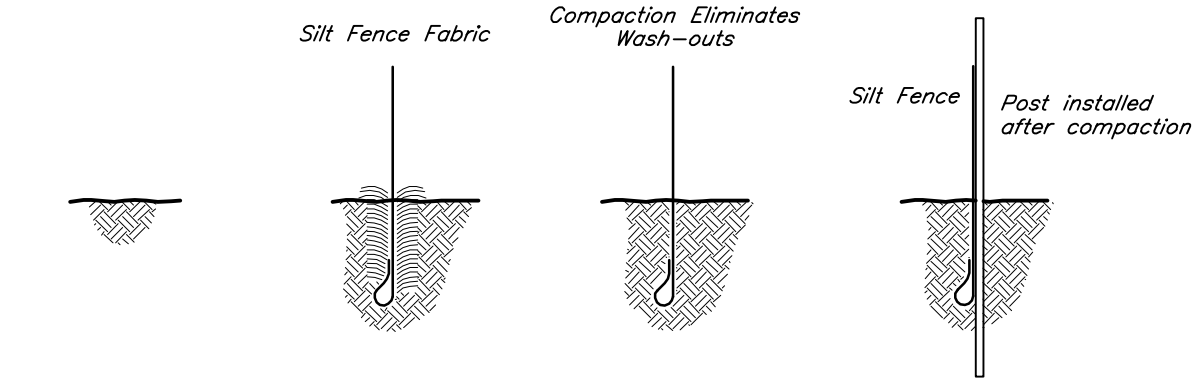
NO MORE THAN 0.6 m OF A 0.9 m FABRIC
IS ALLOWED ABOVE GROUND



ATTACHMENT DETAILS:

- Gather fabric at posts, if needed.
- Utilize three ties per post, all within top 200 mm of fabric.
- Position each tie diagonally, puncturing holes vertically a minimum of 25 mm apart.
- Hang each tie on a post nipple and tighten securely.
- Use cable ties (50 lbs) or soft wire.

MECHANICAL (SLICING) METHOD



a) Before Installation

b) During fabric insertion. Disrupted soil.

c) After Compaction. Greater stability.

d) Completed Installation

MECHANICAL (SLICING) METHOD INSTALLATION SEQUENCE

NOTES:

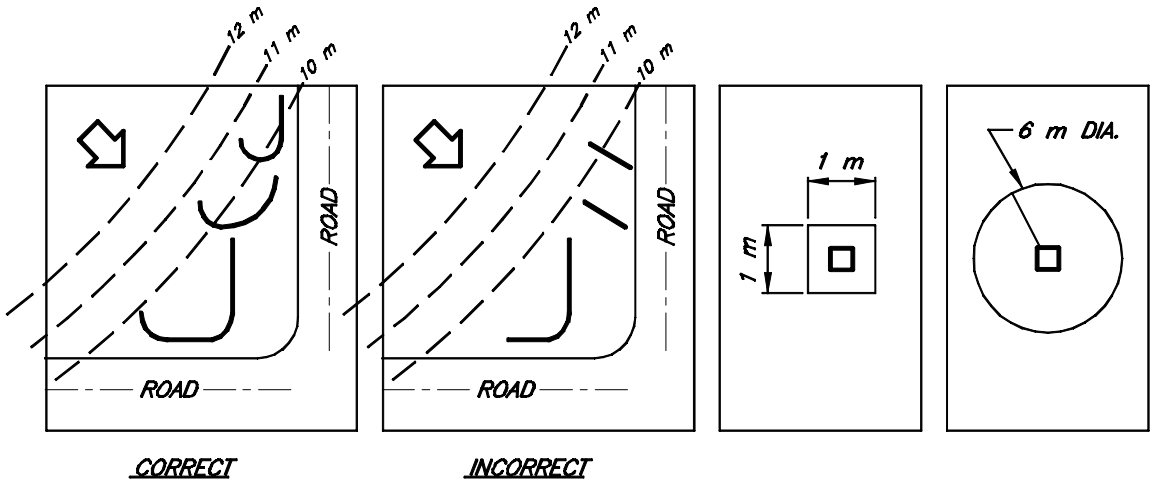
1. INSTALLATION MACHINE MUST ALLOW CONTINUOUS SLICING AND EMBEDMENT OF GEOTEXTILE INTO GROUND WITH MINOR GROUND DISTURBANCE.
2. INSTALLATION MACHINE TYPES WILL VARY WITH MANUFACTURER.
3. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

NOT TO SCALE

SILT FENCE

(MECHANICAL METHOD)

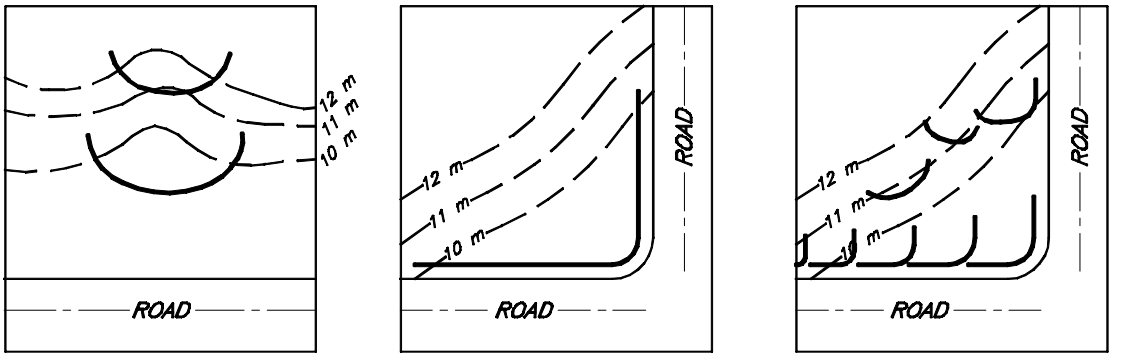
SOURCE: CARPENTER T. 2000



CORRECT INCORRECT

"J" CONFIGURATION

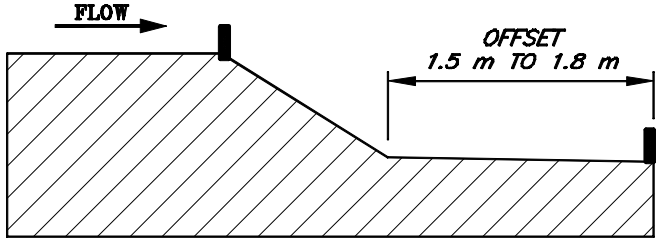
SILT FENCE BARRIER AT STORM INLET



"SMILE" CONFIGURATION

AVOID LONG INSTALLATION

COMBINATION OF "SMILE" AND "J" CONFIGURATIONS



LOCATION AT TOP AND BOTTOM OF SLOPE

NOT TO SCALE

NOTE:

1. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

SOURCE: CARPENTER T. 2000

SILT FENCE
(CONFIGURATION PLAN)

Gabions (a - c) Erosion Control and Sediment Control	B.M.P. #2 (a-c)

Description and Purpose

- Consist of rock placed inside wire baskets to protect steep or erodible slopes from sheet flow erosion
- Protects erodible stream channel banks from potentially high erosive concentrated flow velocities or high tractive forces

a) Slope and Banks

b) Single Gabion Drop Structure for Ditch Channel

c) Double Gabion "Energy Dissipator" Drop Structure for Ditch Channel

Applications

- Permanent measure
- May be used on stream bank aprons and blankets where flow velocities do not exceed 6 m/s
- May be constructed to 0.5H:1V as a low height slope toe protection structure
- May be used on slopes up to 1.5H:1V as slope protection, a grade break and flow check
- Gabion matting is an alternative to riprap armouring of channels
- May be used to construct dikes or weirs
- Used as a drop structure (check structure) to reduce grade between structures and as flow check in channels
- Used as a splash pad to slow down flow velocity and dissipate flow energy

Construction

- Prepare subgrade at designated gabion location on mineral soil
- Excavate trench a minimum of 0.15 m deep to 'key-in' gabion structure
- Construct gabion basket as per manufacturer’s recommendations
- Line interior of basket with non-woven geotextile OR a gravely sand filter layer (if required by design) along areas where the basket is in contact with soil
  - Geotextile must be non-woven fabric to act as a separator (filter) between rock-infill and subgrade soils to minimize infiltration of fine grained particles into the gabion structure
- Backfill basket with rock with wire bracing at 1/3 points (or 0.3 m spacings)

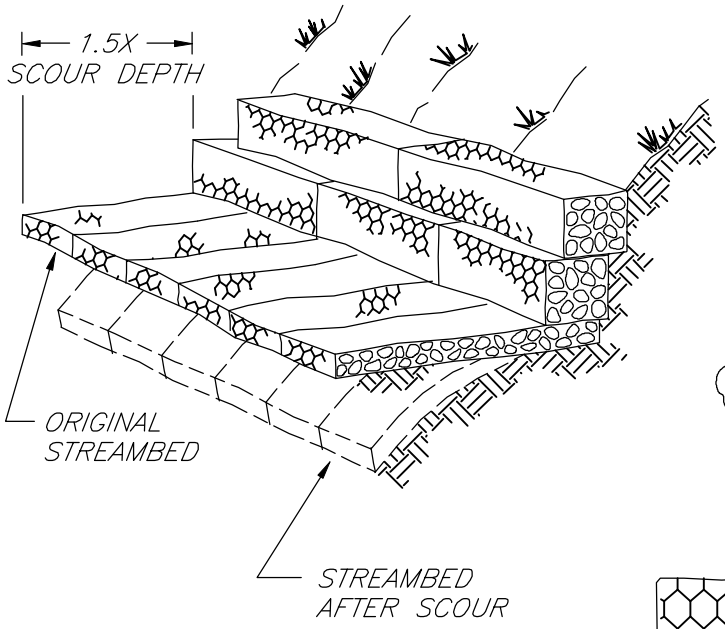
- Install gabion basket top
- Backfill trench and compact soil around edges of completed basket

Construction Considerations

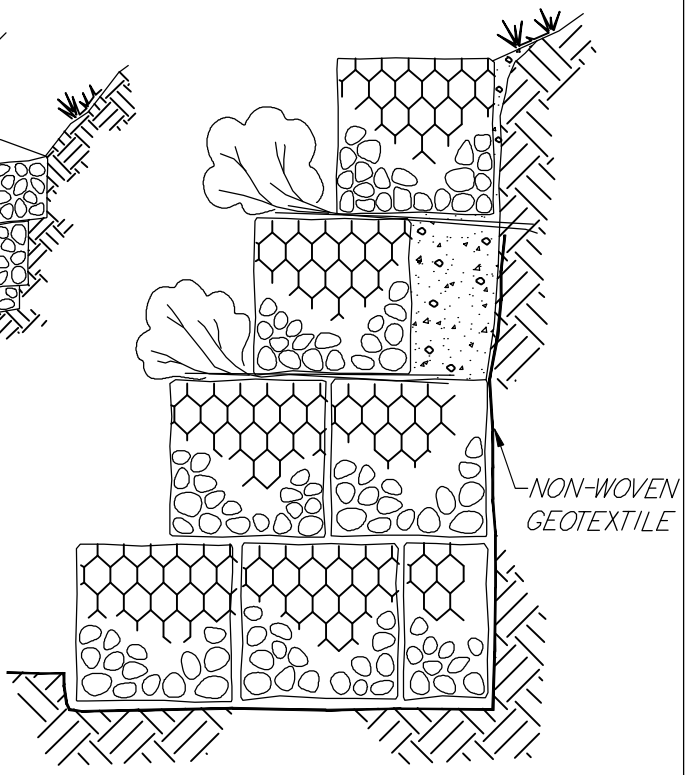
- Gabions should be placed on a properly graded surface
- Non-woven geotextile should be used to prevent loss of underlying material and infiltration of fine grained particles into the gabion structure
- Rock in the baskets may be placed by hand to enhance dense packing of stones and decrease void spaces
- Construct gabions with internal wire diaphragms to maintain structural stability and shape

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans and should be inspected after major storm events, especially where undermining at the toe of the gabion is a concern
  - Repair as necessary; repair may include hand grading and/or infilling undermined area with rocky material
- Removal of silt should be determined based on depth of siltation, channel erosion and establishment of vegetation

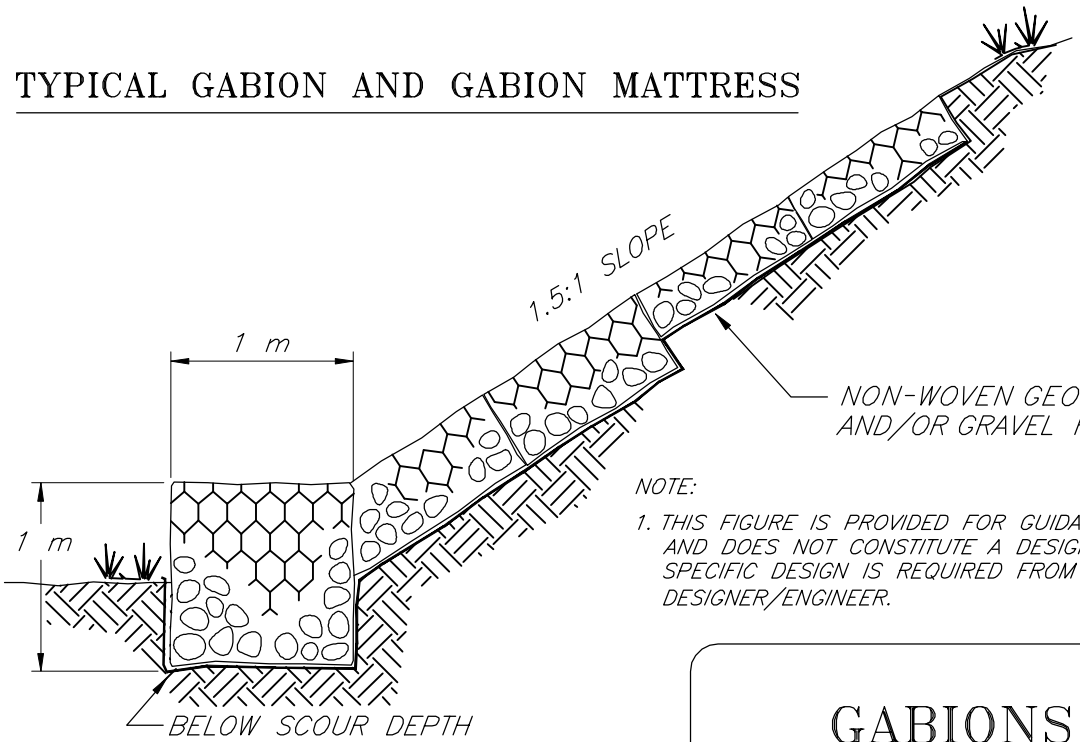


TYPICAL GABION APRON



TYPICAL VEGETATED ROCK GABION

TYPICAL GABION AND GABION MATTRESS



NOTE:

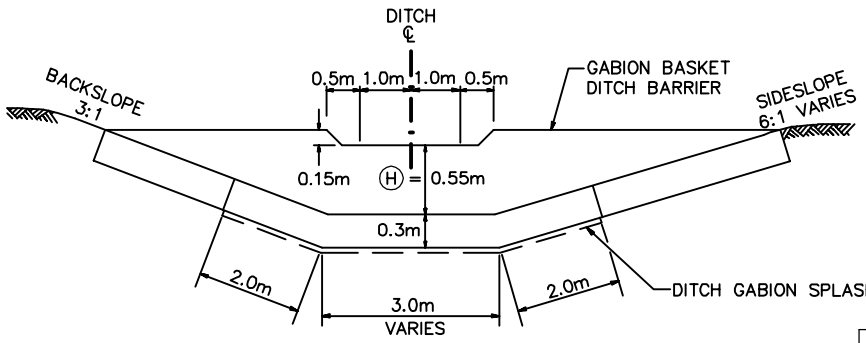
1. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

GABIONS
(SLOPE AND BANK)

FILE: GABIONS

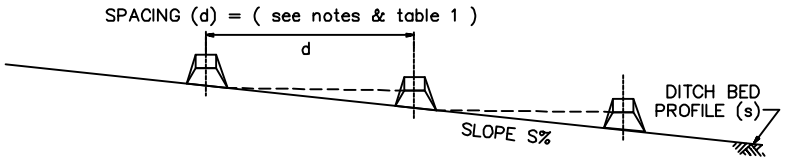
Government of Alberta ■
Transportation

B.M.P. #2a
Typical Section



FRONT VIEW FROM DOWNSTREAM
TYPICAL DITCH CROSS–SECTION
GABION BASKET DITCH BARRIER

N.T.S.

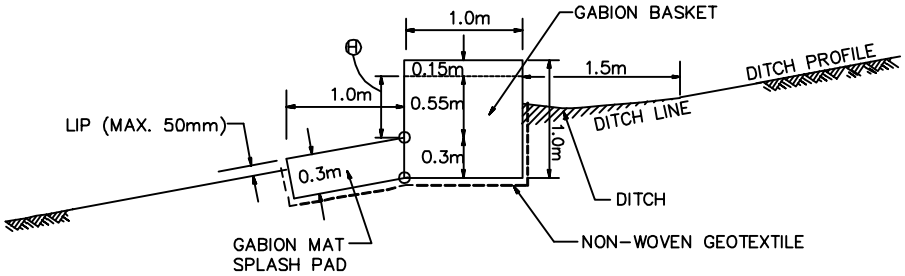


TYPICAL BARRIER SPACING

N.T.S.

SUGGESTED SPACING (d)		
S (%)	(m)	REMARKS
5–7	30	OPTION TO INSTALL A GRADE BREAK (s.a. WEAVE BARRIER) BETWEEN STRUCTURES.
7–8	25	A DOUBLE GABION FOLLOWS EVERY 2 SINGLE GABIONS.
>8%	≤15	DESIGN BY ENGINEER REQUIRED.

TABLE 1



CROSS–SECTION VIEW
"SINGLE GABION" BASKET DITCH BARRIER
& GABION MAT SPLASH PAD

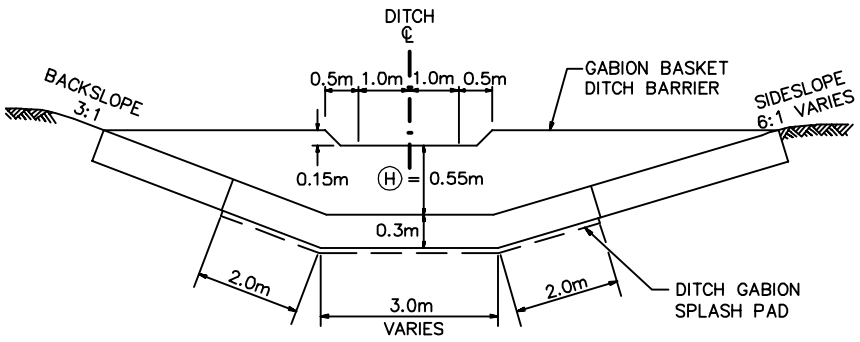
N.T.S.

NOTES:

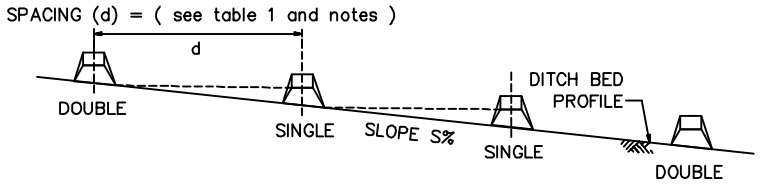
1. SUITABLE FOR MEDIUM TO STEEP GRADES AND CHANNELS LEADING TO WATER COURSE 4% < S < 10%.
2. i) SPACING TO BE DETERMINED BY ENGINEER BASED ON HYDRAULIC CONDITIONS.

   ii) USE IN CONJUNCTION WITH DOUBLE GABIONS OR OTHER BARRIER STRUCTURES.
3. SOIL COVERING BETWEEN STRUCTURES SUGGESTED FOR STEEP GRADE SOIL DITCH.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

GABIONS
SINGLE GABION DROP STRUCTURE FOR DITCH CHANNEL



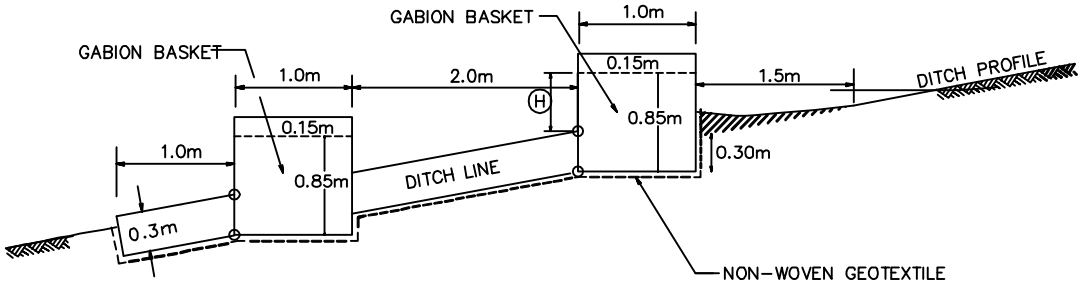
FRONT VIEW FROM DOWNSTREAM
TYPICAL DITCH CROSS–SECTION
GABION BASKET DITCH BARRIEP
N.T.S.



TYPICAL BARRIER SPACING
N.T.S.

SUGGESTED SPACING (d)		REMARKS
S (%)	(m)	
6–8	25	INTER–SPACED WITH 2 SINGLE GABIONS BETWEEN STRUCTURES
	35*	*SEE NOTES
>8%	≤15	DESIGN BY ENGINEER REQUIRED

TABLE 1



CROSS–SECTION VIEW
"DOUBLE GABION" ENERGY DISSIPATION GABION STRUCTURE
(TWO SINGLE GABIONS COMBINED)
N.T.S.

NOTES:

1. SUITABLE FOR STEEP GRADES (6%<S<12%) AND CHANNELS LEADING TO WATER COURSE
2. i) SPACING (d) TO BE DETERMINED BY ENGINEER BASED ON HYDRAULIC CONDITIONS.
   ii) USE IN CONJUNCTION WITH SINGLE GABION AND/OR OTHER GRADE BREAK STRUCTURES.
3. SUGGESTED TWO SINGLE GABIONS AT INTERVAL BETWEEN DOUBLE GABIONS.
4. SOIL COVERING BETWEEN STRUCTURES SUGGESTED FOR STEEP GRADE SOIL DITCH.
5. IF d* = 35 m at 7 to 8% GRADE
   - GRADE BREAK (s.a. PERMEABLE WEAVE BARRIER) SHOULD BE PLACED BETWEEN STRUCTURES.
   - LONG SPACING ALLOWABLE WHEN HYDRAULIC CONDITIONS NOT SEVERE.
6. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

GABIONS
DOUBLE GABION "ENERGY DISSIPATOR" DROP STRUCTURE FOR DITCH CHANNEL

Berm Interceptor Sediment Control	B.M.P. #5

Description and Purpose

- Earth dyke barrier constructed of compacted soil to intercept and divert flow of runoff water away from erodible slopes, sensitive areas or water bodies
- A spillway outlet of erosion-resistant granular material constructed to allow exit of diverted water to less sensitive areas

Applications

- Temporary or permanent measure
- Used instead of, or in conjunction with, diversion ditches
- Perimeter control
- Placed along contours and/or at toe of slope to divert run-off from sensitive areas
- Used to divert water to sediment control structures

Construction

- Construct barrier from bottom up by placing and compacting subsequent lifts of soil
- Degree of compaction of each lift to be specified by the design engineer based on consequences of failure

Construction Considerations

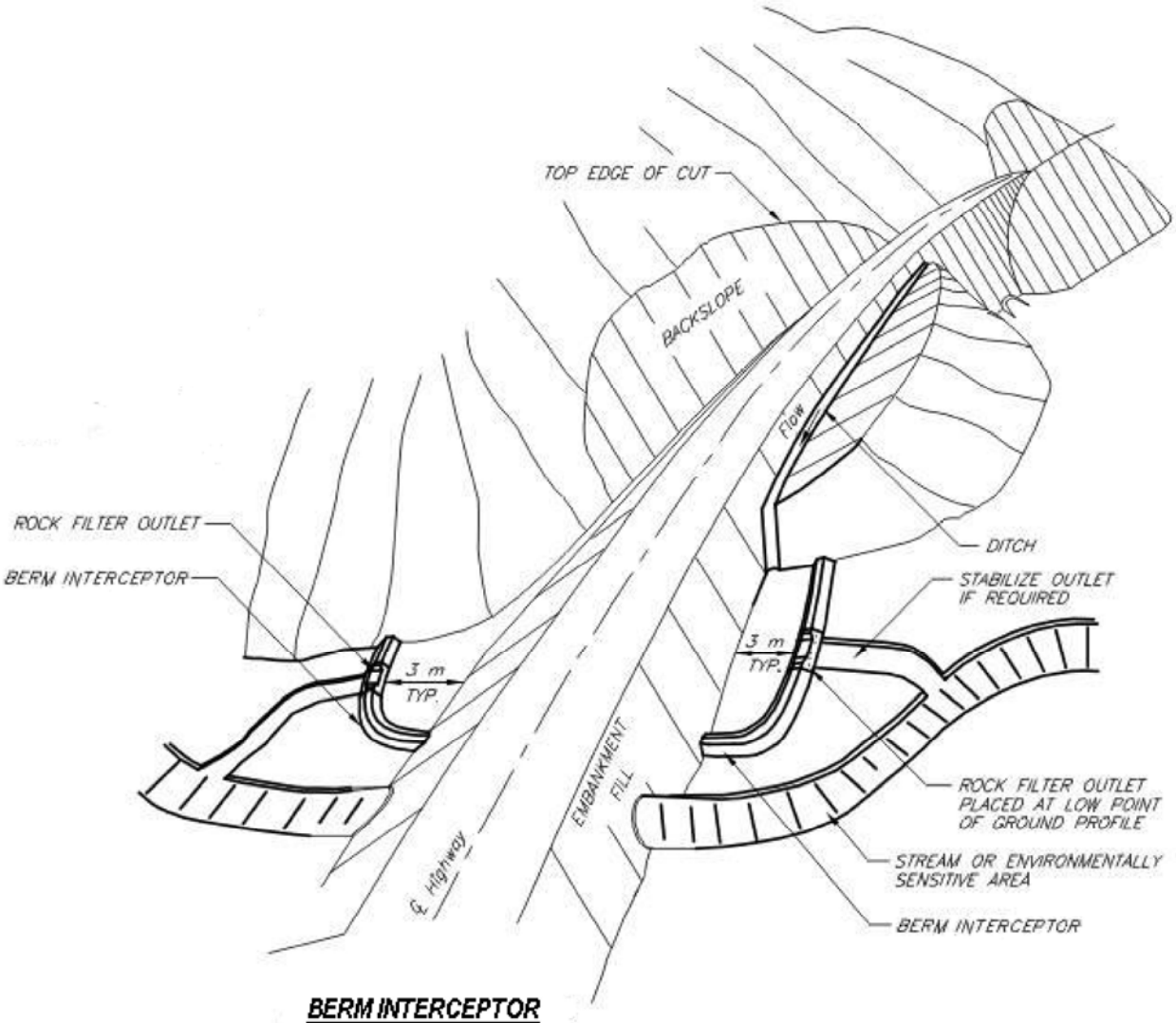
- The barrier should be trapezoidal in cross-section
- Low barriers should have the slopes suited to the construction material used
  - 1.5H:1V for granular soils
  - 2H:1V or flatter for compacted mixed or fine grained soils
    - Slope should be flattened to a minimum of 3H:1V for uncompacted fine grained soils

Inspection and Maintenance

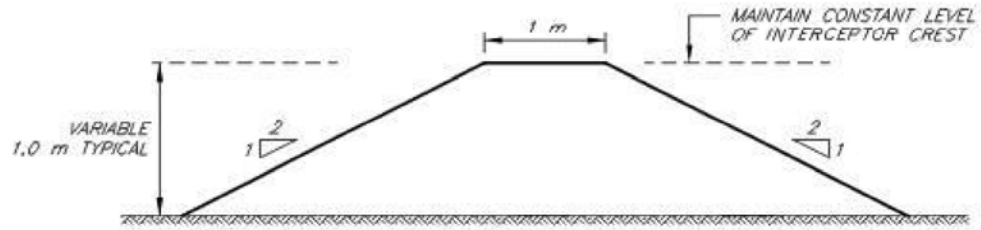
- The degree and extent of inspection and maintenance performed on a earth dyke barrier is directly related to the consequences of failure. An engineer experienced in embankment design and inspection may be required for design, inspection, design of remedial measures, and supervision of their implementation
- Inspection frequency should be in accordance with the PESC and TESC Plans

Berm Interceptor Sediment Control	B.M.P. #5

- Piping failures may be remedied by replacing saturated soils with drier compacted soil and/or by placement of geotextile over the failed area and placing a stabilizing toe berm constructed of granular materials
- Inspect for sediment accumulation and remove sediment when depths reach approximately one-half the barrier height
- Deactivate and remove barrier once slope soils have stabilized and return barrier location to an acceptable condition



BERM INTERCEPTOR
TYPICAL LOCATION



TYPICAL SECTION
BERM INTERCEPTOR

NOTES:
1. SILT ACCUMULATION TO BE REMOVED WHEN HALF BERM INTERCEPTOR HEIGHT COVERED.
2. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

BERM INTERCEPTOR

Government of Alberta
Transportation

Storm Drain Inlet Sediment Barrier (a-f) Sediment Control	B.M.P. #6 (a-f)

Description and Purpose

- Temporary devices constructed to minimize the amount of sediment entering a storm drain by ponding sediment laden runoff at the inlet
- Storm Drain Inlet protection can consist of the following measures:

a) Block and Gravel Sediment Barrier – Option 1

b) Block and Gravel Curb Inlet Sediment Barrier – Option 2

c) Sand Bag Curb Inlet Sediment Barrier – Option 1

d) Sand Bag Curb and Gutter Sediment Barrier – Option 2

e) Straw Bale / Gravel Sediment Barrier - Option

f) Silt Fence Sediment Barrier - Option

Applications

- Temporary measure
- Used where storm drains are operational prior to establishing vegetation on disturbed drainage areas
- Can be effective where drainage enters municipal sewers or watercourses
- Used for small, nearly level (less than 5% grade) drainage areas
- Used as curb inlet barriers in gently sloping ditches and gutters
- Used where drainage area is 0.4 ha (1 ac) or less
- Used in open areas subjected to sheet flow and concentrated flows less than 0.014 m^3/s (0.5 cfs)
- Block and gravel bag barriers are applicable when sheet flows or concentrated flows exceed 0.014 m^3/s (0.5 cfs) and is necessary to allow for overtopping to prevent flooding
- Excavated drop inlet sediment traps are appropriate where relatively heavy flows are expected and overflow capacity is required

Construction

- Place inlet sediment barrier around entrance to drain/pipe. The option appropriate for use is dependent on site conditions.
- Silt fence barrier can be used for soil surfaces

- Gravel or aggregate filled sand bags should be used for asphalt or concrete surfaces
- Aggregate filled sand bags
  - Place sand bags stacked one or two bags high around inlet
- Gravel barriers
  - Place concrete blocks stacked one or two blocks high, with cavities of blocks aligned with direction of flow, around inlet
  - Wrap 13 mm (1/2 inch) wire mesh around concrete blocks
  - Place 25 mm to 38 mm diameter rock around block and wire mesh assembly ensuring rock extends down from top of blocks to asphalt or concrete surfacing
- Gravel filter curb inlet
  - Place concrete blocks stacked one or two blocks high around inlet, with cavities of blocks aligned with direction of flow, forming a 'U' shape
  - Wrap 13 mm (1/2 inch) diameter wire mesh around concrete blocks
  - Place 25 mm to 38 mm diameter rock around block and wire mesh assembly ensuring rock extends down from top of blocks to asphalt or concrete surfacing

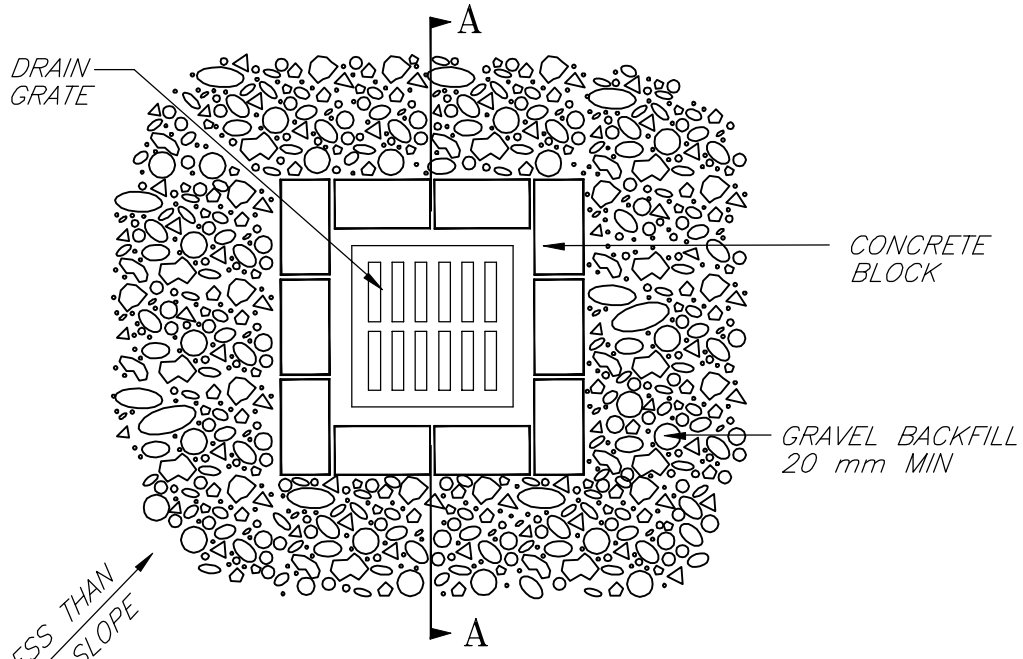
Construction Considerations

- Gravel or aggregate filled sand bags should be used for asphalt or concrete surfaces
- Aggregate filled sand bags
  - Sand bags should be filled with pea gravel, drain rock, or other free draining material
  - Gravel or aggregate filled sand bags should be filled only ¾ full to allow sand bag to be flexible to mould to contours, maintaining continuous contact with surface
  - Barrier should be placed at least 0.1 m from inlet to be protected
  - Several layers of sand bags should be overlapped and tightly packed against one another
  - A one sand bag wide gap should be left in the lowest point of the upper layer to act as an emergency spillway
- Gravel filter inlet berm and gravel filter curb inlet
  - Slope gravel towards inlet at a maximum slope of 2H:1V

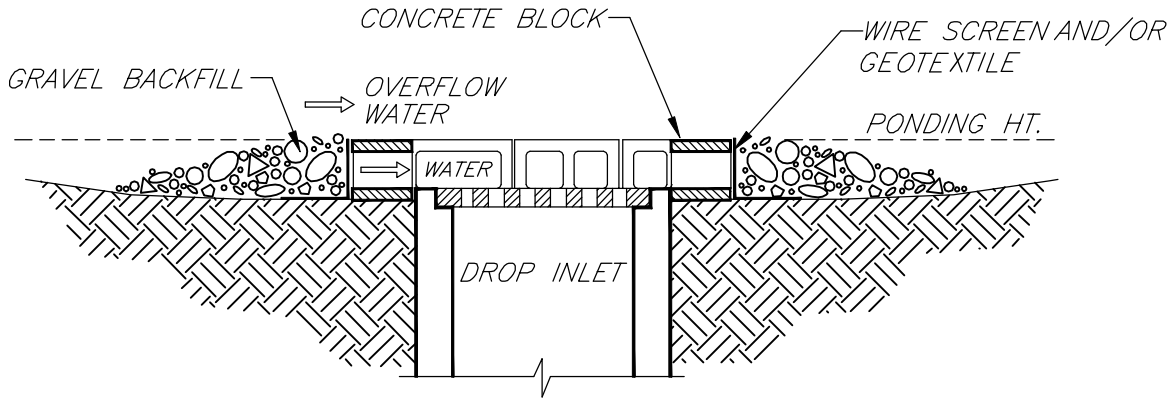
  - Maintain at least 0.3 m spacing between toe of gravel and inlet to minimize gravel entering inlet
  - 25 mm wire mesh may be placed over inlet to prevent gravel from entering inlet
- For drainage areas larger than 0.4 ha (1 ac) runoff should be directed towards a sediment retention device designed for larger flows before allowing water to reach inlet protection structure
- Use aggregate sand bags filled with 25 mm diameter rock in place of concrete blocks for gravel filter inlet berm or gravel filter curb inlet

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Remove sediment build up after each storm event
  - Sediment and gravel should not be allowed to accumulate on roads
- Replace gravel if it becomes clogged with sediment
- Remove all inlet protection devices when inlet protection is no longer required



PLAN VIEW



SECTION A – A

NOTES:

1. STORM DRAIN DROP INLET SEDIMENT BARRIERS ARE TO BE USED FOR SMALL, NEARLY LEVEL DRAINAGE AREAS. (LESS THAN 5%).
2. EXCAVATE A BASIN OF SUFFICIENT SIZE ADJACENT TO THE STORM DRAIN DROP INLET.
3. THE TOP OF THE STRUCTURE (PONDING HEIGHT) MUST BE WELL BELOW THE GROUND ELEVATION DOWNSLOPE TO PREVENT RUNOFF FROM BYPASSING THE INLET. A TEMPORARY DYKE MAY BE NECESSARY ON THE DOWNSLOPE SIDE OF THE STRUCTURE.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

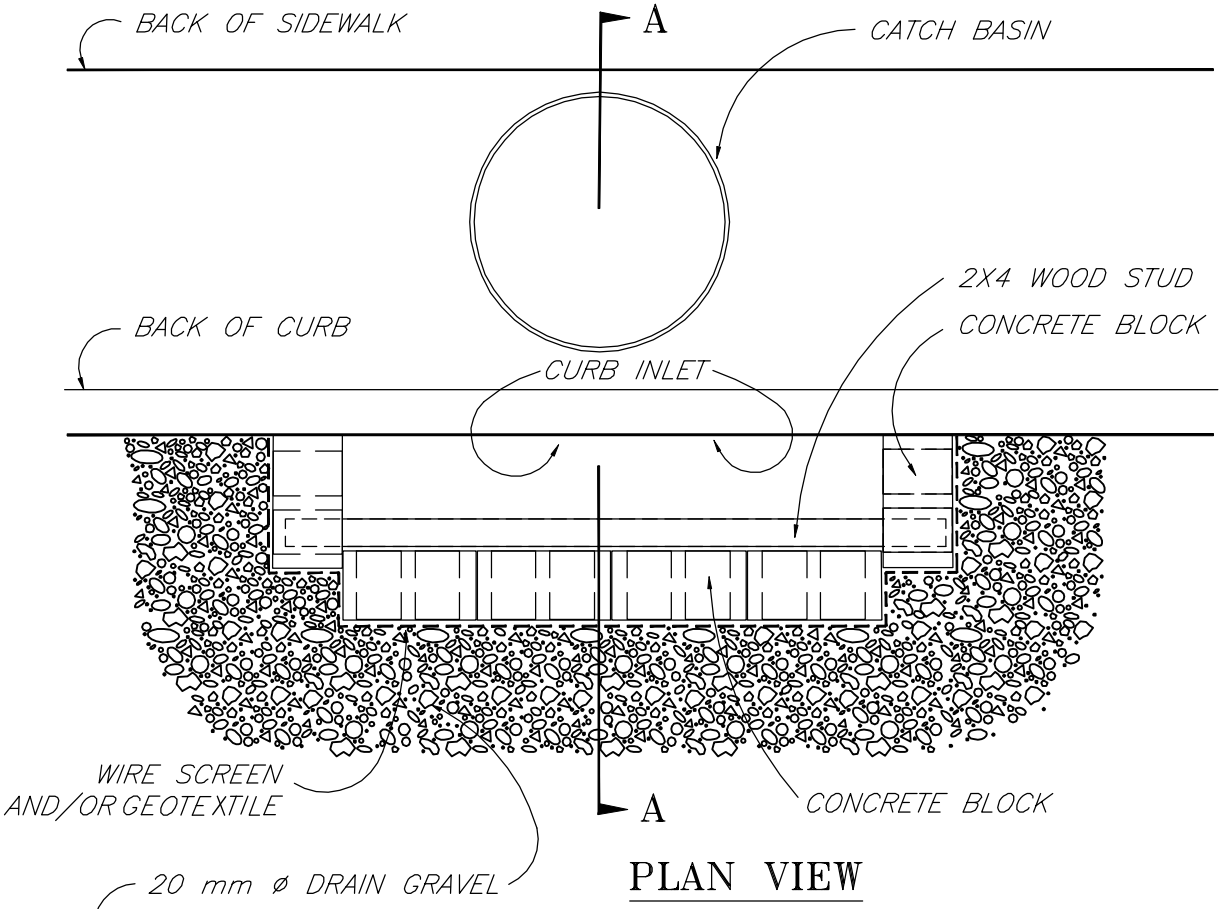
STORM DRAIN DROP INLET SEDIMENT BARRIER

(BLOCK AND GRAVEL – OPTION 1)

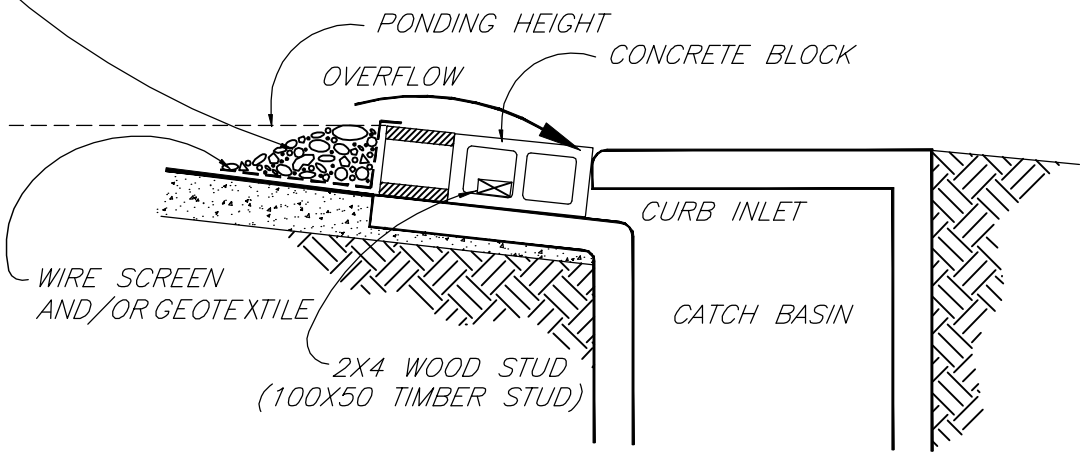
FILE: BGSEDBAR

Government of Alberta ■ Transportation

B.M.P. #6a
Typical Section



PLAN VIEW



SECTION A – A

NOTES:

1. USE BLOCK AND GRAVEL TYPE SEDIMENT BARRIER WHEN CURB INLET IS LOCATED IN GENTLY SLOPING STREET SEGMENT, WHERE WATER CAN POND AND ALLOW SEDIMENT TO SEPARATE FROM RUNOFF.
2. BARRIER SHALL ALLOW FOR OVERFLOW FROM SEVERE STORM EVENT.
3. INSPECT BARRIERS AND REMOVE SEDIMENT AFTER EACH STORM EVENT. SEDIMENT AND GRAVEL MUST BE REMOVED FROM THE TRAVELED WAY IMMEDIATELY.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

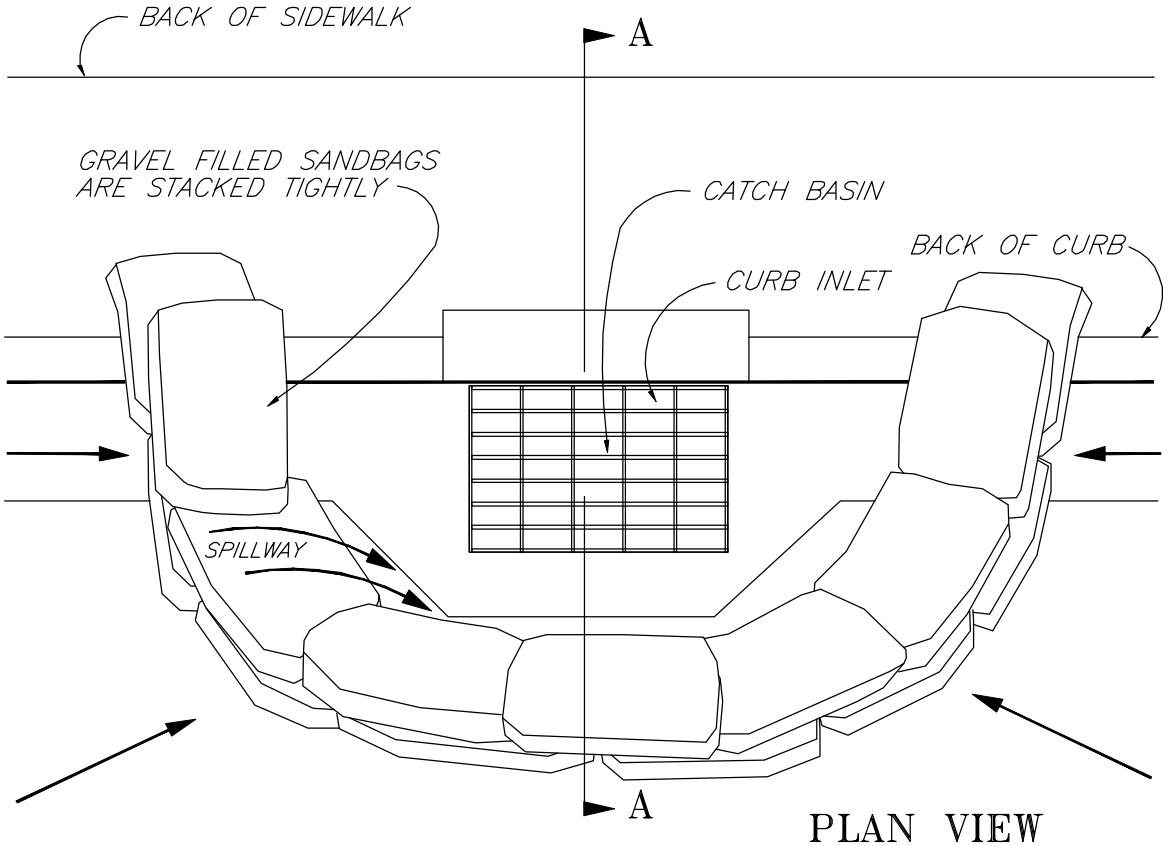
FILE: BLCKCURB

STORM DRAIN CURB INLET SEDIMENT BARRIER

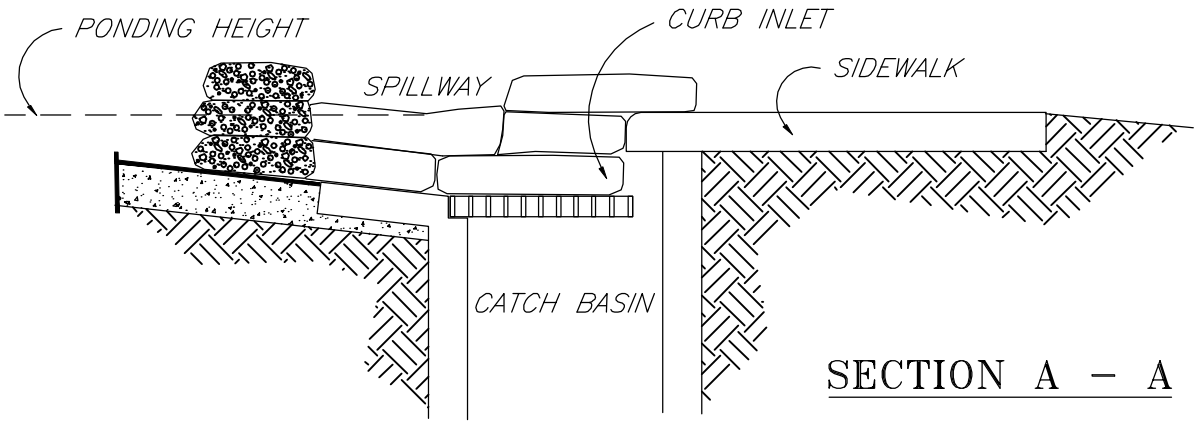
(BLOCK AND GRAVEL – OPTION 2)

Government of Alberta ■ Transportation

B.M.P. #6b
Typical Section



PLAN VIEW



SECTION A – A

NOTES:

1. PLACE CURB TYPE SEDIMENT BARRIERS ON GENTLY SLOPING STREET SEGMENTS WHERE WATER CAN POND AND ALLOW SEDIMENT TO SETTLE OUT.
2. SANDBAGS, OF EITHER BURLAP OR WOVEN GEOTEXTILE FABRIC, ARE FILLED WITH GRAVEL, LAYERED AND PACKED TIGHTLY.
3. LEAVE ONE SANDBAG GAP IN THE TOP ROW TO PROVIDE A SPILLWAY FOR OVERFLOW.
4. INSPECT BARRIERS AND REMOVE SEDIMENT AFTER EACH STORM EVENT. SEDIMENT AND GRAVEL MUST BE REMOVED FROM THE TRAVELED WAY IMMEDIATELY.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

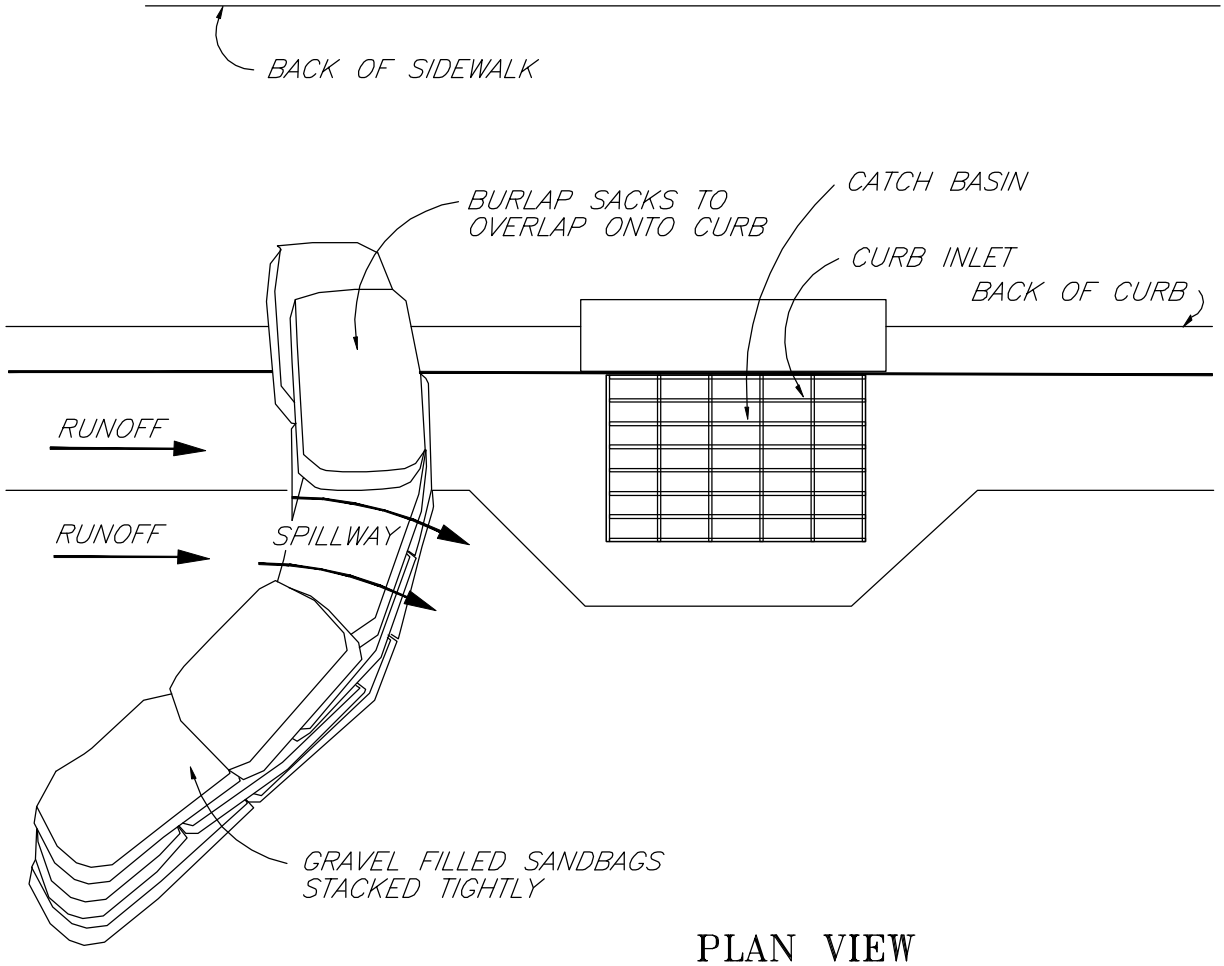
STORM DRAIN CURB INLET SEDIMENT BARRIER

(SANDBAGS – OPTION 1)

FILE: SANDCURB

Government of Alberta ■ Transportation

B.M.P. #6c
Plan View and Section



PLAN VIEW

NOTES:

1. PLACE CURB TYPE SEDIMENT BARRIERS ON GENTLY SLOPING STREET SEGMENTS, WHERE WATER CAN POND AND ALLOW SEDIMENT TO SETTLE OUT.
2. SANDBAGS OF EITHER BURLAP OR WOVEN 'GEOTEXTILE' FABRIC, ARE FILLED WITH GRAVEL, LAYERED AND PACKED TIGHTLY.
3. LEAVE A ONE SANDBAG GAP IN THE TOP ROW TO PROVIDE A SPILLWAY FOR OVERFLOW.
4. INSPECT BARRIERS AND REMOVE SEDIMENT AFTER EACH STORM EVENT. SEDIMENT AND GRAVEL MUST BE REMOVED FROM THE TRAVELED WAY IMMEDIATELY.
5. DESIGN CENTRE SPILLWAY LOWER THAN OUTSIDE EDGE TO MINIMIZE FLOW OUTFLANGING.
6. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

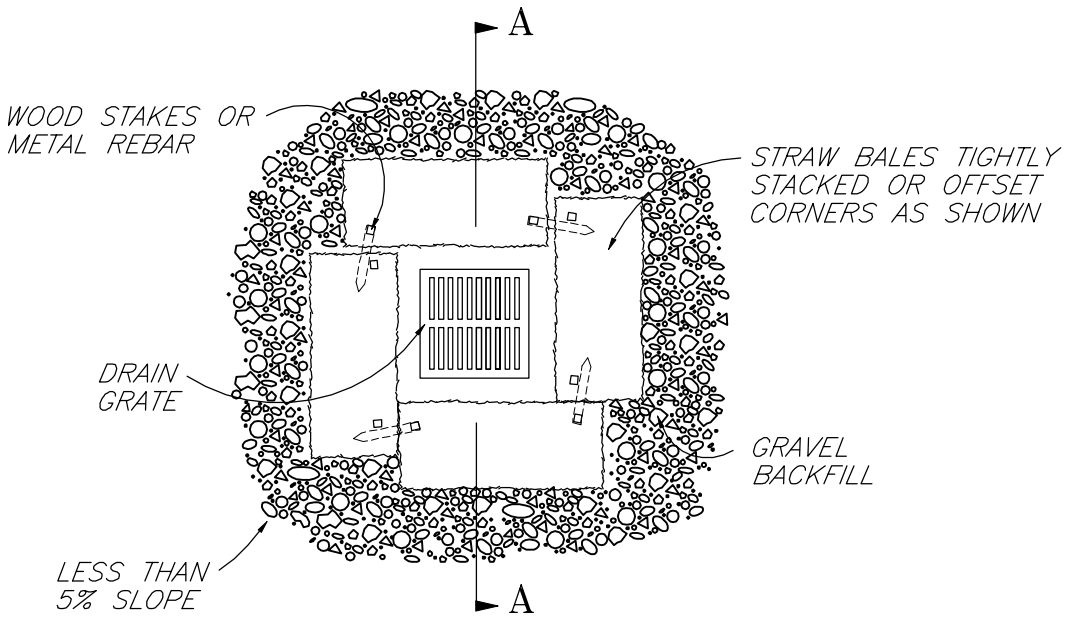
STORM DRAIN INLET CURB AND GUTTER SEDIMENT BARRIER

(SANDBAGS – OPTION 2)

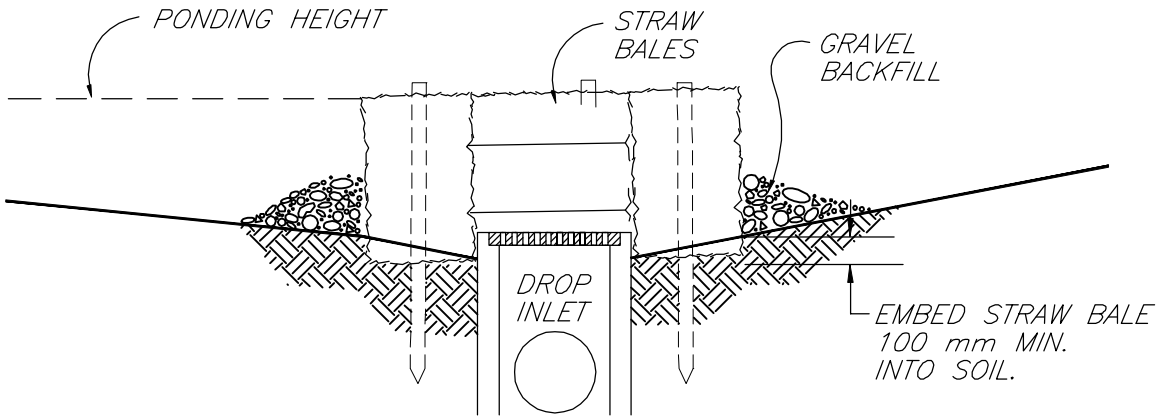
FILE: CURBGTTR

Government of Alberta ■ Transportation

B.M.P. #6d
Plan View



PLAN VIEW



SECTION A–A

NOTES:

1. DROP INLET SEDIMENT BARRIERS ARE TO BE USED FOR SMALL, NEARLY LEVEL DRAINAGE AREAS. (LESS THAN 5%)
2. EMBED THE BALES 100 mm INTO THE SOIL AND OFFSET CORNERS OR PLACE BALES WITH ENDS TIGHTLY ABUTING. GRAVEL BACKFILL WILL PREVENT EROSION OR FLOW AROUND THE BALES.
3. THE TOP OF THE STRUCTURE (PONDING HEIGHT) MUST BE WELL BELOW THE GROUND ELEVATION DOWNSLOPE TO PREVENT RUNOFF FROM BYPASSING THE INLET. EXCAVATION OF A BASIN ADJACENT TO THE DROP INLET OR A TEMPORARY DIKE ON THE DOWNSLOPE OF THE STRUCTURE MAY BE NECESSARY.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

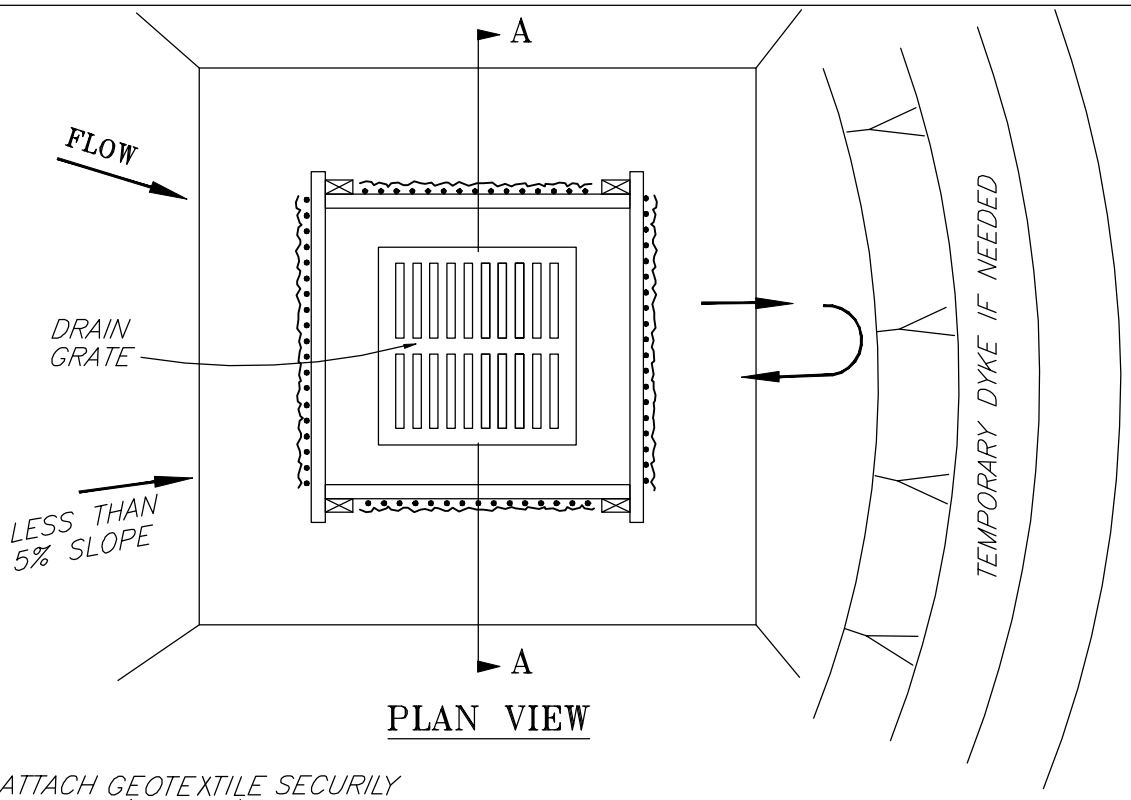
STORM DRAIN DROP INLET SEDIMENT BARRIER

(STRAW BALE / GRAVEL – OPTION)

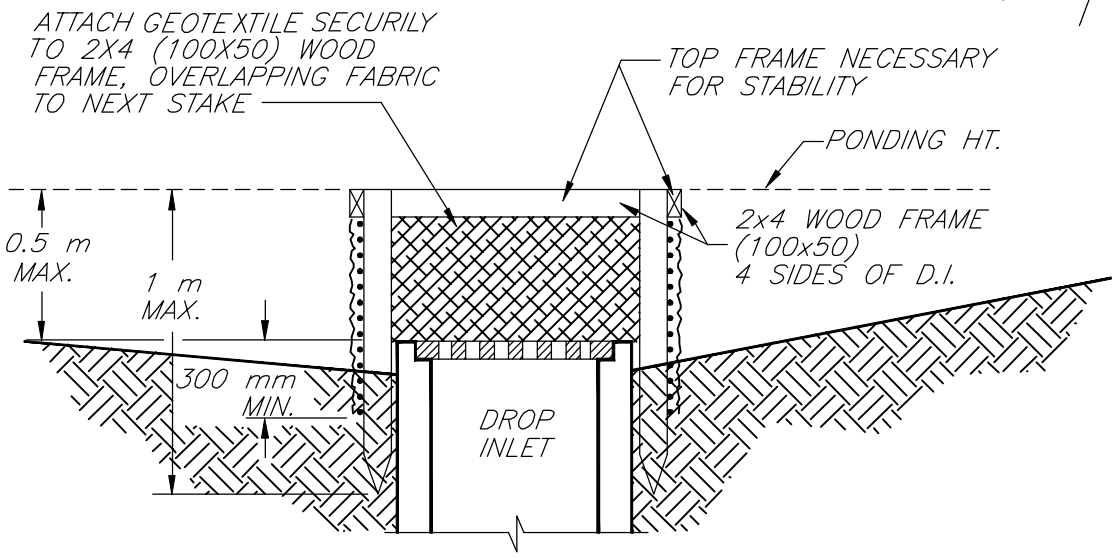
FILE: STRWGRVB

Government of Alberta ■ Transportation

B.M.P. #6e
Typical Section



PLAN VIEW



SECTION A–A

NOTES:

1. DROP INLET SEDIMENT BARRIERS ARE TO BE USED FOR SMALL, NEARLY LEVEL DRAINAGE AREAS. (LESS THAN 5%)
2. USE 2"X4" (100X50mm) WOOD OR EQUIVALENT METAL STAKES, 1 m MINIMUM LENGTH.
3. INSTALL 2"X4" (100X50mm) WOOD TOP FRAME TO INSURE STABILITY.
4. THE TOP OF THE FRAME (PONDING HEIGHT) MUST BE WELL BELOW THE GROUND ELEVATION DOWNSLOPE TO PREVENT RUNOFF FROM BY–PASSING THE INLET. A TEMPORARY DYKE MAY BE NECESSARY ON THE DOWNSLOPE SIDE OF THE STRUCTURE.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

NOT TO SCALE

STORM DRAIN DROP INLET SEDIMENT BARRIER

(SILT FENCE – OPTION)

FILE: SILTFDIB

Government of Alberta ■ Transportation

B.M.P. #6f
Typical Section

Rock Check Dam Erosion Control and Sediment Control	B.M.P. #7

Description and Purpose

- Small dam constructed of rock placed across steep channel
- Decrease flow velocities to reduce erosion caused by storm runoff
- Sediment laden runoff is detained allowing sediment to settle out

Applications

- Temporary or permanent measure
- Reduces long steep grade to intervals of gentle grades between successive structures
- Reduces flow velocities and kinetic energy to decrease erosion potential caused by runoff
- Sediment laden runoff is retained behind structure allowing sediment to settle out
- May be used in channels that drain 4 ha (10 ac) or less
- May be used in steep channels where storm water runoff velocity is less than 1.5 m/s (5 fps)

Construction

- Excavate a trench key a minimum of 0.15 m in depth at the rock check structure location
- Place non-woven geotextile fabric over footprint area of rock check
- Construct structure by machine or hand
- Structure should extend from one side of the ditch or channel to the other
- Structure should be constructed so that centre of the crest is depressed to form a centre flow width which is a minimum of 0.30 m lower than the outer edges
- Height of structures should be less than 0.8 m in height to avoid impounding large volumes of runoff
- Downstream slope of the check dam should be 5H:1V (minimum)
- Upstream slope of the check dam should be 4H:1V (minimum)

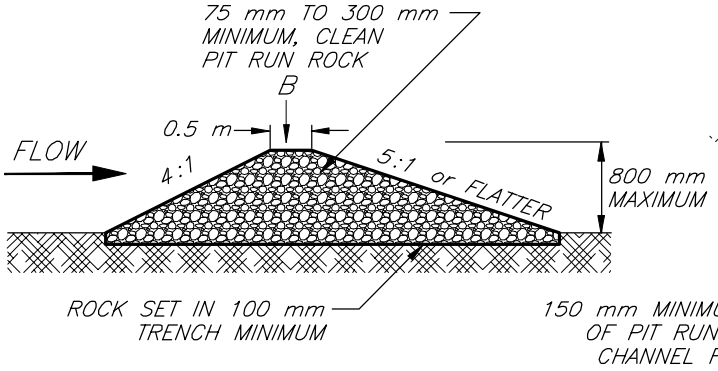
Construction Considerations

- Should be designed with roadside design clear zone requirements in mind.
- Height and spacing between structures should be designed to reduce steep channel slope to intervals of flatter gradient

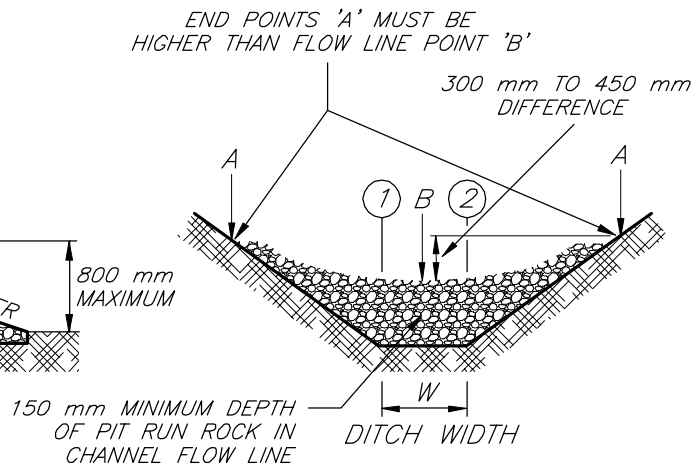
- Rock check structures should be constructed of free draining aggregate
- Aggregate used should have a mean diameter (D_{50}) of between 75 mm and 150 mm and must be large enough to remain in place during high velocity flow situations. Maximum rock diameter should not exceed 150 mm if the structure is to be used as a sediment trap.
- If rock check structures are to be placed in channels with significant high flows, they must be properly designed for stone size and structure spacings

Inspection and Maintenance

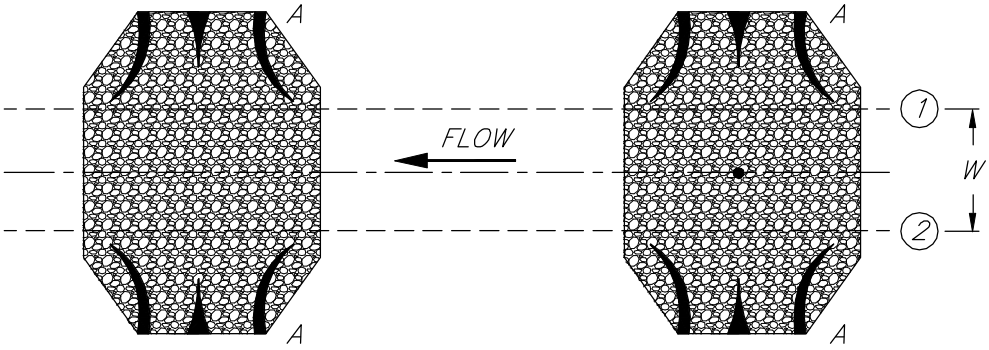
- Inspection frequency should be in accordance with the PESC and TESC Plans
- Remove sediment build up before it reaches one half the check structure height
- Erosion repairs should be made immediately to prevent failure of the structure
- Replace dislodged aggregate immediately with heavier aggregate or gabion structures

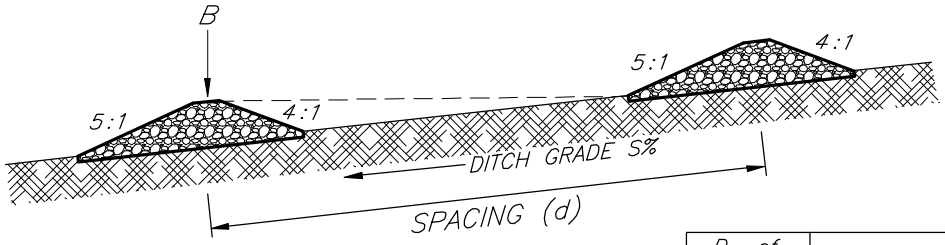


SIDE VIEW



FRONT VIEW





D_{50} of ROCK (mm)	MAXIMUM FLOW DEPTH OVER ROCK (mm)
75	50
150	100

SUGGESTED ROCK DIAMETER AND OVERFLOW DEPTHS

NOTES:

1. SUITABLE FOR FLOW VELOCITY ≤ 1.5 m/s.
2. SUITABLE FOR DRAINAGE AREA ≤ 4 ha.
3. SUITABLE FOR GRADES FROM 5% TO 8%.
4. SPACING (d) AND ROCK SIZE (D_{50}) TO BE DETERMINED BY ENGINEER BASED ON HYDRAULIC CONDITIONS.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

NOT TO SCALE

ROCK CHECK DAM

Government of Alberta ■ Transportation

B.M.P. #7
Typical Section

Synthetic Permeable Barrier Erosion Control and Sediment Control	B.M.P. #10

Description and Purpose

- Double panel, low profile, uni-body porous synthetic barriers used to dissipate flow energy and reduce velocity
- Barriers of patented design constructed of lightweight and durable synthetic materials
- May be used to create a grade break to reduce flow energy and velocities allowing some sediment to settle out at the upstream barrier panel of the barrier structure
- Can be used to dissipate flow energy and trap sediment during the period of revegetation; should be removed at successful re-establishment of vegetation

Applications

- Temporary structure
- May be placed across trapezoidal ditch to dissipate flow energy and reduce flow velocities
- Can be used to supplement as grade breaks along ditch interval between permanent drop structures along steep ditch grades
- May be used as midslope grade breaks along contours of midslope or at toe of disturbed slopes
- Usually used as grade breaks along ditch (3 to 7% grade) in conjunction with erosion control matting or non-woven geotextile as soil covering mattings; usually used in conjunction with permanent gabion structure (i.e., gabion) at steep grade (+6%) areas
- Designed to be reusable

Construction

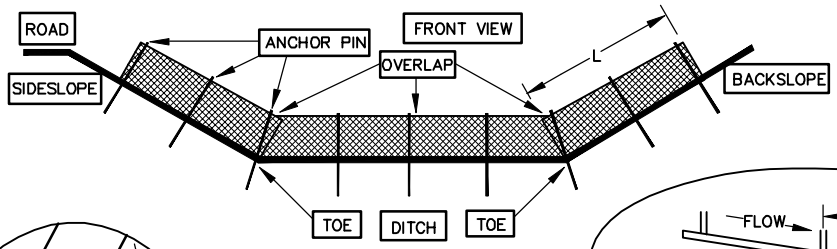
- Install as per manufacturers recommended installation instructions
- Normally installed in conjunction with erosion control matting in ditches and channels
- Prepare soil surface
- Install basal layer of erosion mat or geotextile fabric; key-in basal mat/fabric at upstream end
- Place and anchor barrier panels with adequate pin anchors to basal soils

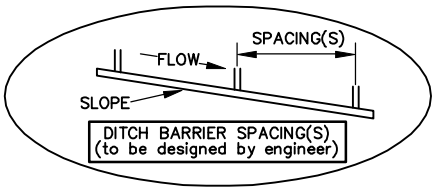
Construction Considerations

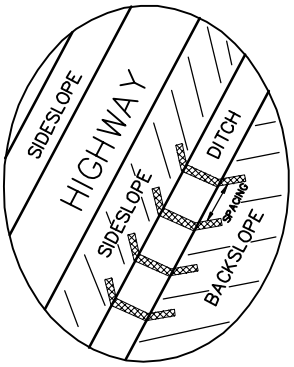
- Maintain intimate contact between base of barrier and soil with laying of basal matting/fabric intimate to ground surface
- Ensure side panel of barrier is extended to outer edges of channel to sufficient height to provide freeboard of channel flow

Inspection and Maintenance

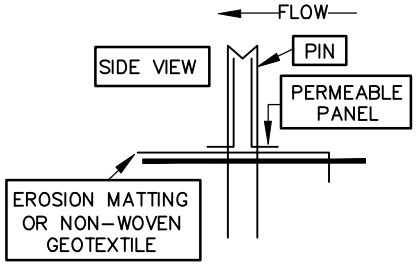
- Inspection frequency should be in accordance with the PESC and TESC Plans
- Remove sediment build-up before it reaches one-half the check structure height
- Do not damage barrier panel during removal of sediment
- Partial or non-removal of sediment build-up will create a non-permeable barrier and low level earth mini-drop structure which will force water flow over-topping the barrier. The option of non-removal of sediments may be open to converting the sediment build-up into a "vegetated earth mini-drop structure" along the ditch with the non-removal of synthetic permeable barrier in-place. This will require topsoil and seeding (or intensive mulch seeding) to promote vegetation growth
- If erosion is noted at the toe or upslope edges of the structure, hand regrading or suitable repairs should be made immediately to prevent failure of the structure
- Remove and deactivate at 1 year after vegetation is established



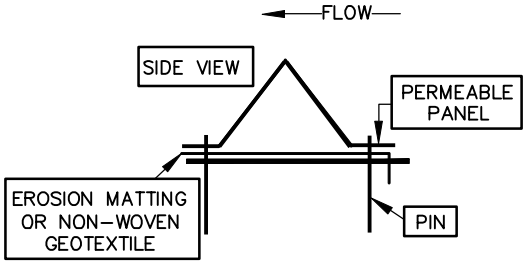




MINIMUM INSTALLATION LENGTH UP SLOPES	
SLOPE	LENGTH: L (m)
2:1	0.55
2.5:1	1.1
3:1	1.1
3.5:1	1.1
4:1	1.1
5:1	1.3
6:1	1.5



1) DOUBLE PANEL



2) TRIANGLE PANEL

SYNTHETIC PERMEABLE DITCH BARRIER

N.T.S.

NOTES:

1. *FOR USE MAINLY AS A GRADE BREAK STRUCTURE FUNCTIONING AS A FLOW ENERGY DISSIPATOR AND VELOCITY RETARDER.*
2. *FOR SECONDARY USE AS SEDIMENT BARRIER.*
3. *REQUIRES NON-WOVEN GEOTEXTILE FABRIC OR BIODEGRADABLE (COCONUT FIBRE PREFERABLE) EROSION BLANKET MAT AT BASE AND KEY-IN TO SOIL AT UPSTREAM END.*
4. *MAY BE INSTALLED AS GRADE BREAK AT GRADE TRANSITION AREAS TO CREATE DISSIPATION OF FLOW ENERGY AND A MORE LAMINAR FLOW REGIME DOWNSTREAM OF STRUCTURE.*
5. *THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.*

SYNTHETIC PERMEABLE BARRIERS

Straw Bale Barrier Sediment Control	B.M.P. #12

Description and Purpose

- A barrier of strawbale primarily used as a perimeter sediment control measure
- May be used to intercept and detain sediment laden runoff allowing a portion of the sediment load to settle out

Applications

- Temporary measure
- Suitable for flow velocities of 0.3 m/s or less
- Usually placed at 1m to 2 m offsets from toe of disturbed slopes
- Size of drainage area should be no greater than 0.1 ha per 30 m length of straw bale sediment barrier
- Maximum flow path length upstream of barrier should be less than 30 m
- Maximum slope gradient above the barrier should be no greater than 2H:1V
- May be used in conjunction with filter fabric as external wrap to encapsulate the bale

Construction

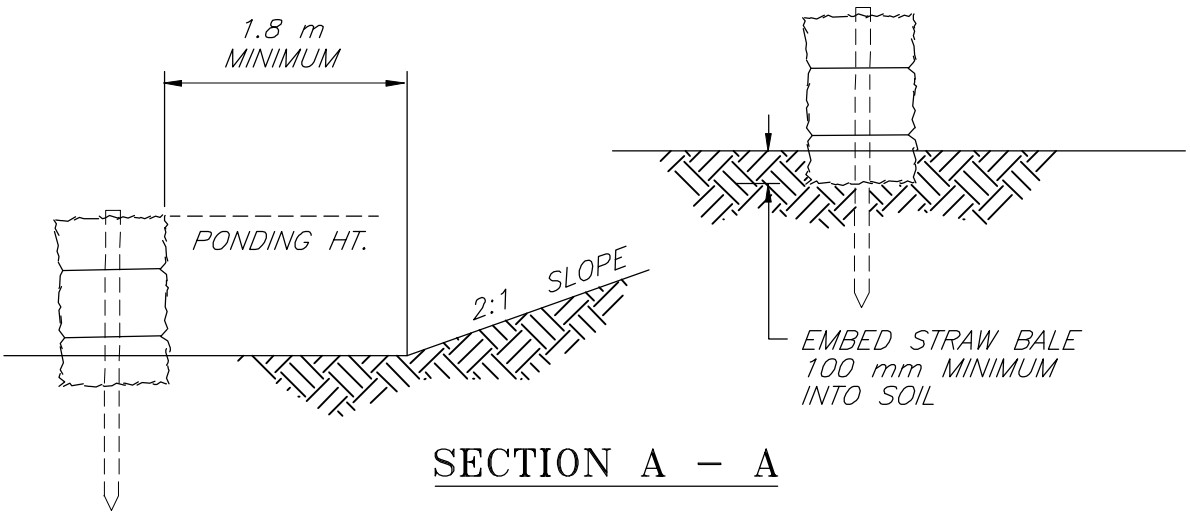
- Straw bale barrier should be located a minimum distance 1.8 m away from the toe of the slope to provide adequate ponding and sedimentation area
- Excavate a trench approximately 0.10 m deep with a width of one straw bale at the straw bale barrier location
- Place straw bales in excavated trench along contour, perpendicular to flow direction
  - Ensure twine or wire is not in contact with the soil
  - Ensure straw bale is in continuous contact with base of trench
  - Ends of barrier should be angled upslope to form enclosure to contain runoff
- Infill all joints with loose straw
- Drive two 50 mm by 560 mm section wooden stakes 1.2 m long through each straw bale, ensuring each stake is embedded a minimum of 0.15 m into soil
- Backfill and compact the upstream and downstream edges of the check structure to seat the straw bales into the subgrade

Construction Considerations

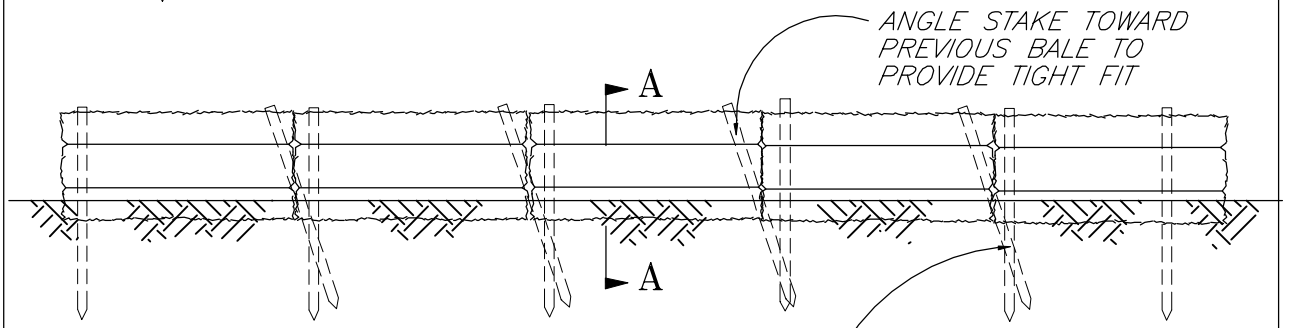
- Maximum lengths of barriers should be 40 m, including ‘J-hook’ or ‘smile’ (similar to silt fence in BMP #1) configuration, to allow escape route for excess runoff
- Barrier should be placed far enough away from toe of slope to provide adequate ponding and sedimentation area (minimum of 1.8 m away from toe of slope is recommended)
- Ends of barriers should be angled upslope (in a ‘J-hook’ or ‘smile’ configuration) to form enclosure to collect runoff
- Straw bales should be:
  - Machine-made
  - Weed free cereal crop straw such as wheat, oats, rye, or barley
  - Tightly compacted and bound with two rows of wire or synthetic string and shall show no signs of weathering
  - No more than one year old

Inspection and Maintenance

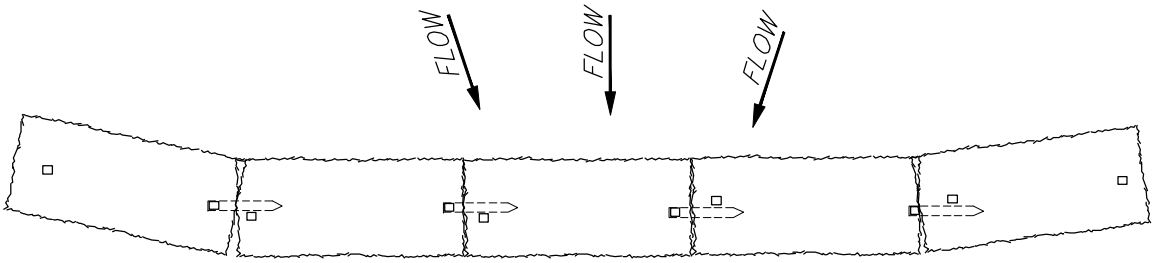
- Inspection frequency should be in accordance with the PESC and TESC Plans
- Remove sediment build up before it reaches one half the check barrier height
- Erosion repairs should be made immediately to prevent failure of the structure
- Replace damaged, decayed or dislodged straw bales immediately



SECTION A – A



SECTION B – B



PLAN

NOTES:

1. THE STRAW BALES SHALL BE PLACED ON SLOPE CONTOUR.
2. BALES TO BE PLACED IN A ROW WITH THE ENDS TIGHTLY ABUTTING.
3. KEY IN BALES TO PREVENT EROSION OR FLOW UNDER BALES.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

STRAW BALE BARRIER

FILE: STRWDIKE

Rolled Erosion Control Products (RECP)

a) Channel Installation
b) Slope Installation
c) Straw Rolls

Erosion Control

B.M.P. #13

Description and Purpose

- Biodegradable or synthetic soil coverings used for temporary or permanent protection of disturbed soils at slopes and channels
- Categories of Rolled erosion control products (RECP) can be:
  - Erosion control blankets (ECB) (generally biodegradable and temporary)
  - Turf reinforcement mats (TRM)
  - Composite turf reinforcement mats (C-TRM)
- RECP may be manufactured of organic material, synthetic material, or as a composite of organic and synthetic materials
- Protect disturbed soils from raindrop impact and surface runoff erosion, increase water infiltration into soil, retains soil moisture and decreases evaporation loss
- Protect seeds from raindrop impact, runoff, and predators
- Stabilizes soil temperature to promote seed germination and enhance vegetation growth

Applications

- Temporary or permanent measure
- May be used to protect disturbed, exposed soils for cut or fill slopes at gradients of 2.5H:1V or steeper
- May be used on slopes where erosion potential is high
  - Silts and sands have higher erosion potential than high plastic clays
- May be used on slopes where vegetation is likely to be slow to develop
- May be used to protect disturbed exposed soils in ditches and channels (with high flow velocities) by providing additional tractive resistance cover in conjunction with a successful high density vegetative growth established

Construction (Slopes)

- RECP should be installed in accordance with manufacturer's directions

The following is a general installation method:

- Prepare surface and place topsoil and seed

- Surface should be smooth and free of large rocks, debris, or other deleterious materials
- Blanket should be anchored at top of slope in a minimum 0.15 m by 0.15 m trench for the entire width of the blanket
- The blanket should be rolled out downslope
  - (1) Where the blanket roll is not long enough to cover the entire length of the slope, a minimum 0.15 m by 0.15 m check slot should be excavated at the location of the lap, and the downslope segment of blanket anchored in the check slot, similar to the method used for the top of the slope, or (2) when blankets must be spliced down the slope, place blanket end over end (shingle style with approximately 0.10 m overlap. Staple through overlapped area at 0.3 m intervals.
  - The upslope portion of blanket should overlap the downslope portion of blanket, shingle style, at least 0.15 m with staple anchors placed a maximum 0.3 m apart
  - Adjacent rolls of blanket should overlap a minimum 0.1 m
  - Anchors should be placed along central portion of blanket spaced at $4/m^2$ minimum (0.5 m spacing) for slopes steeper than 2H:1V and $1/m^2$ (1 m spacing) for slopes flatter than 2H:1V
  - Anchors along splices between adjacent rolls should be placed 0.9 m apart

Construction (Channels)

- **A Blanket should be installed in accordance with manufacturers directions**

The following is a general installation method

- Prepare surface and place topsoil and seed
  - Surface should be smooth and free of large rocks, debris, or other deleterious materials
- Begin by excavating a minimum 0.15 m deep and 0.15 m wide trench at the upstream end of channel and place end of RECP into trench
  - Use a double row of staggered anchors approximately 0.1 m apart (i.e., 0.2 m linear spacing) to secure RECP to soil in base of trench
  - Backfill and compact soil over RECP in trench
- Roll centre RECP in direction of water flow on base of channel
- Place RECP end over end (shingle style) with a minimum 0.15 m overlap downgrade

- Use a double row of staggered anchors approximately 0.1 m apart to secure RECP to soil

– Full length edge of RECP at top of sideslopes must be anchored in a minimum 0.15 m deep and 0.15 m wide trench

- Use a double row of staggered staple anchors a maximum of 0.1 m apart (i.e., 0.2 m linear spacing) to secure RECP to soil in base of trench
- Backfill and compact soil over RECP in trench

– Overlap RECP on sideslopes (shingle style down channel) a minimum of 0.1 m over the centre RECP and secure RECP to soil with anchors spaced a maximum of 0.2 m apart

– In high flow channels, a check slot across the width of the channel is recommended at a maximum spacing of 10 m to anchor the ends of the RECP to the underlying soil

- Use a double row of staggered staple anchors a maximum of 0.1 m apart (0.2 m linear spacing) to secure RECP to soil in base of check slot
- Backfill and compact soil over RECP in check slot

– Anchor terminal ends of RECP in a minimum 0.15 m deep and 0.15 m wide trench

- Use a double row of staggered anchors a maximum of 0.1 m apart (i.e., 0.2 m linear spacing) to secure RECP to soil in base of trench
- Backfill and compact soil over RECP in trench

Construction Considerations

- Slopes should be topsoiled and seeded prior to placing RECP
- Ensure blanket is in intimate contact with the soil by properly grading soil, removing rocks or deleterious materials, prior to placing blanket
- In channels, blankets should extend to above the anticipated flow height, with a minimum 0.5 m of free board
- For turf reinforcement mat (TRM), blanket should be placed immediately after topsoiling
- Blanket should be anchored by using wire staples, metal geotextile stake pins, or triangular wooden stakes

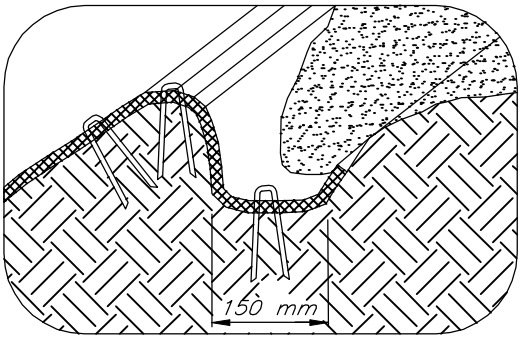
  – All anchors should be a minimum of 0.15 to 0.2 m in length

  - For loose soils, use longer anchors

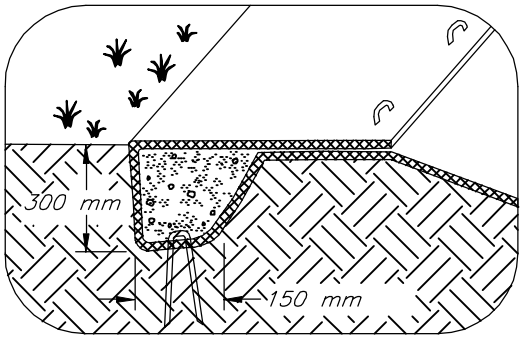
- Blankets should be placed longitudinal to direction of flow, with fabric not stretched but maintaining contact with underlying soil
- It is essential to understand product specifications and follow manufacturers instructions on installation methods

Inspection and Maintenance

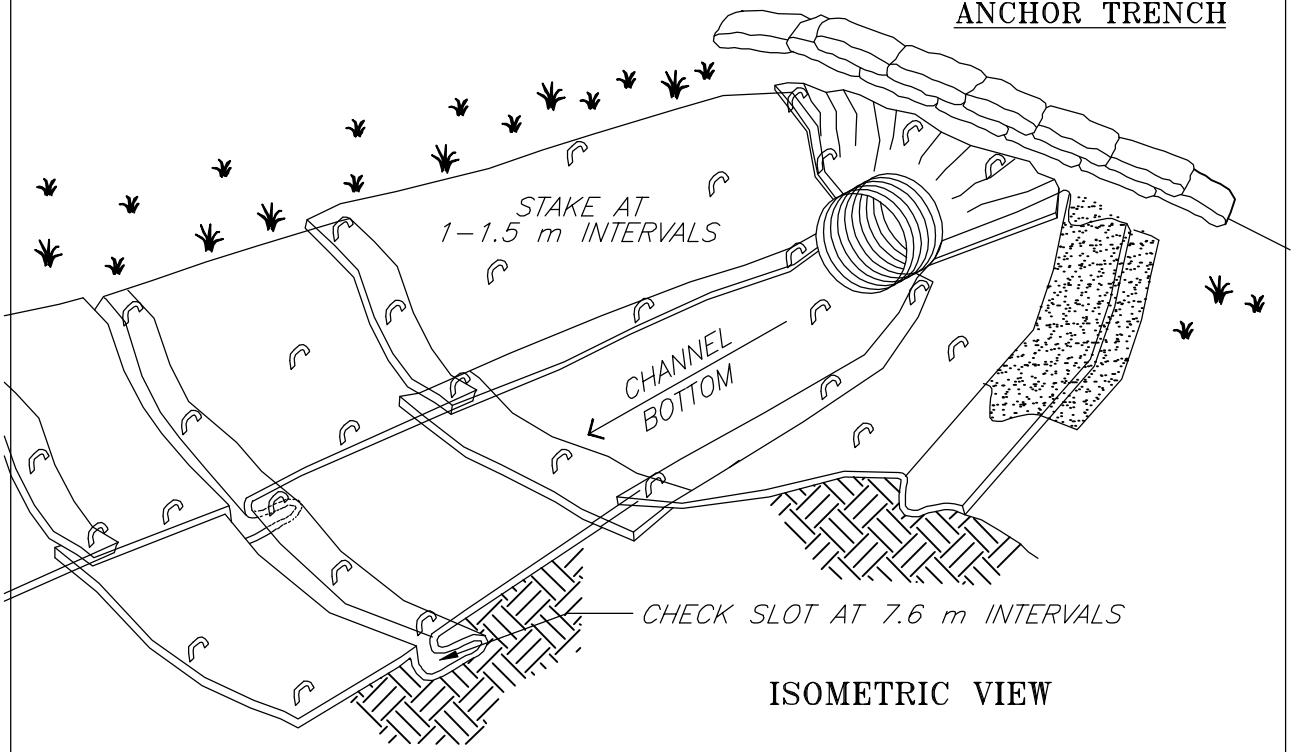
- Areas covered with blankets should be inspected/remediated regularly or in accordance with the PESC and TESC Plans, especially after periods of severe rainfall or storm events, to check for blanket separation or breakage
- Any damaged or poorly performing areas should be repaired/remediated immediately. Regrading of the slope by hand methods may be required in the event of rill or gully erosion.
- Inspection and maintenance should continue until dense vegetation is established
- Areas with low vegetation density should be reseeded
- After approximately one year, a top dressing of fertilizer may be applied to improve vegetation cover and assist degradation of temporary blankets



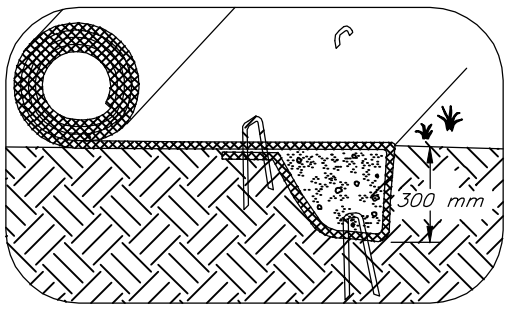
LONGITUDINAL ANCHOR TRENCH



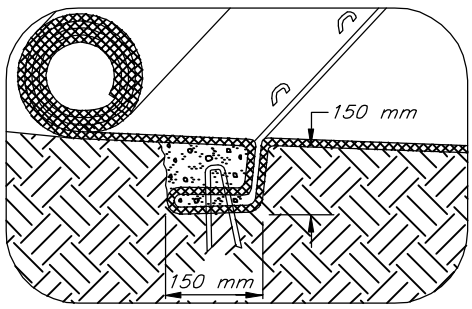
TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH



ISOMETRIC VIEW



INITIAL CHANNEL ANCHOR TRENCH



INTERMITTENT CHECK SLOT

NOTES:

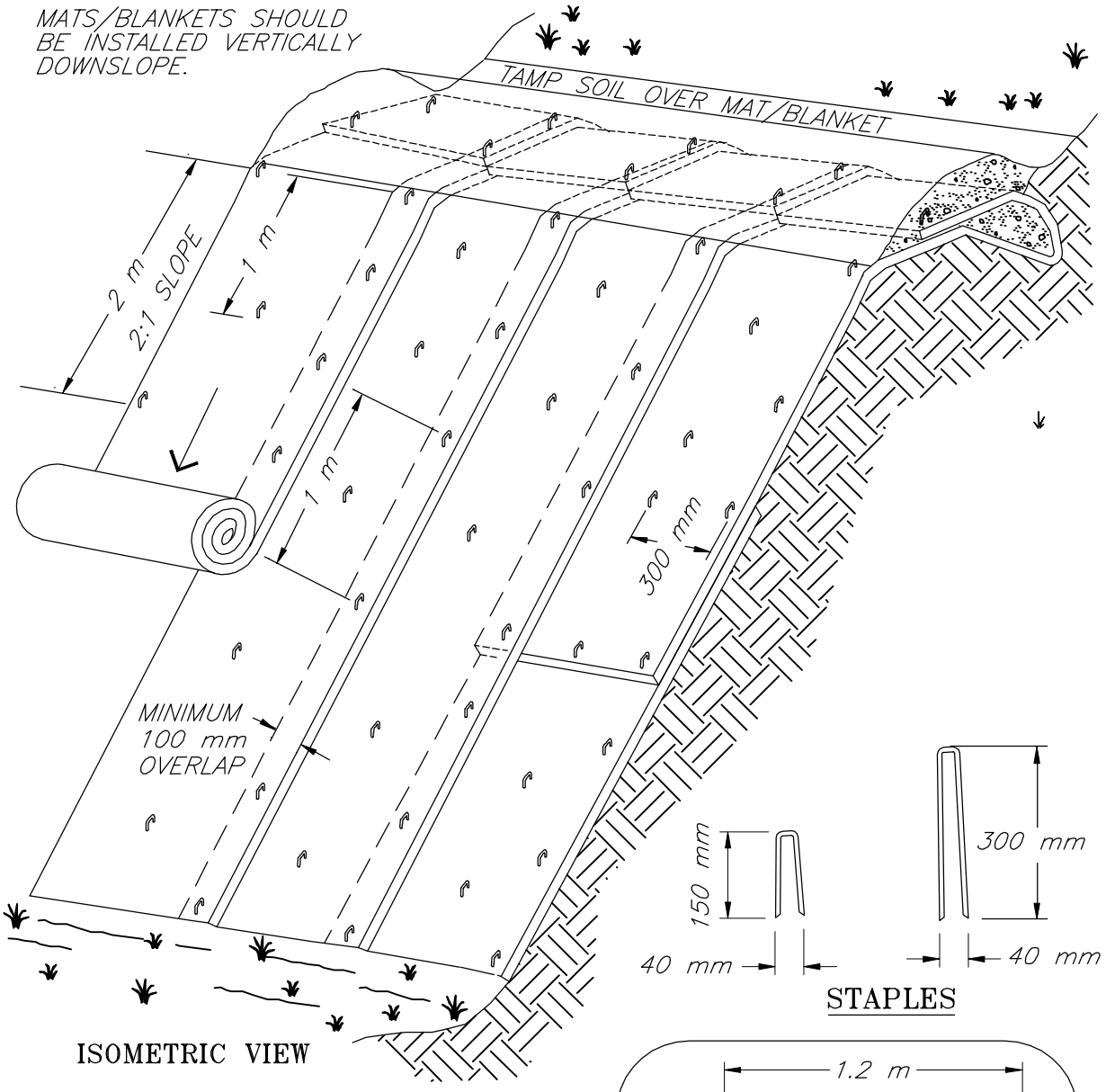
1. CHECK SLOTS TO BE CONSTRUCTED PER MANUFACTURERS SPECIFICATIONS.
2. STAKING OR STAPLING LAYOUT PER MANUFACTURERS SPECIFICATIONS.
3. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

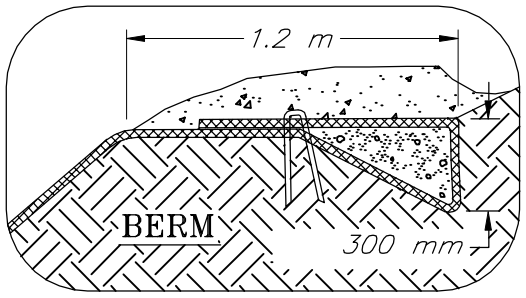
ROLLED EROSION CONTROL PRODUCTS (RECP)

CHANNEL INSTALLATION

Government of Alberta ■
Transportation

B.M.P. #13a
Typical Section





NOT TO SCALE

TYPICAL SLOPE SOIL STABLIZATION

NOTES:

1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS AND GRASS. MATS/ BLANKETS SHALL HAVE GOOD SOIL CONTACT.
2. APPLY PERMANENT SEEDING BEFORE PLACING BLANKETS.
3. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH THE SOIL. DO NOT STRETCH.
4. CHECK SLOTS, STAKING, STAPLING AND OTHER CONSTRUCTION DETAILS PER MANUFACTURES SPECIFICATIONS.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

ROLLED EROSION CONTROL PRODUCTS (RECP) SLOPE INSTALLATION

Riprap Armouring
a) Slope Protection
b) Channel Protection

Erosion Control

B.M.P. #14
(a & b)

Description and Purpose

- Large, loosely placed cobbles or boulders placed along channel banks or slopes to protect underlying soil from erosion due to flowing water
- Can protect slopes and channel banks against erosion

Applications

- Permanent measure
- May be used on channel banks and slopes with flow velocities ranging from 2 m/s to 5 m/s (dependent on rock size and thickness); appropriate for slopes that do not exceed 2H:1V
- Riprap only needs to be placed at lower portion of channel section to the anticipated flow height (mean annual peak flow) plus freeboard
  - Other form of soft armouring (RECP blankets, seeding) can be used to promote vegetation to protect soil at upper portion of channel slopes, above riprap
- Must be used in conjunction with a non-woven geotextile underlay acting as a filtration separator with basal soil
- For fluctuating high flow channel, the riprap should be underlain by a layer of granular filter material for cyclic drawdown long-term performance with/without an extra layer of non-woven geotextile as underlay

Construction

- Grade the slope or channel to final design grade
- Place filter (underlay) layer on prepared slope
  - Filter layer can consist of non-woven geotextile underlay and/or well graded granular material dependent on hydraulic conditions
- Place riprap layer
- Riprap should consist of a graded mixture of sound, durable stone with at least 50% of the riprap material being larger than 200 mm in diameter
- Riprap should be sized according to the following gradation and mass:

		Riprap Class			
		1M	**1**	**2**	**3**
Nominal Mass **Nominal Diameter**	**kg** **mm**	**7** **175**	**40** **300**	**200** **500**	**700** **800**
None heavier than:	kg	40	130	700	1800

	or mm	300	450	800	1100
No less than 20% or more than 50% heavier than:	kg or mm	10 200	70 350	300 600	1100 900
No less than 50% or more than 80% heavier than:	kg or mm	7 175	40 300	200 500	700 800
100% heavier than:	kg or mm	3 125	10 200	40 300	200 500

Percentage quoted are by mass.
Sizes quoted are equivalent spherical diameters, and are for guidance only.

Source: AT Bridge Spec. 2010

- Non-woven geotextile fabric underlay below riprap should meet the following specifications and physical properties:

Non-Woven Geotextile Filter Fabric
Specifications and Physical Properties

	Class 1M, 1 and 2	**Class 3**
Grab Strength	650 N	875 N
Elongation (Failure)	50%	50%
Puncture Strength	275 N	550 N
Burst Strength	2.1 MPa	2.7 MPa
Trapezoidal Tear	250 N	350 N
Minimum Fabric Overlap to be 300 mm		

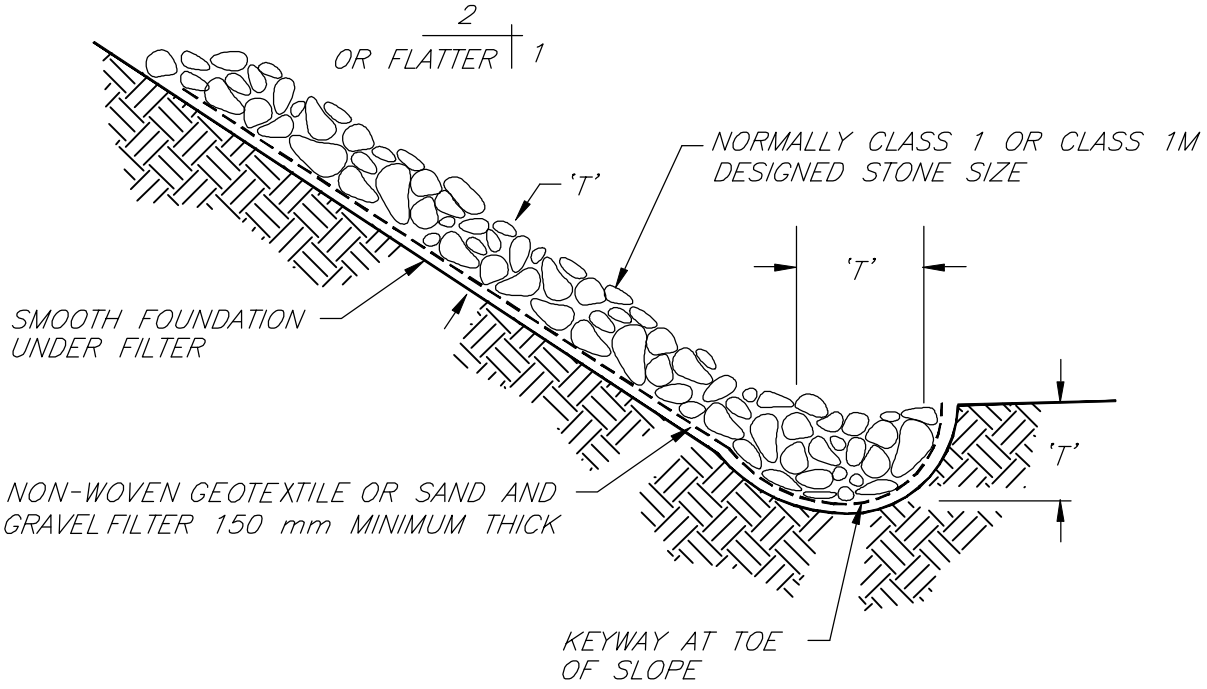
Source: AT Bridge Spec. 2010

Construction Considerations

- Riprap should be placed in a uniform thickness across the channel so as not to constrict channel width
- Blasted rock is preferred (if available)
- Riprap layer should be 1.5 to 2 times the thickness of the largest rocks used, 1.5 to 3 times the thickness of the D_{50} material, and not less than 300 mm in thickness

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Periodic inspections to check for erosion of protected material or movement of riprap



TYPICAL SECTION

NOTE:

1. 'T' = THICKNESS: THICKNESS SHALL BE DETERMINED BY THE ENGINEER.
   MINIMUM THICKNESS = 300 mm. (i.e. 1.5x D_{50}) FOR D_{50} = 200 mm.
2. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

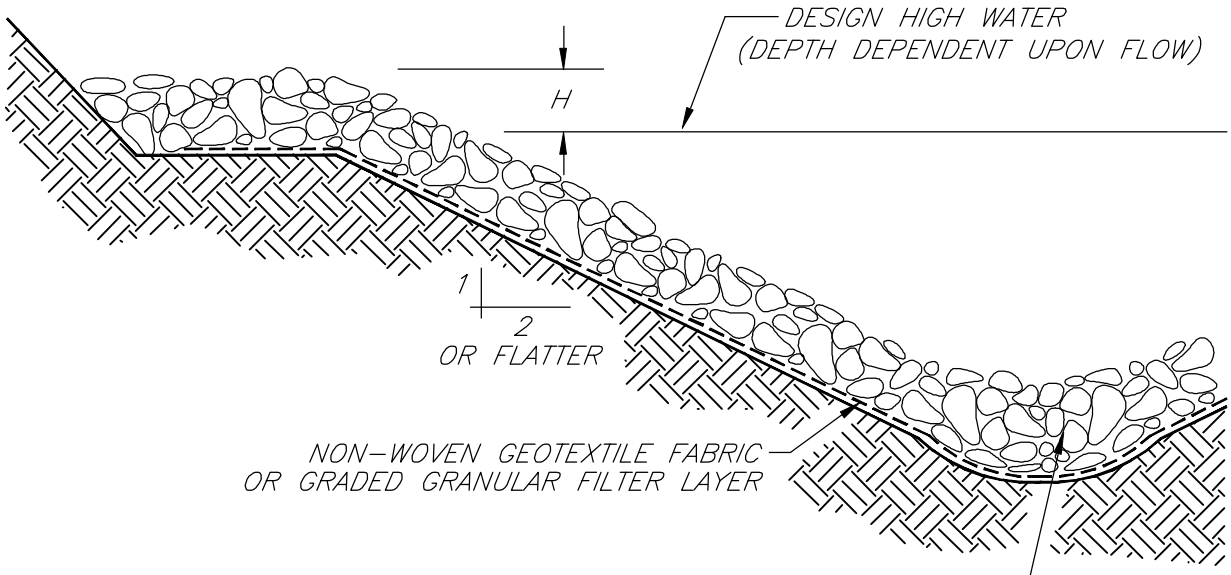
RIPRAP ARMOURING FOR SLOPE

FILE: RIPRAP

Government of Alberta ■ Transportation

B.M.P. #14a
Typical Section

DESIGN HEIGHT (H), WIDTH AND STONE SIZE SHALL
BE DETERMINED BY THE ENGINEER



MINIMUM 300 mm THICK LAYER OF 50 mm MINIMUM DIAMETER DRAIN ROCK. D_{50} =200 mm. LARGER STONE SHALL BE USED DEPENDENT UPON GRADIENT, SOIL TYPE, AND DESIGN FLOW.

TYPICAL SECTION

NOTES:

1. RIPRAP GRADATION AND THICKNESS SHALL BE DETERMINED BY THE ENGINEER IN ACCORDANCE WITH HYDRAULIC CONDITIONS.
2. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

RIPRAP ARMOURING FOR CHANNEL

FILE: RCKCHNEL

Government of Alberta ■ Transportation

B.M.P. #14b
Typical Section

Energy Dissipators a) for Culvert Outlet b) for Trough at Bridge Headslope Sediment Control	B.M.P. #17

Description

a) Hard armour (riprap, gravel, concrete) placed at pipe outlets, in channels, and at downstream side of check structures to reduce velocity and dissipate energy of concentrated flows (BMP 17a)

b) Standard Drain Trough Terminal Protection Structure generally used at bridge headslope (BMP 17b)

- Minimizes scour at flow impact location with dissipated flow energy

Applications

- Permanent measure
- May be used at outlets of pipes, drains, culverts, conduits, or channels with substantial flows
- May be used at slope drain outlets located at the bottom of mild to steep slopes
- May be used where lined channels discharge into unlined channels
- May be used as splash pad on downstream side of gabions, check structures, berms, barriers, and silt fences to prevent erosion caused by overtopping of structure

Construction

- Grade the area to final design grades and elevations
- Sub-excavate energy dissipator location to thickness of energy dissipator
- Place filtration bedding material on base of excavation
  - Bedding can be comprised of well graded sand and gravel or non-woven geotextile
  - Acts as separating filter between fine grained subgrade and riprap size energy dissipator material
- Place energy dissipator material (riprap, gravel, concrete) over filtration bedding material
  - Top of energy dissipator should be flush with surrounding grade

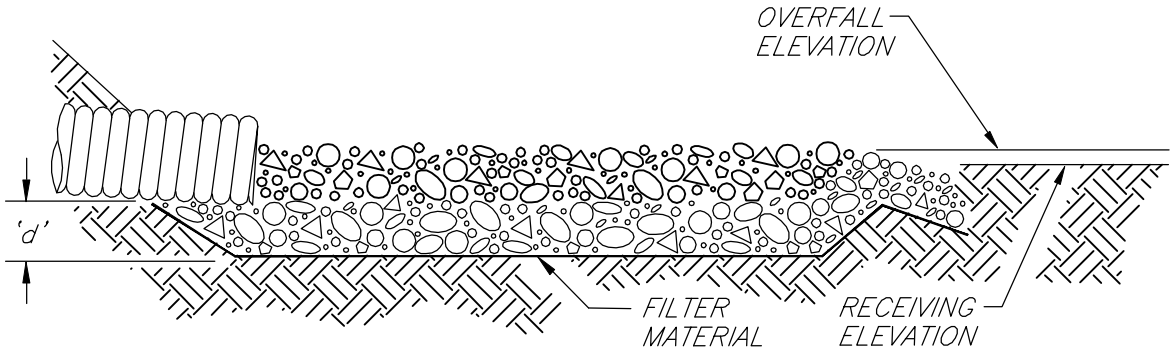
Construction Considerations

- Length of energy dissipator (L_a) at outlets shall be of sufficient length to dissipate energy

  - L_a = 4.5 x D (where D is the diameter of the pipe or channel at the outlet)
  - Energy dissipator should extend upstream of the outlet approximately a minimum distance of 0.5 x D
- Width of energy dissipator (W_a) at outlets shall be of sufficient width to dissipate energy
  - W_a = 4 x D
- Thickness of energy dissipator (d_a) at outlets shall be of sufficient thickness to dissipate energy
  - d_a = 1.5 x maximum rock diameter (with a minimum thickness of 0.30 m)
- Energy dissipator (splash pad, apron) shall be set at zero grade and aligned straight, with the direction of flow at the outlet
- Bedding (filtration) layer can comprise either non-woven geotextile or a minimum of 0.15 m well graded sand and gravel layer
- Energy dissipator should be constructed of well-graded riprap
  - Minimum D_{50} = 150 mm. Preferable D_{50} = 300 mm
  - Minimum thickness = a) 1.5 x D_{50} or b) 0.30 m to 0.45 m thickness (a or b whichever is greater)
- Energy dissipator shall be designed to accommodate a 10-year peak runoff or the design discharge of the upstream channel, pipe, drain, or culvert, whichever is greater
- The energy dissipator shall be constructed flush with the surrounding grade and shall be directly in line with direction of outlet flow

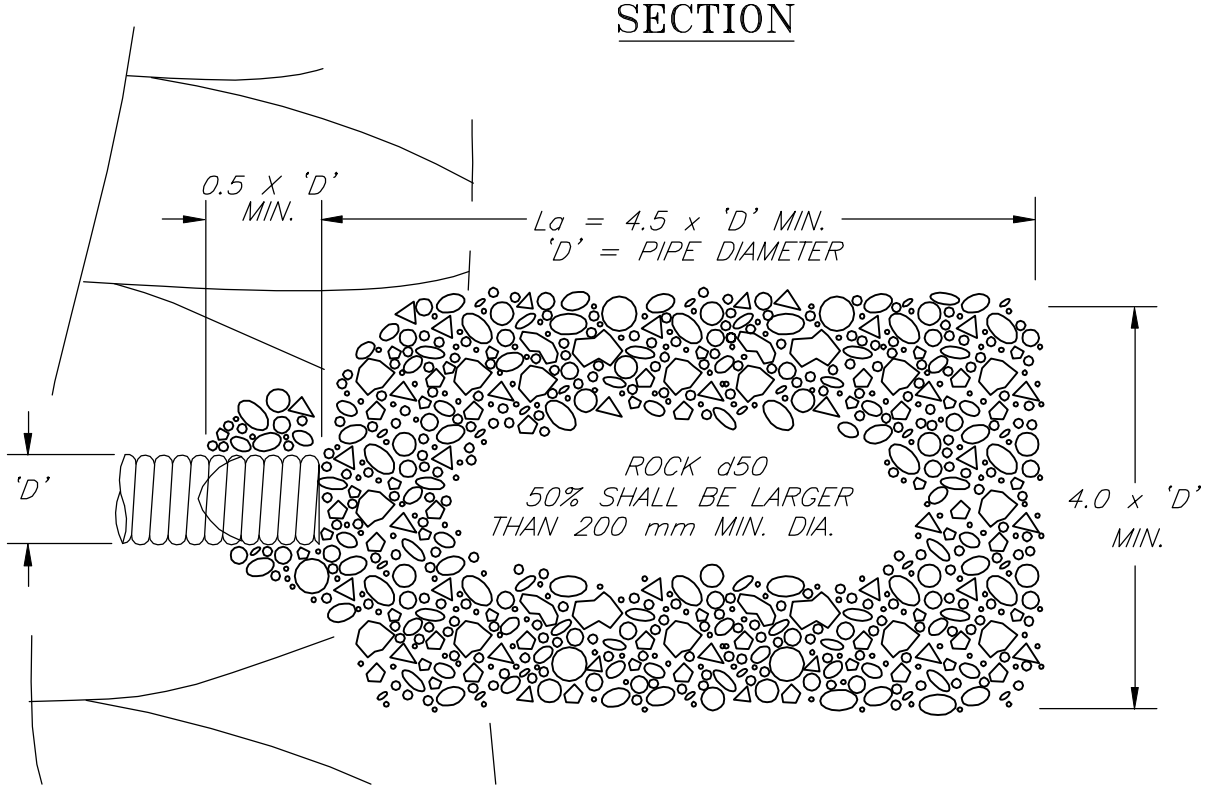
Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Any damage should be repaired immediately



B) MINIMUM THICKNESS = 300 mm. (i.e. 1.5x D_{50}) FOR D_{50} = 200 mm.

SECTION



PLAN

NOTES:

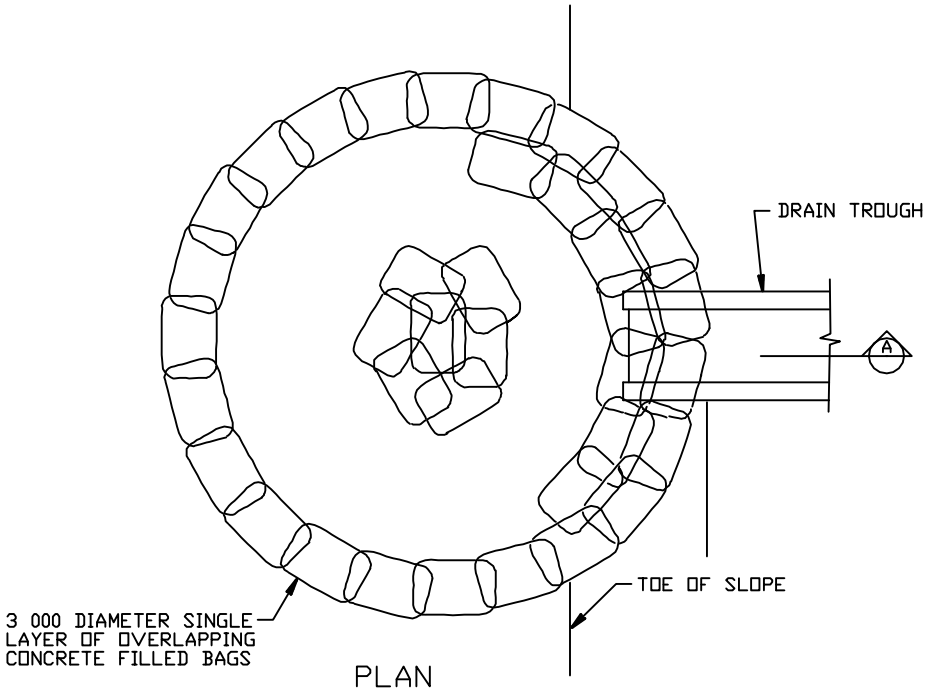
1. 'La' = LENGTH OF APRON. DISTANCE 'La' SHALL BE OF SUFFICIENT LENGTH TO DISSIPATE ENERGY.
2. APRON SHALL BE SET AT A ZERO GRADE AND ALIGNED STRAIGHT.
3. FILTER MATERIAL SHALL BE FILTER FABRIC OR 150 mm THICK MINIMUM GRADED GRAVEL LAYER.
4. FOR PIPE DIAMETER > 600 mm, DESIGN BY ENGINEER IS REQUIRED.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

ENERGY DISSIPATOR FOR CULVERT OUTLET

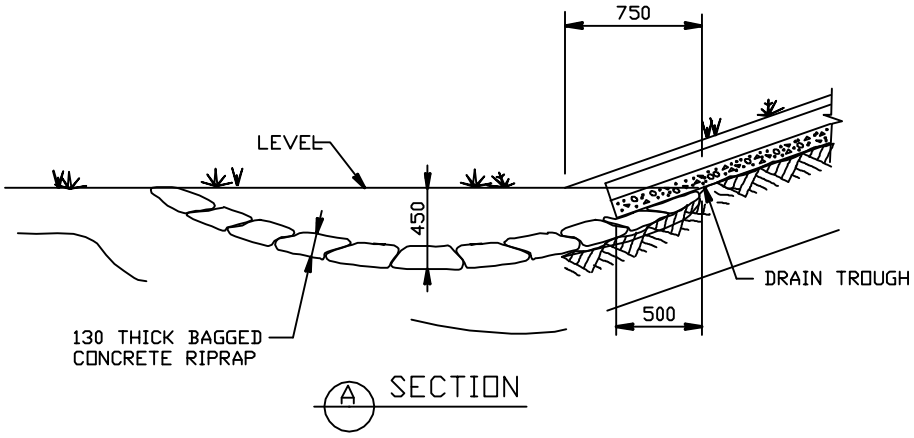
FILE: ENRGYDIS

Government of Alberta ■ Transportation

B.M.P. #17a
Typical Section



PLAN



A SECTION

GENERAL NOTES

- DIMENSIONS ARE GIVEN IN mm. DETAILS ARE NOT TO SCALE.
- PLACING OF BAGGED CONCRETE RIPRAP SHALL START AT THE BOTTOM CENTRE OF THE DISHED AREA AND SHALL PROCEED IN A CONTINUOUS SPIRAL FASHION OUTWARD UNTIL THE ENTIRE DISH IS COVERED. EACH CONCRETE FILLED BAG SHALL LAP OVER THE EDGES OF THE PREVIOUSLY PLACED BAGS.

  SOURCE: ALBERTA TRANSPORTATION: SPECIFICATIONS FOR BRIDGE CONSTRUCTION
  DRAWING: S-1410-91

- THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

ENERGY DISSIPATOR

FOR SEMI-CIRCULAR TROUGH DRAIN TERMINAL PROTECTION FOR BRIDGE HEADSLOPE

Government of Alberta ■
Transportation

B.M.P. #17b
Typical Section

Sediment Traps and Basins a) Riser Outlet Option b) Permeable Rock Berm Outlet Option Sediment Control	B.M.P. #18

Description and Purpose

- Low height dam enclosure for impoundment of sediment laden storm water, sedimentation of silt size particles and release of treated storm water
- Used to trap sediment laden run off and promote settlement of sediment prior releasing to enter downstream or watercourses
- Constructed by excavating a pond or building embankments above the original ground surface
- Sediment traps and basins can be divided on size of pond impoundment enclosure
  - Basin (Type I) for pond area $\geq$500 m²
  - Trap (Type II) for pond area $\leq$500 m²

Applications

- Permanent measure
- Used at terminal or selective intermediate points of concentrated runoff for impoundment of runoff and sedimentation of silt prior to release of treated runoff downstream
- Used as sedimentation control measure at perimeter of construction sites where sediment laden run off may enter watercourses, storm drains, or other sensitive areas
- Used where there is a need to impound a significant amount of sediment from significant areas of land disturbance
- Sediment basins (Type I) used for disturbed drainage areas greater than 2.0 ha
- Sediment traps (Type II) used for disturbed drainage areas of 2.0 ha, or less
- Where practical, contributing drainage areas should be subdivided into smaller areas and multiple sedimentation impoundment installed

Construction

- The consequences of failure for any water retaining structure will determine the level of effort in the design and construction phases. The construction guidelines presented herein are minimum requirements. A geotechnical engineer should design water retaining structures if the consequences of failure warrant.
- All footprint area for embankment dyke should be stripped of vegetation, topsoil, and roots to expose mineral subgrade soils

- Embankment fill material should be clean mineral soil with sufficient moisture to allow proper compaction
  - Fill should be placed in lifts not exceeding 150 mm in compacted thickness and should be compacted to a minimum of 95% Standard Proctor maximum dry density (SPD)
- The main outlet structure should be installed at farthest possible point from inlet
  - Outlet should be placed on firm, smooth ground and should be backfilled to 95% SPD
  - Proper inlet and outlet protection should be installed to protect from scour
  - Outlet pipe should consist of corrugated steel pipe to protect (against pinching and blockage)
- The embankment should be topsoiled, seeded or protected with gravel or riprap immediately after construction
- Construct an emergency spillway to accommodate flows not carried by the principle outlet
  - Emergency spillway should consist of an open channel (earth or vegetated) over native undisturbed soil (not fill)
  - If spillway is elevated, it should be constructed of riprap
  - Spillway crest should be depressed at least 0.15 m below embankment

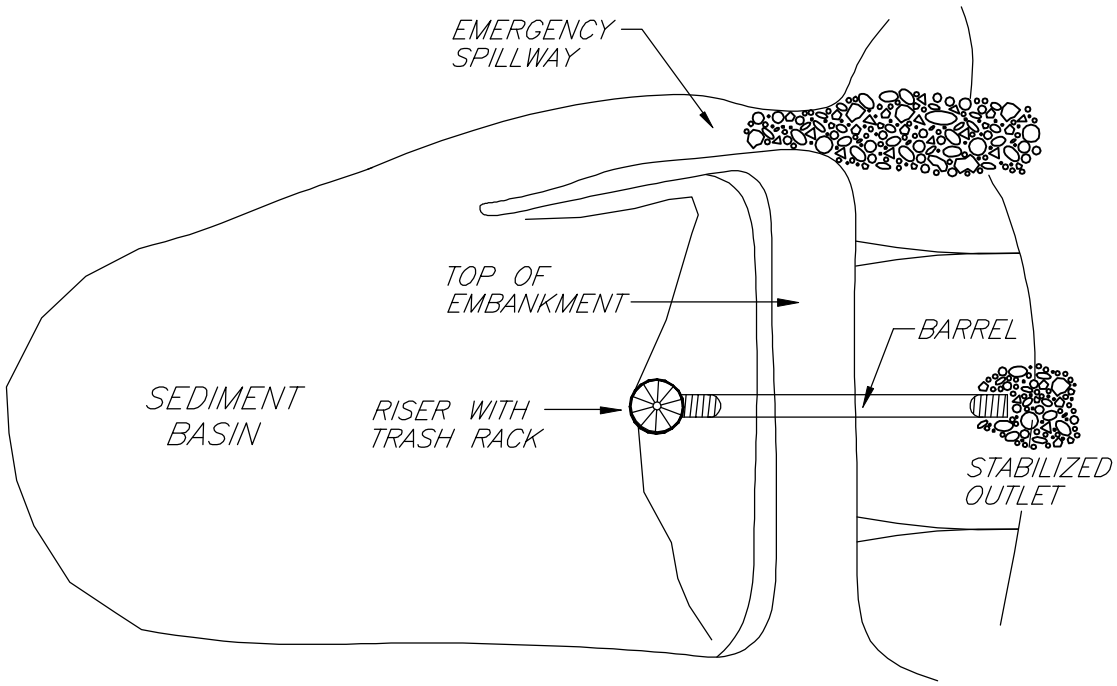
Construction Considerations

- Preferable to strip to mineral soil only along the footprint area required for dyke construction; can leave pond floor centre area cleared but unstripped
- Can be constructed by excavating, constructing embankments, or a combination of the two methods
- Baffles should be provided to prevent short-circuiting of flow from inlet to outlet
- Construct sediment ponds and basins at site perimeter and environmentally sensitive areas prior to wet season and construction activities
- Sediment pond/basin bottom should be flat or gently sloping towards outlet
- Dyke slopes should not be steeper than 2H:1V and should be compacted
- Basins should be located where:
  - Low embankment can be constructed across a swale or low natural terrain

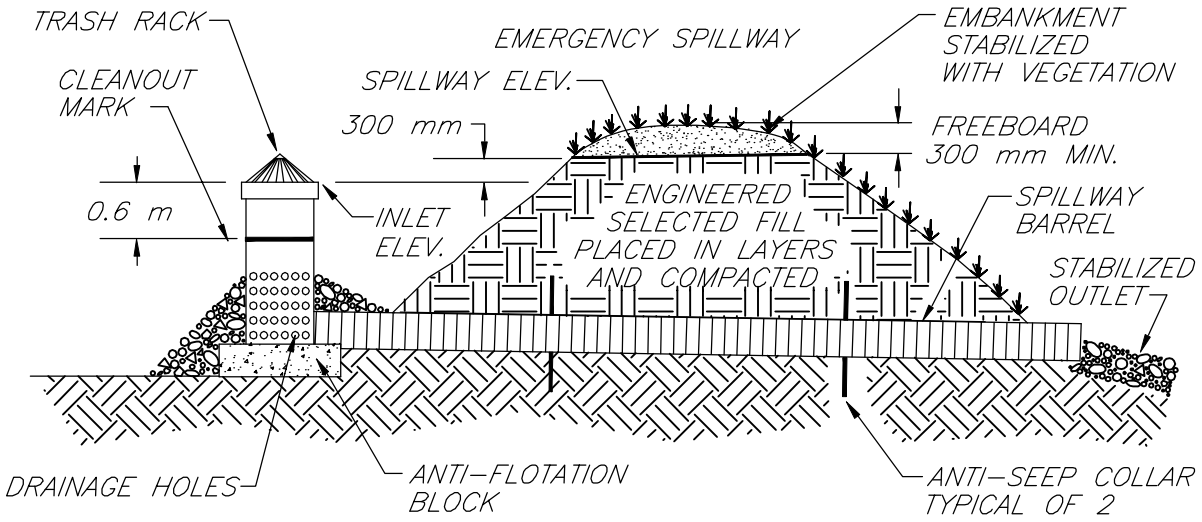
- It is accessible for maintenance work, including sediment removal

Inspection and Maintenance

- Regular inspection is required to identify seepage, structural soundness, outlet damage or obstruction and amount of sediment accumulation
- Inspection frequency should be in accordance with the PESC and TESC Plans
- Sediment should be removed upon reaching 1/2 height of the containment berm or within 0.4 m of crest of embankment
- Sediment traps may be deactivated or removed after vegetation of previously disturbed upstream areas has been established



PLAN



SECTION

NOTES:

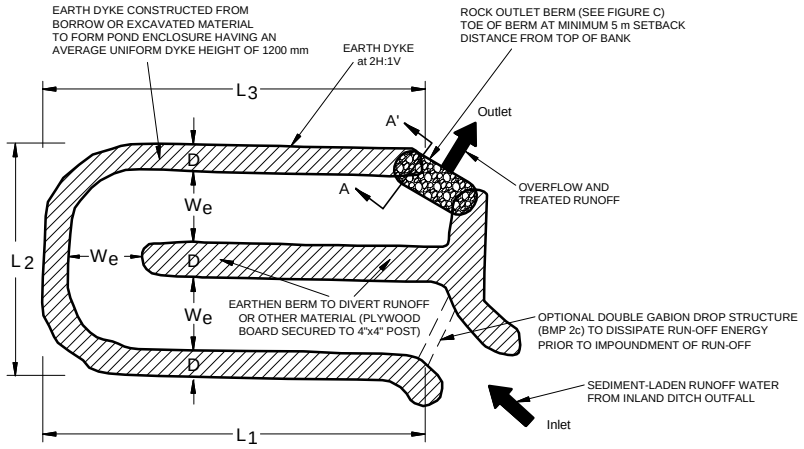
1. THE TEMPORARY SEDIMENT BASIN, DESIGNED BY A QUALIFIED PROFESSIONAL, IS REQUIRED FOR DISTURBED AREAS GREATER THAN 2.02 HECTARES (5 ACRES) WITH A DRAINAGE AREA LESS THAN 40.4 HECTARES (100 ACRES).
2. THE SEDIMENT BASIN MAY BE REMOVED WITHIN 3 YEARS.
3. HEIGHT OF ENGINEERED SELECTED FILL EQUAL TO 1 m.
4. FOR CONFIGURATION AND FLOW CHAMBER DESIGN (i.e. LENGTH(L) & WIDTH(W_e) OF BASIN), REFER TO BMP 18b.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

TYPICAL SEDIMENT BASIN (RISER OUTLET OPTION)

FILE: SEDBASIN

Government of Alberta ■ Transportation

B.M.P. #18a
Typical Section

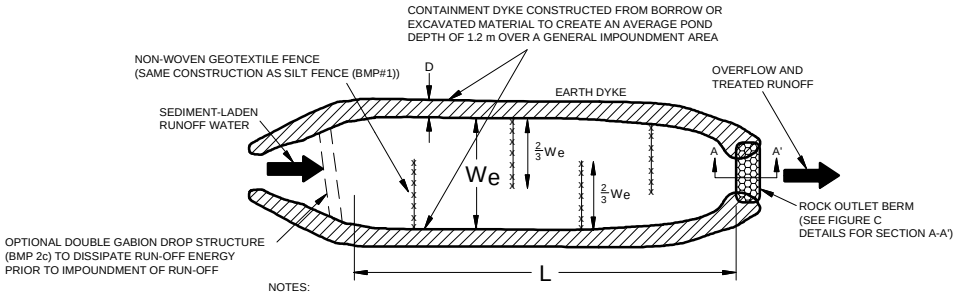


NOTES:

1. CONTRIBUTING RUNOFF AREA CAN BE LARGER THAN 2.0 ha BUT LESS THAN 40.0 ha.
2. EFFECTIVENESS APPROPRIATE FOR REMOVING MEDIUM TO COARSE SILT PARTICLES SUSPENDED IN RUNOFF.
3. FLOW PATH L = $L_1 + L_2 + L_3$ FLOW WIDTH W $_e$ 6 m MINIMUM
4. PROVIDE 1 TO 2 m (1 TO 2% GRADE) ELEVATION DROP BETWEEN INLET AND OUTLET GRADES.
5. SHAPE OF POND TO CONFORM TO TOPOGRAPHY WITH OUTLET AT MINIMUM 5 m FROM TOP OF BANK.
6. CONSTRUCTION TO ENSURE SWALES AND BAFFLES ARE TO CHANNEL WATER INTO THE PROPOSED SEDIMENTATION PONDS.

Plan View

Figure A Type 1 Sedimentation Pond Containment Structure (Sediment Basin)

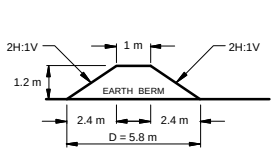


NOTES:

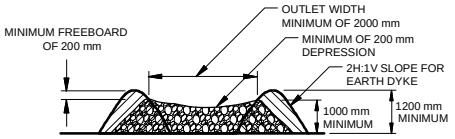
1. CONTRIBUTING RUNOFF AREA SHOULD BE OR SMALLER THAN 2.0 ha.
2. EFFECTIVENESS APPROPRIATE FOR REMOVING MEDIUM TO COARSE SILT PARTICLES SUSPENDED IN RUNOFF.
3. L/W_e RATIO 3:1 CAN BE APPROPRIATE.
4. W_e = 8 m MINIMUM BOTTOM WIDTH.
5. NON-WOVEN GEOTEXTILE FABRIC WITH A0S 0.15mm.

Plan View

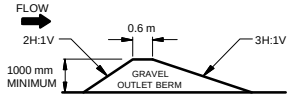
Figure B Type II Containment Structure (Sediment Trap)



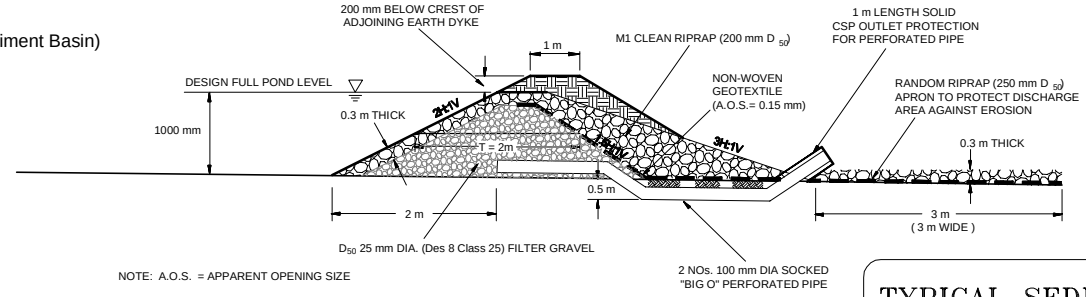
EARTH DYKE (D)



OUTLET FRONT VIEW



SECTION A-A' (SIMPLIFIED)



NOTE: A.O.S. = APPARENT OPENING SIZE

Figure C Section A-A' - Details for Sedimentation Pond
(Permeable Structure with Rock Filter Barrier and Perforated Pipe)

NOTES:

1. *DEACTIVATED WITHIN 3 YEARS AFTER SATISFACTORY FULL REVEGETATION OF THE DISTURBED AREA OF POTENTIAL EROSION SOURCES UPSTREAM.*
2. *THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.*

SOURCE: 1) FIFIELD (2001) FOR STRUCTURE PLAN
2) EBA FOR OTHER DESIGN DETAILS

TYPICAL SEDIMENT BASIN (PERMEABLE ROCK BERM OUTLET OPTION)

Slope Drains
a) Slope Drain
b) Overside Drain

Sediment Control

B.M.P. #19

Description and Purpose

- Heavy duty, flexible pipe "Big O" that carries water from top to bottom of fill or cut slope to prevent concentrated water flowing downslope and eroding face of slope

Applications

- Temporary or permanent measure
- Used on cut or fill slopes where there is a high potential for upslope runoff waters to flow over the face of the slope causing erosion, especially at areas where runoff converges resulting in concentrated runoff flows (e.g., possible breach of low catchwater ditch at top of a cut slope)
- Used in conjunction with some form of water containment or diversion structures, such as diversion channels, berms, or barriers, to convey upslope runoff water and direct water towards slope drain

Construction

- Construct diversion or intercept channel, ditch block, barrier, or other inflow apron structure at crest of slope to channel flow toward the slope drain inlet
- Install slope drain through inlet berm or barrier with a minimum of 0.45 m of soil cover above top of drain pipe to secure the inlet
  - Install scour inlet protection (such as riprap, sand bags)
- Install energy dissipator (such as riprap, gravel, concrete) at downslope outlet end of slope drain
  - Outlet must not discharge directly onto unprotected soil
- Secure the pipe from movement by tying to steel anchor stakes, hold-down grommets, or other approved anchor method
  - Space anchors on each side of drain pipe at maximum 3 m intervals along entire length of drain pipe
  - Anchor stakes should have a minimum 1 m embankment

Construction Considerations (For guidance only)

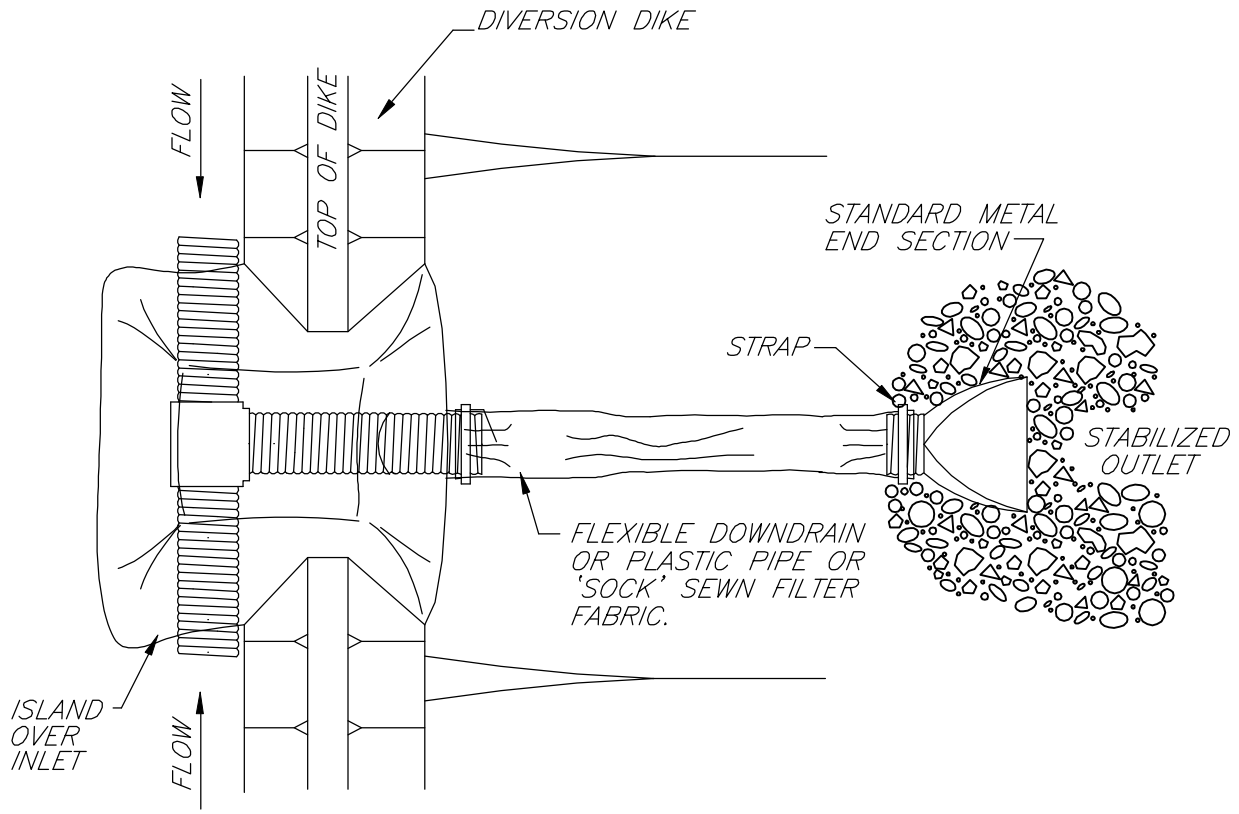
- Use coiled drain pipe for low flows only
- If constructing inflow apron at crest of slope out of sandbags, only fill each sandbag ¾ full, this will allow sandbag to be flexible enough to mould around drain pipe and remain in continuous contact with the ground

- Several slope drains may be required if upslope drainage areas are too large for one drain pipe

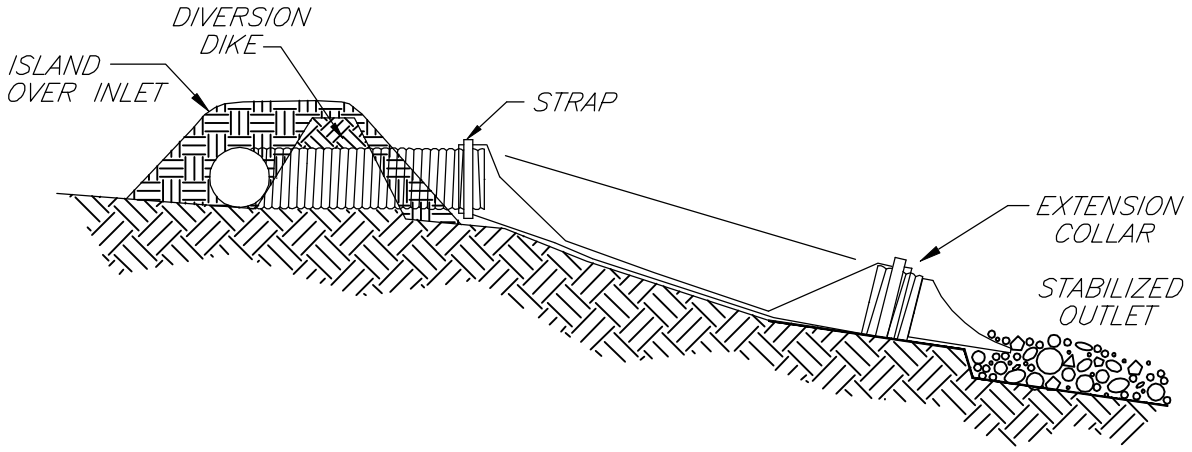
Size of Slope Drain	
Maximum Drainage Area (ha)	**Pipe Diameter (mm)**
0.2	300
0.6	450
1.0	530
1.4	600
2.0	760

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Repair any damaged section of pipe immediately
- **If evidence exists of pipe movement, install additional anchor stakes to secure and anchor at zones of movement**
- Remove sediment from upslope inflow apron area after each storm event otherwise either downslope sediment transport will occur or cause the drainpipe to be plugged which could result in overtopping of inflow apron structure and sheet flow over slope face



PLAN VIEW



SECTION

NOTE:

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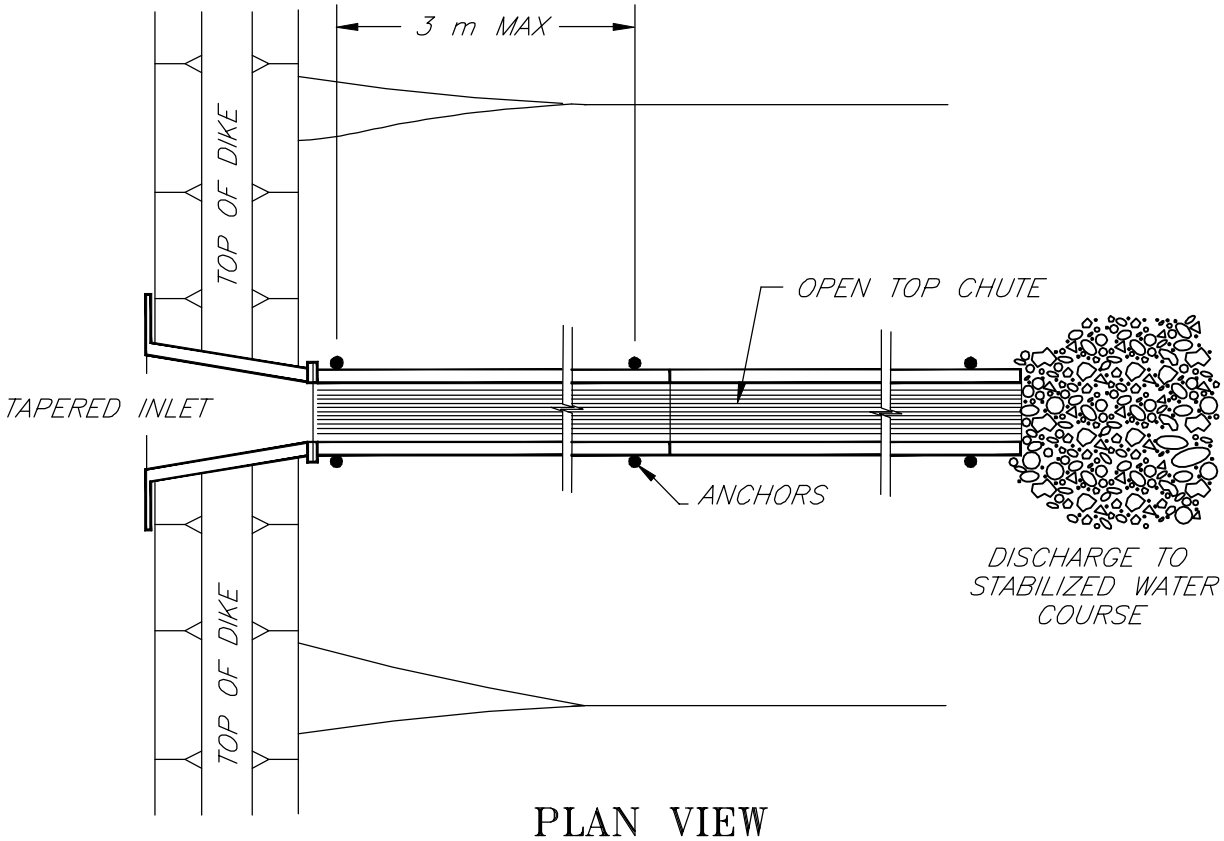
SLOPE DRAIN

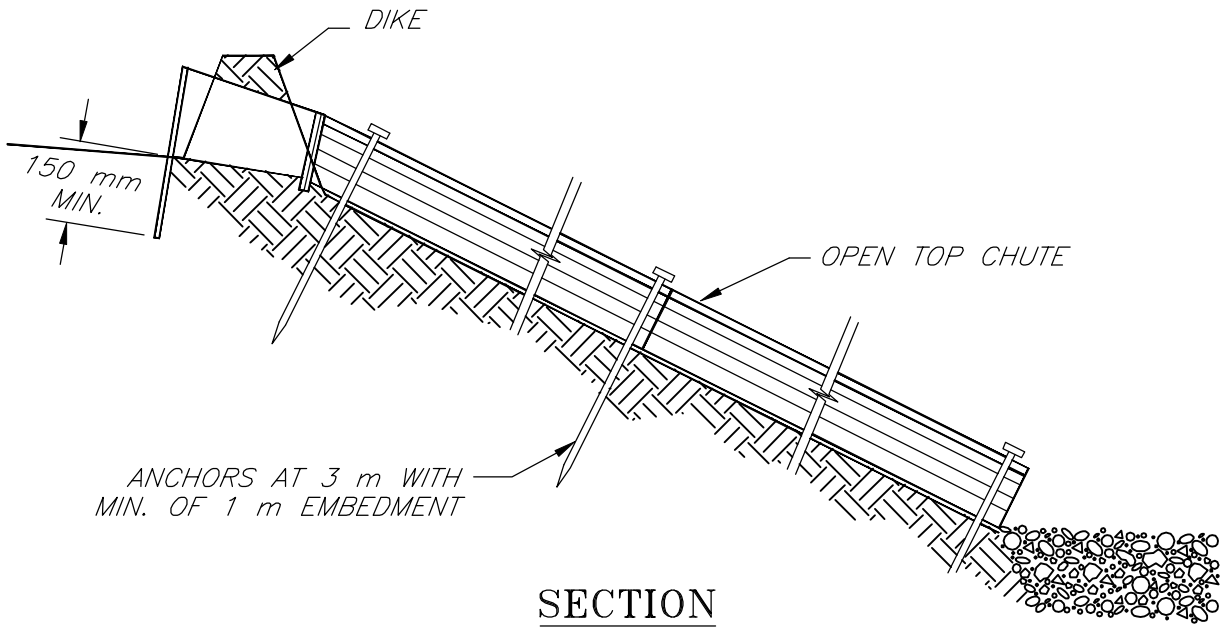
FILE: SLOPEDRN

Government of Alberta ■ Transportation

B.M.P. #19a
Typical Section



PLAN VIEW



SECTION

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OVERSIDE DRAIN

FILE: OSDRAIN

Government of Alberta ■ Transportation

B.M.P. #19b
Typical Section

Offtake Ditch (Intercept Ditch) Erosion Control	B.M.P. #21

Description and Purpose

- Channels or swales commonly located along the crest of cuts slopes to intercept and convey runoff away from flowing down a newly excavated bare soil slope and to minimize erosion of slope from overlanding sheet flow
- Can be tied to outfall to slope drains (or downdrains) which carry water from higher slope elevations to lower elevation of a slope

Applications

- Permanent measure
- Effective method of intercepting runoff to avoid excessive sheet flow over slope and causing erosion, especially on cut slopes in highly erodible soils (sand and silt)
- Can be used in conjunction with slope drains which was installed down a large cut slope
- May be lined with vegetation, rip rap, erosion control blankets, or some other erosion protection measure, but this requirement may be appropriate only at highly sensitive and high risk environmental areas
- Can be used in conjunction with sediment control measures, such as check structures or permeable synthetic barriers as normal channel design, but this requirement may be appropriate only at highly sensitive and high risk environmental areas

Construction

- Use backhoe to form ditch a minimum offset distance of 2 m between crest of highway slope and top of offtake ditch sideslope, thus providing a dyke width of 1 m
  - Place and compact excavated soil to form a dyke between crest of highway slope and offtake ditch channel to provide adequate depth (1 m) of the offtake ditch
    - The consequence of failure on this dyke will determine the level of compaction effort required
  - Sideslopes of ditch should not be steeper than 2H:1V (depending upon material type)
  - Depth of ditch (from base of ditch to top of embankment) should be a minimum of 1 m in depth; width of ditch should be 1 m minimum
  - Ditch grade should be graded a minimum of 1% to promote positive drainage and outfall

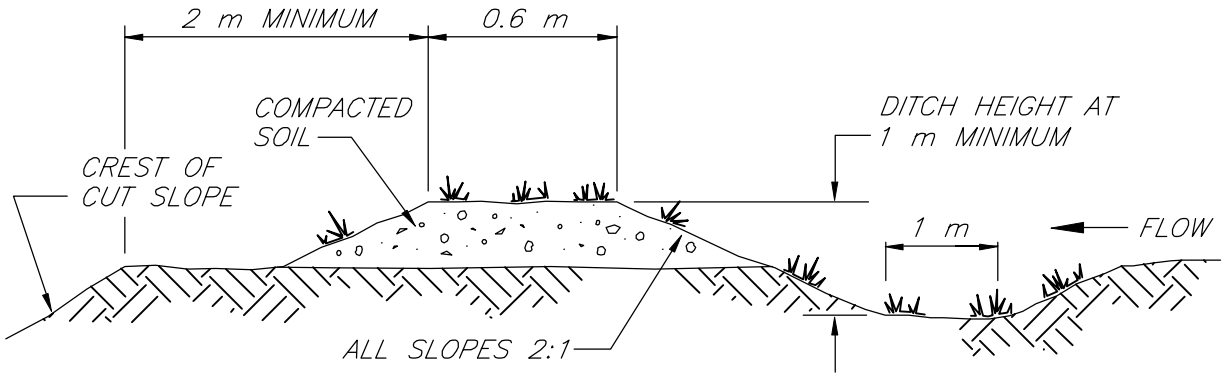
Offtake Ditch (Intercept Ditch) Erosion Control	B.M.P. #21

Construction Considerations

- Channel should be graded towards nearest outfall (draw) or drainage pipe

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Repair any damage to channel immediately



TYPICAL OFFTAKE DITCH

NOTES:

1. THE DITCH BEHIND THE DYKE SHALL HAVE POSITIVE GRADE TO A STABILIZED OUTLET.
2. THE DYKE SHALL BE ADEQUATELY COMPACTED TO PREVENT FAILURE.
3. FOR SENSITIVE HIGH RISK AREAS, THE DITCH SHALL BE STABILIZED WITH TEMPORARY OR PERMANENT SEEDING OR RIPRAP.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

OFFTAKE DITCH
(INTERCEPT DITCH)

FILE: TEMPDIKE

Government of Alberta ■ Transportation

B.M.P. #21
Typical Section

Seeding Erosion Control	B.M.P. #22

Description and Purpose

- The planting or placing seed into soils of cut slope or fill embankment slopes after a layer of organic topsoil is spread over the slope
- Provides erosion protection through development of a shallow root structure from seed germination and plant growth

Applications

- Permanent or temporary measure
- Temporary seeding with rapidly growing plants may be applied to interim stockpile/excavation areas which will be exposed for more than 30 days
- Permanent seeding may be applied to exposed bare soil areas which have been graded to final contours
- Permanent seeding may be applied to landscape corridors, slopes and channels by broadcasting, furrowing or spraying on with mulch tackifier
- Provides habitat for wildlife after vegetation establishment
- Can be enhanced with a protective layer of mulches or rolled erosion control products (RECPs) to improve growth environment

Construction

- The site to be seeded should be prepared prior to seeding
- Surface should be graded to design grades and then topsoiled
- Seedbed should be 75 to 150 mm deep, with the top 75 mm consisting of topsoil free of large clods or stones
- Seed should be applied immediately after seedbed preparation using broadcast seed spreaders, cyclone (broadcast) spreaders, or seed drills to ensure uniformity of application
- Seedbed should be harrowed, raked, or chain-dragged to ensure proper seed-soil contact
- Fertilizer should then be applied after seeding

Seeding Erosion Control	B.M.P. #22

Construction Considerations

- Seeding rate for all mixes should be 25 kg/ha minimum
- Fall rye may be added to each mix to provide early growth and protection from soil erosion.
- Fall rye seeding rate is 5 kg/ha
- Selection of proper vegetation seed mix depends on soil conditions, climate conditions, topography, land use, and site location
- Planting of seeds by hydraulic seeding and mulching techniques should be considered for slopes steeper than 3H:1V where seedbed preparation is difficult, or where application of seed, mulch, and fertilizer in one continuous operation is desirable
- Sod may be installed for faster results, however it is very costly but essential for high risk sensitive areas
- If mulch is placed as a germination medium for seeds, the mulch layer may be further protected with a biodegradable matting to prevent mulch from being washed or blown away

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Freshly seeded areas should be inspected frequently to ensure growth is progressing
- Additional stormwater control measures should be considered for areas damaged by runoff
- Reseedings may be required within 1 to 5 year intervals after initial seeding
- Small bare spots may need to be reseeded several times at subsequent years after initial application
- Larger areas may need to be completely retreated
- Cutting or mowing grasses will encourage the establishment and spread of the grass

Alberta Transportation has adopted seed mixes (provided below) depending on site location. The various areas of the province used in selecting the seed mix are presented (Alberta Transportation Seed Mixture Zones Map).

Alberta Transportation
Grass Seed Mixtures used on Highway and Bridge Projects

*This Special Provision (*Spc_G039.wpd (2005)) *is to be used in conjunction with AT Standard Specification 2.20 "Seeding" and Design Bulletin No. 25. The Consultant must perform the vegetation assessment and the soil testing for fertilizer (if required) as part of his design work.*

Zone 1 - Peace River District - north and west of High Level:

Seed Mix Zone	Native Seed Mix - Zone 1		% by Dry Weight
	Common Name	Latin Name	
1 Wetland Mixedwood	Slender Wheat Grass	*Agropyron trachycaulum*	40%
	Fringed Brome (1)	*Bromus ciliatus*	15%
	Tufted Hairgrass	*Deschampsia cespitosa*	15%
	Northern Wheat Grass	*Agropyron dasystachyum*	10%
	Rocky Mountain Fescue	*Festuca saximontana*	10%
	Fowl Bluegrass	*Poa palustris*	10%

Note (1): Fringed Brome seed shall be coated.

Agronomic Seed Mix - Zone 1		
Common Name	Latin Name	% by Dry Weight
Pubescent Wheat Grass	*Agropyron trichophorum*	40%
Dahurian Wildrye	*Elymus dahuricus*	22%
Sheep Fescue	*Festuca ovina*	30%
Perennial Ryegrass	*Lolium perenne*	8%

Zone 2 - Athabasca District (south of Athabasca) and Grande Prairie District

Seed Mix Zone	Native Seed Mix - Zone 2		% by Dry Weight
	Common Name	Latin Name	
2 Dry Mixedwood	Slender Wheat Grass	*Agropyron trachycaulum*	35%
	Fringed Brome (1)	*Bromus ciliatus*	20%
	Tufted Hairgrass	*Deschampsia cespitosa*	10%
	Northern Wheat Grass	*Agropyron dasystachyum*	15%
	Rocky Mountain Fescue	*Festuca saximontana*	10%
	Fowl Bluegrass	*Poa palustris*	10%

Note (1): Fringed Brome seed shall be coated.

Agronomic Seed Mix - Zone 2		
Common Name	**Latin Name**	**% by Dry Weight**
Pubescent Wheat Grass	*Agropyron trichophorum*	40%
Dahurian Wildrye	*Elymus dahuricus*	22%
Sheep Fescue	*Festuca ovina*	30%
Perennial Ryegrass	*Lolium perenne*	8%

Zone 3 - Athabasca District (north of Athabasca) and Hwy. Nos. 88, 750, 986

Seed Mix Zone	**Native Seed Mix - Zone 3**		**% by Dry Weight**
	Common Name	**Latin Name**	
3 Central Mixedwood	Slender Wheat Grass	*Agropyron trachycaulum*	35%
	Fringed Brome (1)	*Bromus ciliatus*	10%
	Tufted Hairgrass	*Deschampsia cespitosa*	10%
	Canada Wildrye	*Elymus canadensis*	10%
	Rocky Mountain Fescue	*Festuca saximontana*	20%
	Tickle Grass	*Agrostis scabra*	10%
	Fowl Bluegrass	*Poa palustris*	5%

Note (1): Fringed Brome seed shall be coated.

Agronomic Seed Mix - Zone 3		
Common Name	**Latin Name**	**% by Dry Weight**
Pubescent Wheat Grass	*Agropyron trichophorum*	40%
Dahurian Wildrye	*Elymus dahuricus*	22%
Sheep Fescue	*Festuca ovina*	30%
Perennial Ryegrass	*Lolium perenne*	8%

Zone 4 - Lethbridge District (east of Hwy 22), Calgary District (east of Hwy 22), and Hanna District

Seed Mix Zone	Native Seed Mix - Zone 4		% by Dry Weight
	Common Name	Latin Name	
4 Mixedgrass and Dry Mixedgrass	Slender Wheat Grass	*Agropyron trachycaulum*	30%
	Canada Wildrye	*Elymus canadensis*	15%
	Mountain Brome	*Bromus carinatus*	15%
	Northern Wheat Grass	*Agropyron dasystachyum*	10%
	Western Wheat Grass	*Agropyron smithii*	5%
	Indian Rice Grass	Orzyopsis hymenoides	5%
	Alkali Grass	Puccinellia distans	10%
	Needle and Thread Grass	Stipa comata	10%

Agronomic Seed Mix - Zone 4		
Common Name	Latin Name	% by Dry Weight
Pubescent Wheat Grass	*Agropyron trichophorum*	32%
Dahurian Wildrye	*Elymus dahuricus*	30%
Sheep Fescue	*Festuca ovina*	30%
Cereal Rye	*Secale cereale*	8%

Zone 5 - Stony Plain, Vermillion, and Red Deer (east of Hwy 22) Districts:

Seed Mix Zone	Native Seed Mix - Zone 5		% by Dry Weight
	Common Name	Latin Name	
5 Central Parkland	Slender Wheat Grass	*Agropyron trachycaulum*	25%
	Northern Wheat Grass	*Agropyron dasystachyum*	10%
	Fringed Brome [(1)]	*Bromus ciliatus*	15%
	Green Needle Grass	*Stipa viridula*	15%
	Canada Wildrye	*Elymus canadensis*	10%
	Indian Rice Grass	*Orzyopsis hymenoides*	10%
	Nuttall's Alkali Grass	*Puccinellia nuttalliana*	10%
	Western Wheat Grass	*Agropyron smithii*	5%

Note [(1)]: Fringed Brome seed shall be coated.

Agronomic Seed Mix - Zone 5		
Common Name	**Latin Name**	**% by Dry Weight**
Pubescent Wheat Grass	Agropyron trichophorum	32%
Dahurian Wildrye	Elymus dahuricus	30%
Sheep Fescue	Festuca ovina	30%
Cereal Rye	Secale cereale	8%

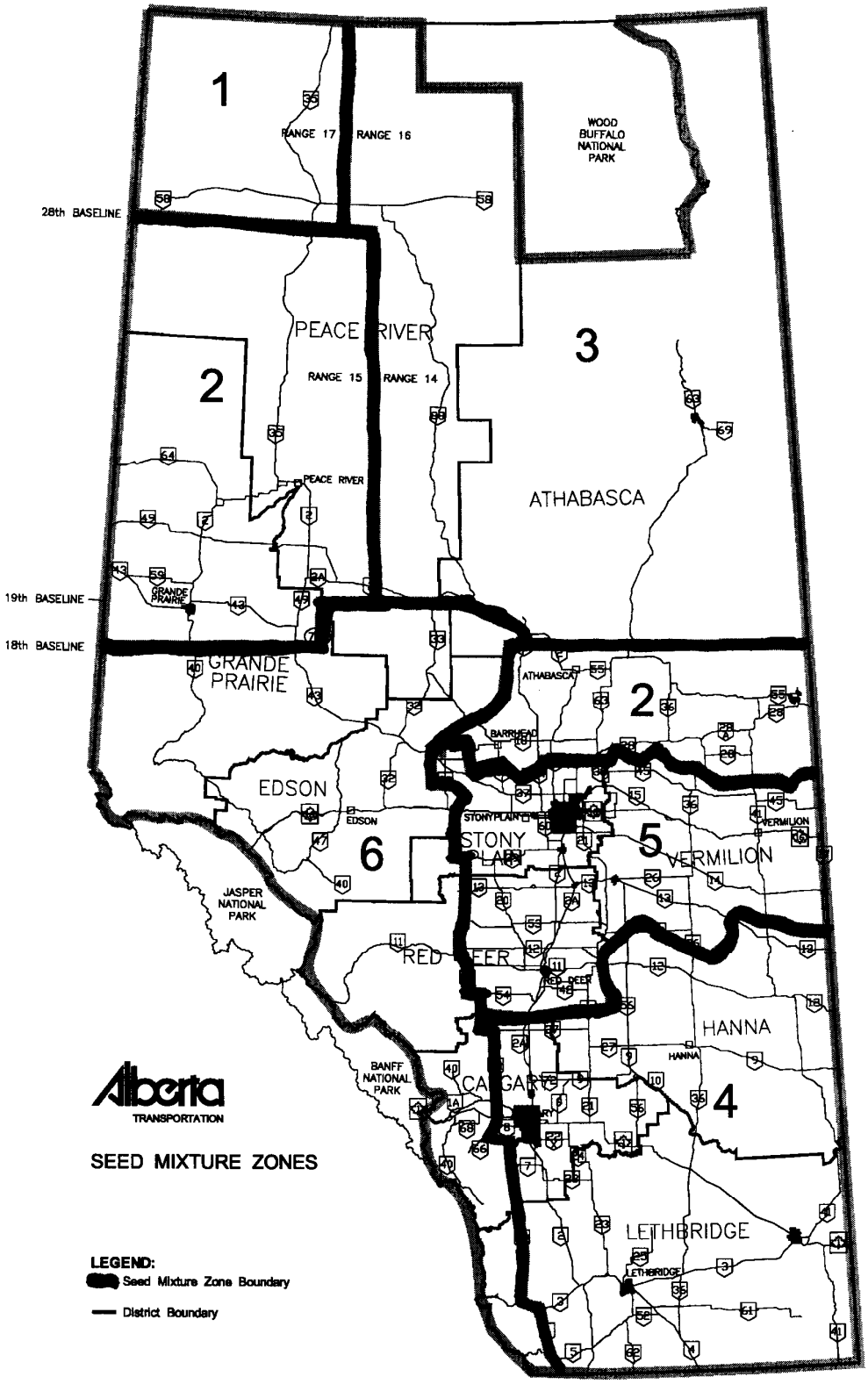
Zone 6 -Lethbridge, Calgary, and Red Deer Districts all located west of Hwy 22):

Seed Mix Zone	**Native Seed Mix - Zone 6**		**% by Dry Weight**
	Common Name	**Latin Name**	
6 Lower Foothills	Slender Wheat Grass	Agropyron trachycaulum	30%
	Smooth Wildrye	Elymus glaucus	20%
	Northern Wheat Grass	Agropyron dasystachyum	10%
	Tickle Grass	Agrostis scabra	10%
	Fringed Brome (1)	Bromus ciliatus	10%
	Tufted Hairgrass	Deschampsia cespitosa	10%
	Foothills Rough Fescue	Festuca campestris	10%

Note (1): Fringed Brome seed shall be coated.

Agronomic Seed Mix - Zone 6		
Common Name	**Latin Name**	**% by Dry Weight**
Pubescent Wheat Grass	Agropyron trichophorum	40%
Dahurian Wildrye	Elymus dahuricus	22%
Sheep Fescue	Festuca ovina	30%
Perennial Ryegrass	Lolium perenne	8%

Seeding Erosion Control	B.M.P. #22



Mulching Sediment Control and Erosion Control	B.M.P. #23

Description and Purpose

- Application of organic material or other normally biodegradable substances as a protection layer to the soil surface (i) to minimize raindrop/runoff erosion and conserve a desirable soil moisture property for plant growth, and/or (ii) to promote seed germination and plant growth
- Mulches conserve soil moisture, reduce runoff velocities and surface erosion, control weeds, help establish plant cover, and protect seeds from predators, raindrop impact, and wind/water erosion

Applications

- Temporary measure
- Can be used as an organic cover or growth medium for seeds where topsoil is not readily available
- Can be used to provide temporary and permanent erosion control
- May be used with or without seeding in areas that are rough graded or final graded
- May be applied in conjunction with seeding to promote plant growth
- May comprise organic mulches (such as straw, wood fibres, peat moss, wood chips, pine needles, compost) or chemical mulches (such as vinyl compounds, asphalt, rubber, or other substances mixed with water)
- Chemical mulches may be used to bind other mulches in a hydroseeding-hydromulching application

Installation

- Prepare soil surface by removing large rocks or other deleterious materials
- Apply topsoil and seed, if required, and if topsoil is readily available
- Apply mulch as per supplier's recommendations
- Certain mulches may require additional anchoring to minimize loss of mulch due to wind or water erosion

Construction Considerations

- Install mulches as per manufacturers' or suppliers' recommendations
- Organic Mulches
  - Straw

- Refers to stalks or stems of small grain (primarily wheat) after drying and threshing
- Straw should be free of weeds
- Loose straw is very susceptible to movement by blowing wind and water runoff and should be anchored either with chemical tackifier or some form of netting
- When properly secured to surface, straw is highly suitable for promoting good grass cover quickly, however, it may be a fire hazard in dry conditions

– Raw Wood Fibre

- Mixture of cellulose fibres; a minimum of 4 mm in length extracted from wood
- Wood fibres usually require a soil binder and should not be used as erosion control during periods of hot dry weather in the summer or for late fall seeding unless it is used in conjunction with another suitable mulch as it is prone to removal by blowing wind or water runoff
- Wood fibre is primarily used in hydroseeding-hydromulching operations where it is applied as part of a slurry and when used in conjunction with a tackifier; it is well suited for tacking straw mulch on steep slopes

– Peat Moss

- Comprises partly decomposed mosses and organic matter under conditions of excessive moisture
- Usually available in dried and compressed bundles
- Should be free of coarse material
- Useful soil conditioner to improve organic content of soil promoting plant growth
- Highly susceptible to removal by blowing wind and water runoff if dry and spread on top of soil

– Wood Chips

- By-products of timber processing comprised of small, thin pieces of wood
- Decompose slowly
- Suitable for placing around individual plants (shrubs and trees) and for areas that will not be closely mowed
- Highly resistant to removal by blowing wind and water runoff

– Bark Chips (Shredded Bark)

- By-products of timber processing comprised of small, thin pieces of tree bark

- Suitable for areas that will not be closely mowed
- Have good moisture retention properties and are resistant to removal by blowing wind and water runoff

– Pine Needles

- Comprise needles from coniferous trees (pine, spruce)
- Needles should be air dried and free of coarse material
- Decompose slowly
- Suitable for use with plants that require acidic soils
- Resistant to removal by blowing wind and water runoff

– Compost (Straw Manure)

- Comprised of organic residues and straw that have undergone biological decomposition until stable
- Should be well shredded, free from coarse material, and not wet
- Has good moisture retention properties and is suitable as a soil conditioner promoting plant growth
- Relatively resistant to removal by blowing wind and water runoff if not dried out completely

– Chemical Mulches

- Comprised of acrylic co-polymers, vinyl compounds, asphalt, rubber, or other substances mixed with water
- Usually used in hydroseeding-hydromulching applications
- Should be applied in accordance with suppliers' recommendations

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Areas damaged by washout or rilling should be regraded if necessary and recovered with mulch immediately
- Additional stormwater control measures should be considered for areas of severe rilling erosion damaged by runoff
- Small bare spots may need to be reseeding and recovered with mulch

Topsoiling Erosion Control	B.M.P. #25

Description and Purpose

- The covering of exposed mineral soils with soils of high organic content to minimize raindrop erosion potential
- Provides a medium for vegetation to grow

Applications

- Temporary or permanent measure
- May be used to provide a bedding medium for seed germination and a cover to exposed soil that is not suitable to promote vegetation growth
- May be used on slopes with a maximum gradient of 2H:1V
- Normally topsoil is placed prior to seeding, mulching, hydroseeding-hydromulching, seeding and installing rolled erosion control products (RECP), or planting of trees/shrubs

Construction

- Prepare ground surface to final grade by removing large rocks or other deleterious materials
- Apply topsoil with dozer or light track equipment to design thickness
- Track walk upslope or downslope (do not overcompact topsoil by heavy equipment; only track walk one pass) to provide a contour of roughness of topsoil to further minimize erosion

Construction Considerations

- Topsoil should be free of weeds which may inhibit re-vegetation of desirable plants (i.e., grass)
- Subgrade should be roughened by track walking up/down the slope prior to topsoiling to promote adhering of topsoil to subgrade (surface roughening of subgrade is especially required if topsoiling is not scheduled immediately after completion of the grade)
- Topsoil should be moistened regularly during periods of hot dry weather to minimize wind erosion
  - Hydroseeding-hydromulching topsoil will minimize wind erosion of topsoil

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans

- Areas damaged by washout or rilling should be regraded and re-topsoiled immediately

Sodding Erosion Control	B.M.P. #26

Description and Purpose

- Use of grass sod to cover and stabilize disturbed areas of bare soil
- Rapidly establishes vegetative cover in environmentally sensitive areas where complete cover of the disturbed soil surface is essential and conventional or hydroseeding and mulching may not be effective to erosion protection for high risk areas
- Acts as a vegetative buffer
- Sod may be nursery or field sod composed of one or more species/cultivars of grasses and may contain associated plants such as legumes

Applications

- Temporary or permanent measure
- Irrigation (watering) required after placement
- May be used to protect soil surface from water and wind erosion where adequate topsoil and fertilizer can be provided
- Best used for areas that have steep grades or require immediate protection, or at locations where aesthetic appearance is a priority

Construction

- Prepare smooth ground surface by removing large rocks or other deleterious materials
- Apply design thickness of topsoil and fertilizer (if required)
- Lay sod strips on prepared surface with long axis perpendicular to direction of slope (or in channels, perpendicular to anticipated direction of flow)
  - Butt-joint ends of adjacent sod strips tightly together
  - Roll or tamp each sod strip to ensure continuous contact between topsoil and underside of sod strip
  - Secure each strip of sod with an anchor embedded a minimum of 0.15 m into underlying soil
  - Anchors should be spaced a maximum distance of 0.6 m apart
- Adjacent rows of sod strips should have staggered joints

Construction Considerations

- Sod must not be placed on frozen ground
- During hot and dry periods, topsoil should be cool and wetted by irrigation prior to placing sod strips
- Freshly installed sod should be irrigated (watered) to moisten the topsoil to minimum depth of 0.1 m
  - Irrigation aids in the development of root matrix within the topsoil
- Successful installation requires the use of freshly cut, healthy sod
  - Storage time of cut sod on-site prior to installation should be kept to as short a time period as possible

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
  - Areas damaged by washout or rilling should be regraded and resodded immediately
- Additional erosion control measures should be considered for rilled or gullied areas
- Small bare spots may need to be resodded
- Sodded areas should be maintained by periodically fertilizing, irrigating (watering), mowing, and weed control, depending on location and maintenance plan
- Sod that is to be mowed periodically as part of its maintenance plan should not be mowed within one month of installation
- Grass clipping from mowing operations should be left on the sod unless they accumulate to a depth greater than 1 cm

Live Staking Streambank Stabilization Technique	B.M.P. #27a

Description and Purpose

- Consists of installing woody plantings (trees and shrubs) to develop a root matrix within the soil, increasing subsurface soil strength and stabilizing slopes with deeper root systems than grasses
- Reduces erosion potential of slopes and channel banks

Applications

- Temporary or permanent measure
- May be used on slopes stable enough to support vegetation; however, there is a low success rate for steep slopes and channel banks with gradients greater than 1H:1V
- May be used on slopes and channel banks with adequate sunlight, moisture, and wind protection to support vegetation
- May be used as bio-engineering stabilization in cases where there have been historical shallow slope instability, soil movements on eroded slopes and gullies
- May be used along channels to provide higher channel roughness to reduce flow velocity and in sedimentation ponds to provide higher sedimentation duration of runoff impoundment

Construction

- Used on cut or fill slopes or in ditches/channels
- Comprised of willow or poplar stakes inserted into the ground; other indigenous plants may be acceptable
- Individual dormant willow or poplar stakes should be cut to a minimum length of 0.5 m using pruning shears
  - Cuts should be made at a 45° angle a minimum of 0.05 m (5 cm) below a leaf bud
  - All side shutes should be trimmed to within 0.05 m of the main stem
- Install live stakes in a 1 m by 1 m grid
- Make a pilot hole a minimum of 0.3 m in depth to insert live stake into
  - Use iron bar, broom handle or other tool to make pilot hole
- Insert live stake into pilot hole and lightly tamp soil around live stake
- A minimum of two leaf buds should remain above grade

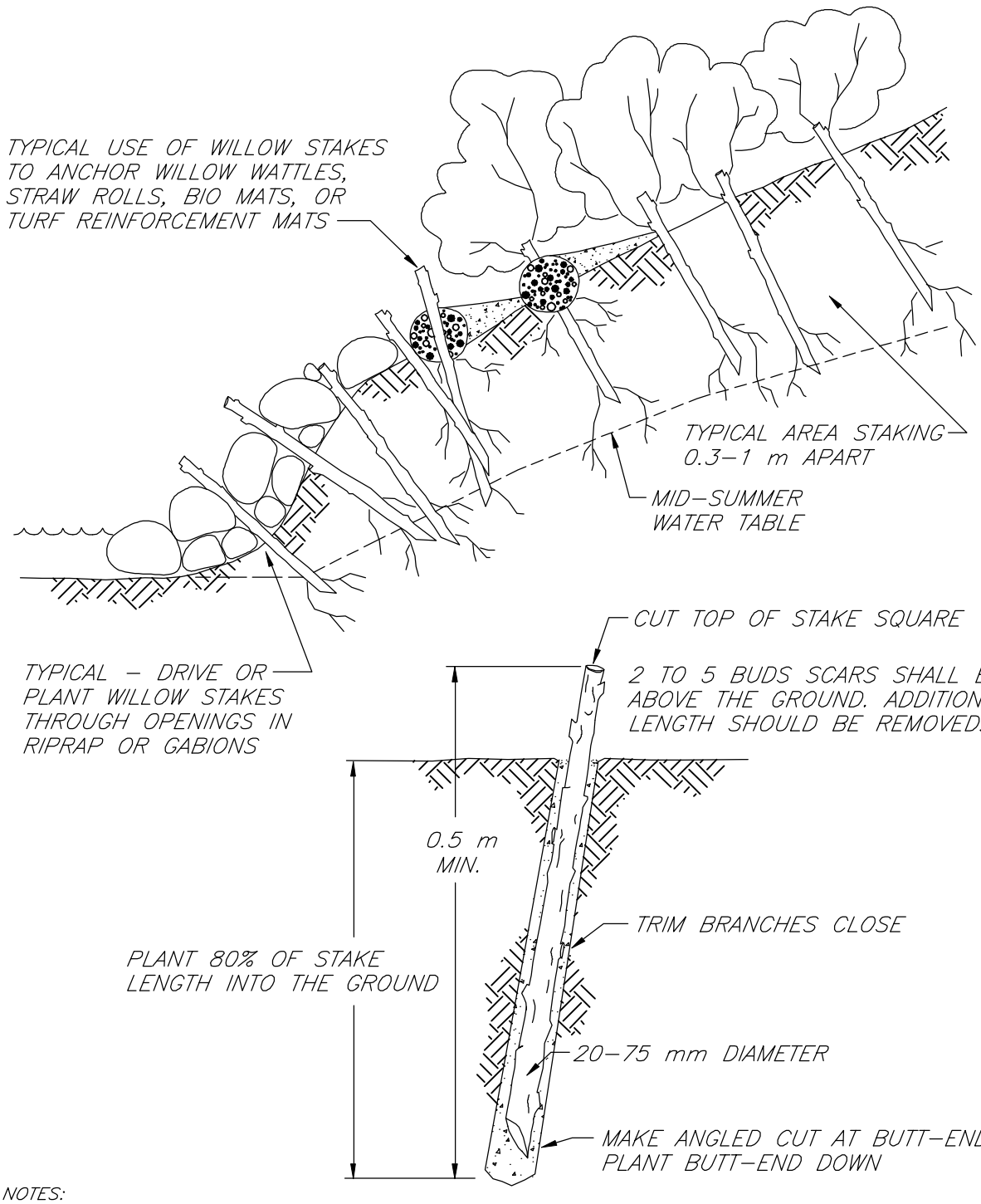
Live Staking Streambank Stabilization Technique	B.M.P. #27a

Construction Considerations

- Successful installation requires the use of freshly cut branches or stakes
  - Storage time of cut branches/stakes on-site prior to installation should be kept to as short a time period as possible
- Successful growth dependant on soil moisture and rainfall conditions
- Consultation with agrologist, greenhouse growers, local expertise can be beneficial in selecting and procuring appropriate species for planting

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
  - Areas damaged by washout or erosion rilling should be replanted immediately
- Additional stormwater control measures should be considered for severe rilling areas damaged by runoff
- Watering plants is required for first one to two months after planting



NOTES:
1. HARVEST AND PLANT STAKES DURING THE DORMANT SEASON.
2. USE HEALTHY, STRAIGHT AND LIVE WOOD AT LEAST 1 YEAR OLD.
3. MAKE CLEAN CUTS AND DO NOT DAMAGE STAKES OR SPLIT ENDS DURING INSTALLATION, USE A PILOT BAR IN FIRM SOILS.
4. SOAK CUTTINGS FOR 24 HOURS (MIN.) PRIOR TO INSTALLATION.
5. TAMP THE SOIL AROUND THE STAKE.
6. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

NOT TO SCALE

LIVE STAKING

FILE: LIVESTK

Description and Purpose

- Consists of installing woody plantings (trees and shrubs) to develop a root matrix within the soil, increasing subsurface soil strength and stabilizing slopes with deeper root systems than grasses
- Reduces erosion potential of slopes

Applications

- Temporary or permanent measure
- May be used on slopes stable enough to support vegetation; however, there is a low success rate for steep slopes with gradients greater than 1H:2V
- May be used on slopes with adequate sunlight, moisture, and wind protection to support vegetation
- May be used as bio-engineering stabilization in cases of historical shallow slope instability soil movements on eroded slopes and gullies
- May be used to reduce flow velocity and in sedimentation ponds to provide higher sedimentation duration of runoff impoundment
- Particularly appropriate for highway embankments that encroach upon riparian areas or floodways
- Slopes that need additional geotechnical and erosion reinforcement are good candidates for brushlayering
- Steeper slopes require the use of inert reinforcements such as geotextiles (ECBs, TRMs, coir netting), wire (twisted or welded gabion wire) or geogrids
- If either steady, long term seepage or temporary bank return flows after flood events are a problem, the brushlayers act as a horizontal drainage layer or conduits that relieve internal pore water pressure

Construction

- First construct any lower bank or in-stream stabilizing measures such as a rock or log toe structure
- Excavate the first horizontal bench, sloping back into the hillslope at about 10%
- Install any drainage required along the back of each bench
- Place branches that are at least 1.8 m long on the bench
- Branches should crisscross at random with regard to size and age
- Place 20 branches per linear m on the bench, with the butts of the branches along the inside edge of the bench
- 20-45 cm of the growing tip should protrude beyond the face of the slope
- Cover and compact (add water if necessary) the brushlayer with 15 cm lifts of soil to reach the designed vertical spacing, typically 0.5 m to 1.2 m apart

- Slope the top of each fill bench back into the hill
- Construct another brushlayer
- When placed, the protruding tips of the cuttings are above the butts due to the back slope of the bench
- Proceed up the bank as desired
- The erosion and failure potential of the slope (i.e., drainage, soil type, rainfall, and length and steepness of the slope) determine spacing between the brushlayers
- On long slopes, brushlayer spacing should be closer at the bottom and spacing may increase near the top of the slope

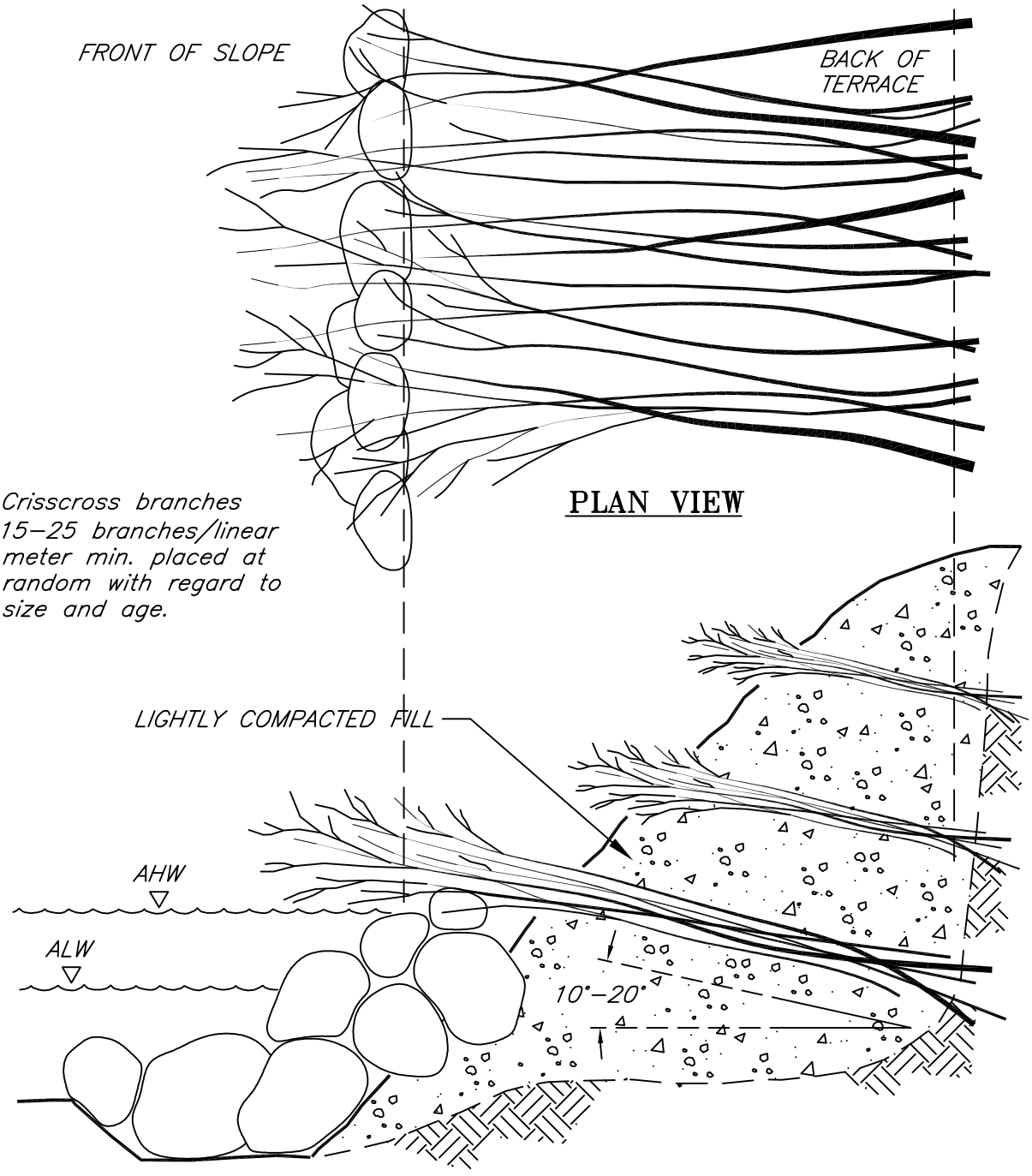
Construction Considerations

- Successful installation requires the use of freshly cut branches or stakes
  - Storage time of cut branches/stakes on-site prior to installation should be kept to as short a time period as possible
- Successful growth dependant on soil moisture and rainfall conditions
- Consultation with agrologist, greenhouse growers, local expertise can be beneficial in selecting and procuring appropriate species for planting
- Installed during soil fill operations which result in the branches being inserted deeply into the slopes and thereby increasing the likelihood that the branches will encounter optimum soil and moisture conditions
- Live cuttings are most effective when implemented during the dormancy period of chosen plant species
- Live willow branches (or cuttings of other adventitiously-rooting species) at least 1.8 m long, with a minimum diameter of 20 mm
- Heavy equipment is usually employed for the construction of embankments
- A bucket loader and/or backhoe or excavator can facilitate the work
- Water should be available for achieving optimum soil moisture

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Inspect planted areas at least twice per year or after significant storm events (1:2 year storm and/or 40 mm rainfall in 24 hours)
  - Areas damaged by washout or erosion rilling should be replanted immediately
- Additional stormwater control measures should be considered for severe rilling areas damaged by runoff
- Watering plants is required for first one to two months after planting
- The live cuttings or branches should establish successfully without irrigation requirements given the proximity to water

- Inspect the cuttings for adequate vegetative establishment (as evidenced by root and shoot production from the imbedded stems) and for signs of localized erosion such as rilling from runoff or sloughing from stream scour
- Brushlayer treated streambanks should also be inspected for localized slope movements or slumps
- These localized slope failures and/or areas of poor vegetative establishment can often be repaired by re-installing the brushlayers in these zones
- The site should be examined for possible signs of flanking erosion, which must be addressed with ancillary protective measures lest the flanking threatens the integrity and effectiveness of the protective brushlayer fill
- As with all resistive streambank structures, flanking is always a potential problem
- If frozen soil is employed in constructing the soil lifts between brushlayers, some settlement may occur when the soil thaws. This settlement may falsely signal a slope failure
- The most likely causes of failure are the following:
  - Inadequate reinforcement from the brushlayer inclusions, i.e., too large a vertical spacing or lift thickness for the given soil and site conditions, slope height, slope angle, and soil shear strength properties
  - Inadequate tensile resistance in the brushlayers as result of too small an average stem diameter and/or too few stems per unit width
  - Failure to properly consider seepage conditions and install adequate drainage measures, e.g., chimney drain, behind brushlayer fill, and conversely inadequate moisture applied during installation, and inadequate attention to construction procedures and details



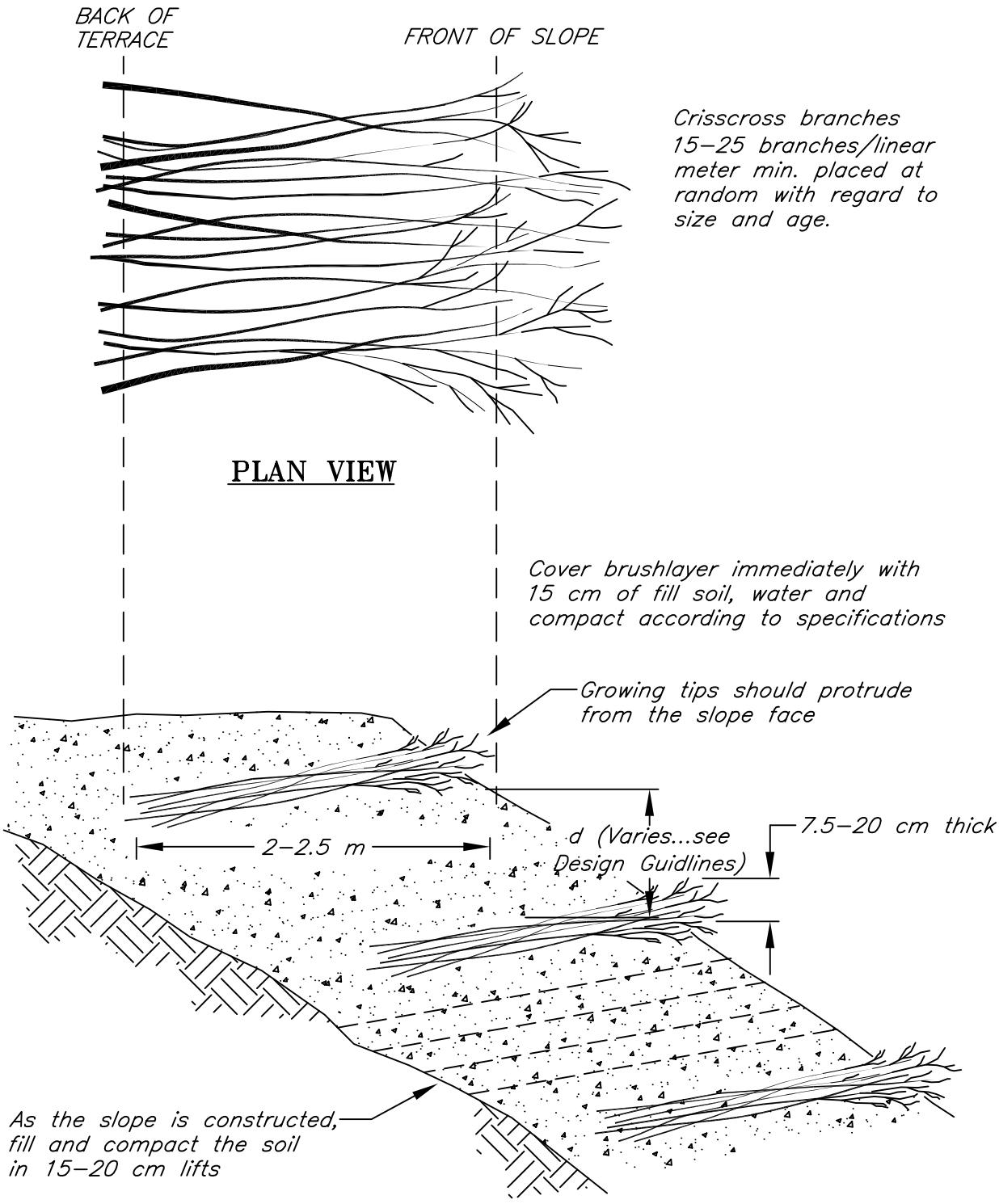
NOTES:
1. Tilt branches down into the slope 10°–20° min.
2. Brushlayering may be constructed with non–compacted or compacted backfill without damage to the brush layer.
3. Branches irrespective of length, should protrude 20–45 cm beyond the face of the slope.

BRUSHLAYERING WITH ROCK TOE PROTECTION

FILE: BRLAY–RT

Government of Alberta ■ Transportation

B.M.P. #27b1
Typical Section

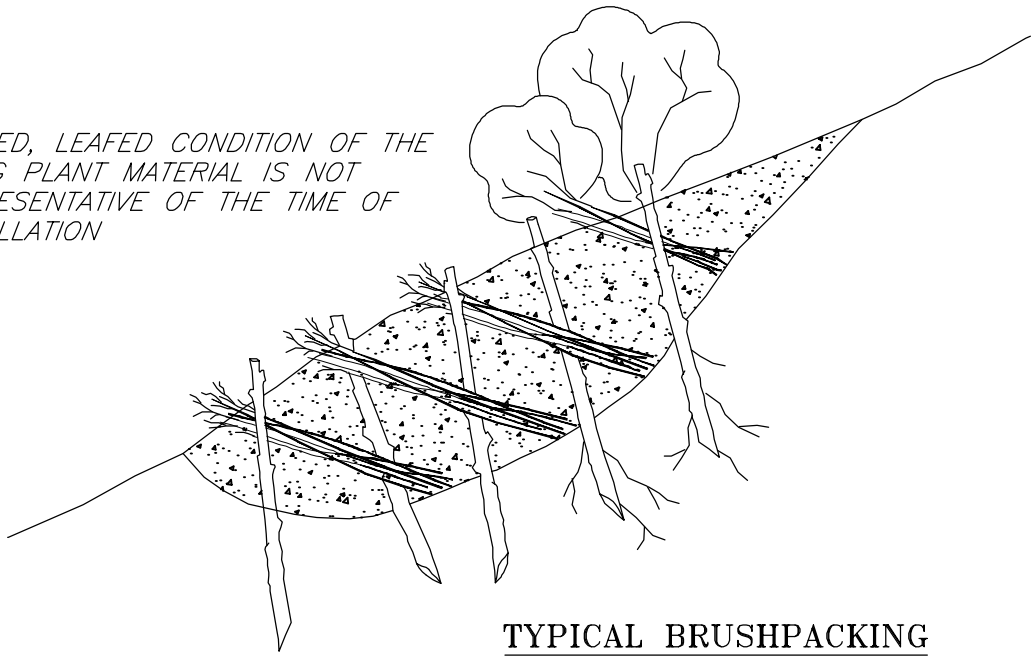


TYPICAL BRUSHLAYERING WITH SLOPE CONSTRUCTION

BRUSHLAYERING

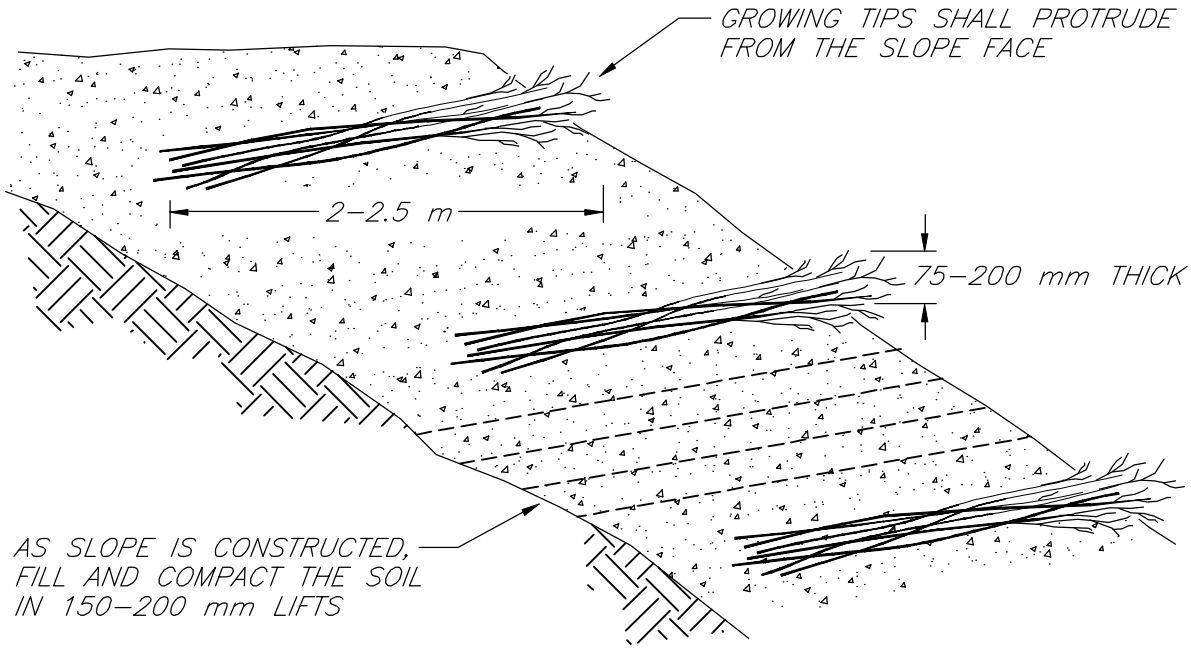
FILE: BRSHLAYR

NOTE:
ROOTED, LEAFED CONDITION OF THE LIVING PLANT MATERIAL IS NOT REPRESENTATIVE OF THE TIME OF INSTALLATION



TYPICAL BRUSHPACKING

COVER BRUSHLAYER IMMEDIATELY WITH 150 mm OF FILL SOIL, WATER AND COMPACT ACCORDING TO SPECIFICATIONS



TYPICAL BRUSHLAYERING WITH SLOPE CONSTRUCTION

NOTE:

1. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

BRUSHLAYERING

FILE: BRSHLAYR

Government of Alberta ■ Transportation

B.M.P. #27b3
Typical Section

Riparian Zone Preservation Sediment Control and Erosion Control	B.M.P. #30

Description and Purpose

- Protection of existing plants and trees adjacent to all natural water bodies (riparian zones) adjacent to construction areas
- Existing vegetation acts as an effective vegetative buffer strip as a form of erosion and sediment control measure

Applications

- Permanent measure
- Existing established vegetation acts as an effective sediment control and erosion control buffer strip barrier to slow down flows and allow sedimentation filtration to occur
- May be used along property boundaries to minimize sediment transport off construction site despite non-presence of watercourse adjacent

Construction

- It is highly important to preserve an established vegetative buffer as freshly planted vegetation generally require substantial growth periods before they are as effective as established riparian zones
- Wherever possible, retain as much existing vegetation as possible between construction areas and sensitive zones (wetlands, marshes, streams, floodplains, etc.) to entrap sediment and to minimize sediment transport off of the construction site into the sensitive zones
- Define and delineate riparian zones to be preserved in Environmental Construction Operations Plan (ECO Plan) prior to commencement of construction
- Clearly mark riparian zones to be preserved in the field (with construction fencing, survey flagging, or other highly visible measure) so all personnel involved with construction operations can identify areas to be preserved

Construction Considerations

- Riparian zones must be fenced off immediately to minimize trespassing and to ensure effectiveness of riparian zone is maintained
- Do not allow equipment to enter areas not necessary to construction
- Based on site-specific situations established buffer zones of adequate width

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans

Riparian Zone Preservation Sediment Control and Erosion Control	B.M.P. #30

- Maintain fences protecting riparian zones from trespassing

Scheduling

Sediment Control and Erosion Control

B.M.P. #32

Description and Purpose

- Scheduling the sequence and timing arrangement of construction activities (1) to efficiently maximize the amount of erosion protection installed (such as topsoiling and seeding) as soon as a portion of grade construction is completed, and (2) to limit the portion of land disturbance (construction) compatible with the efficient rate of construction of erosion control measures achievable
- Incorporating erosion and sedimentation control concerns during the scheduling phase will minimize the amount and duration of bare soil exposure to erosion elements and ensure erosion and sedimentation control measures are implemented at an appropriate time
- Scheduling may be designed during planning stages by the contractor and altered during construction to suit actual conditions encountered

Applications

- Temporary measure

Implementation

- Incorporate a schedule with erosion protection perspective to form part of the overall construction plan
- Determine sequencing and timetable for the start and end of each item, such as clearing, grubbing, stripping, etc.
- Incorporate installation of appropriate erosion and/or sediment control measures in construction schedule
- Allow sufficient time before rainfall begins to install erosion and/or sediment control measures
- Whenever possible, schedule work to minimize extent of site disturbance at any one time
- Incorporate staged topsoiling and revegetation of graded slopes as work progresses
  - Don’t leave all topsoiling and revegetation until the very end of the project

Inspection and Maintenance

- Routinely verify that construction activities and the installation of erosion and sediment control measures is progressing in accordance with schedule
  - If progress deviates from schedule, take corrective action

- When changes to the project schedule are unavoidable, alter the schedule as soon as practicable to maintain control of erosion

Stabilized Worksite Entrances Sediment Control and Erosion Control	B.M.P. #33

Description and Purpose

- Comprised of a gravel pad located at site access points (entrances) that are used to reduce the amount of sediment carried off construction sites by vehicles
- Collect sediment from vehicle washing and retains sediment on construction site
- Should include water supply to wash off excess soil from vehicles prior to exiting the constructions site

Applications

- Temporary measure
- For use anywhere vehicles enter or exit a construction site

Implementation

- Install gravel pad at planned entrances to worksite
  - Gravel pad (minimum of 15 m in length) should be of sufficient length to accommodate longest anticipated vehicle entering or exiting the site
  - Width of pad should be sufficient to accommodate the widest anticipated vehicle entering or exiting the site (minimum of 3.6 m in width)
  - Thickness of gravel pad should be a minimum of 0.30 m thick (0.3 m thickness is preferred for highway projects) and should comprise 50 to 150 mm diameter coarse aggregate placed on top of woven geotextile filter fabric
- Install temporary sediment control measures (such as straw bale barriers or silt fences) to collect washed off sediment from gravel pad

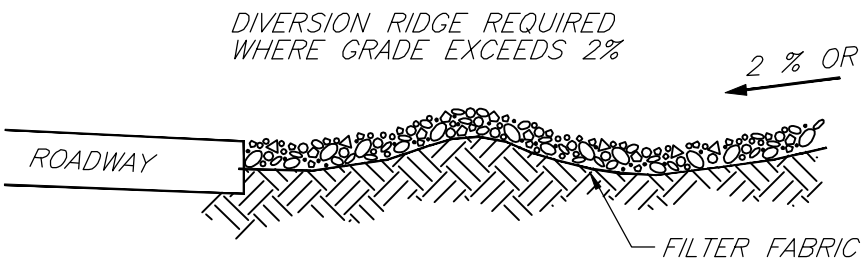
Construction Considerations

- Should be constructed at all access points to construction sites
  - If impractical to construct at all access points, limit vehicle access traffic to stabilized worksite entrances only
- Entrances located with steep grades or at curves on public roads should be avoided
- Woven geotextile filter fabric should be used as underlay below gravel pad as strength requirement
- Install an elevated ridge adjacent to roadway if gradient of the gravel pad is steeper than 2%, sloped towards the roadway

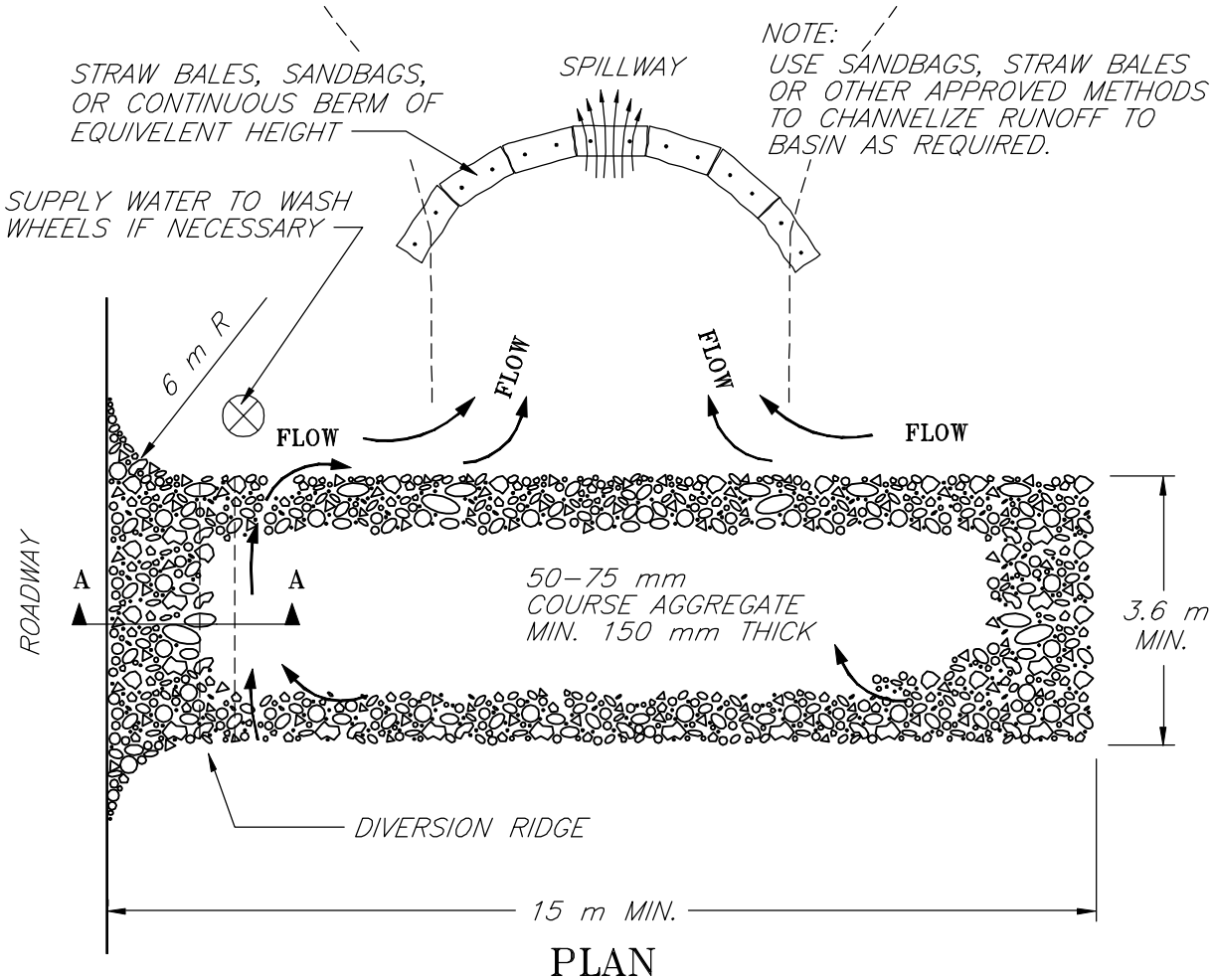
Inspection and Maintenance

Stabilized Worksite Entrances Sediment Control and Erosion Control	B.M.P. #33

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Granular material should be regraded when required
  - Material may need to be added to fill large voids to maintain a minimum pad thickness of 0.30 m
- Inspect and clean out downstream sediment control measures at least once per week and after periods of significant rainfall
- Material accidentally deposited onto public roads should be cleaned as soon as possible



SECTION A – A



PLAN

NOTES:

1. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHT–OF–WAYS. THIS MAY REQUIRE TOP DRESSING, REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.
2. WHEN NECESSARY, WHEELS SHALL BE CLEANED PRIOR TO ENTRANCE ONTO PUBLIC RIGHT–OF–WAY.
3. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABLIZED WITH CRUSHED STONE THAT DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN.
4. FOR HIGHWAY CONSTRUCTION, 300mm THICKNESS OF GRAVEL IS PREFERRED.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

TEMPORARY GRAVEL CONSTRUCTION ENTRANCE/EXIT

FILE: ENTRANCE

Slope Texturing (a-c) Sediment Control	B.M.P. #34 (a - c)

Description and Purpose

- Texturing of slopes, either by roughening the surface, tracking the surface, or installing grooves or benches
- Texturing reduces the runoff velocity, traps sediment, and increases the infiltration of water into the soil

a) Surfacing Roughening

b) Grooved or Serrated Slope

c) Benched Slope

Applications

- Temporary measure
- May be used to roughen the exposed soils on the slope surface in the direction of water flow to minimize erosion and to entrap some sediments
- May be used on fresh cut or fill slopes (8 m length or longer; practical travel reach of a dozer) with gradients of generally 3H:1V or steeper (2H:1V as general steepness limit) constructed in cohesive soils
- May be used on slope subgrade that will not be immediately topsoiled, vegetated or otherwise stabilized
- May be applied to topsoiled slope to provide track serration to further reduce erosion potential
- May be used in graded areas with smooth and hard surfaces
- As part of slope design, benching may be used to effect a reduction of erosion hazard where a long slope length needs to be shortened into smaller sectional lengths with mid-benches; normally a 3 m wide bench can be appropriate
  - Benching is usually a permanent slope design feature and should only be designed by a qualified geotechnical engineer
  - Benching of a long slope section to divide into short sections can reduce erosion hazard in the range of 30 to 50% (e.g., sediment yield for 15 m high 3H:1V slope with mid-bench)

Construction

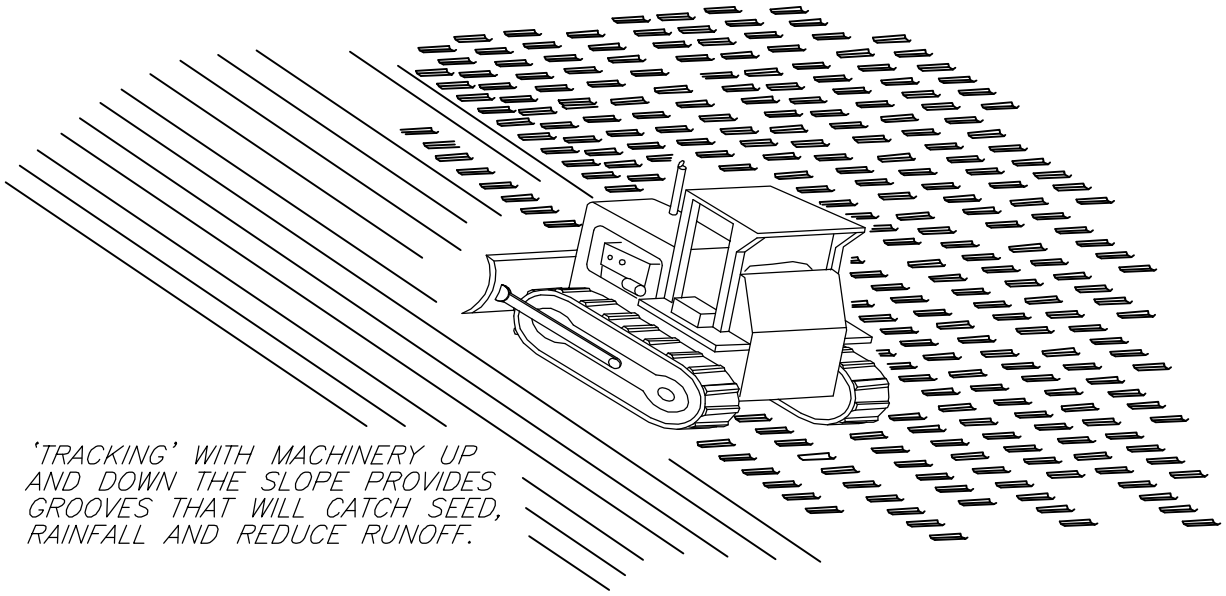
- Surface Roughening
  - Leave soil in rough grade condition, do not smooth grade soil

  - Large lumps of soil will aid in decreasing runoff velocities, trap sediment, and increase infiltration of water

- Surface Tracking
  - Using tracked construction equipment to move up and down the slope, leaving depressions perpendicular to the slope direction; limit passes to prevent overcompaction of the surface
  - Depressions in the soil will aid in decreasing runoff velocities, trap sediment, and increase infiltration of water
- Grooving
  - Excavating shallow furrows across the width of the slope, perpendicular to the direction of the slope
  - If used, contour grooves should be approximately 0.1 to 0.2 m in depth
- Grooves can be made by using equipment or hand
- Benching
  - Construction of narrow, flatter sections of soil on the slope, perpendicular to the direction of the slope
  - Benches should be designed by qualified geotechnical engineer

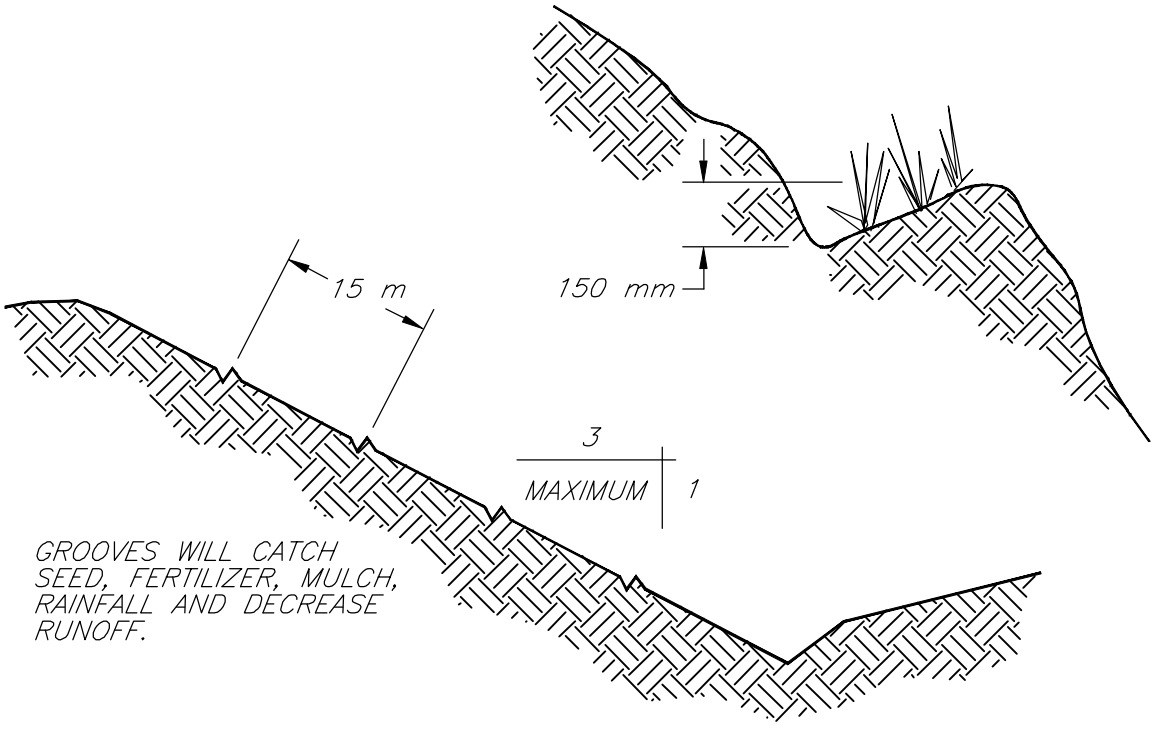
Construction Considerations

- During tracking operations, care must be taken to minimize disturbance to the soil where the equipment turns or changes direction
- Minimize the number of tracking passes to 1 or 2 times to avoid overcompaction, which can negatively impact the vegetation growth
- It is practical to track roughen a slope length of greater than 8 m for practical up/down slope operation of a small bulldozer. It is important to minimize the loosening of soil caused by turning movement of the bulldozer at the end of each pass. As the erosion potential is lower for slope of low vertical height (<3 m height and 3H:1V slope), the tracking of low height slope is not required and not practical for bulldozer tracking operation.



'TRACKING' WITH MACHINERY UP AND DOWN THE SLOPE PROVIDES GROOVES THAT WILL CATCH SEED, RAINFALL AND REDUCE RUNOFF.

TRACKING



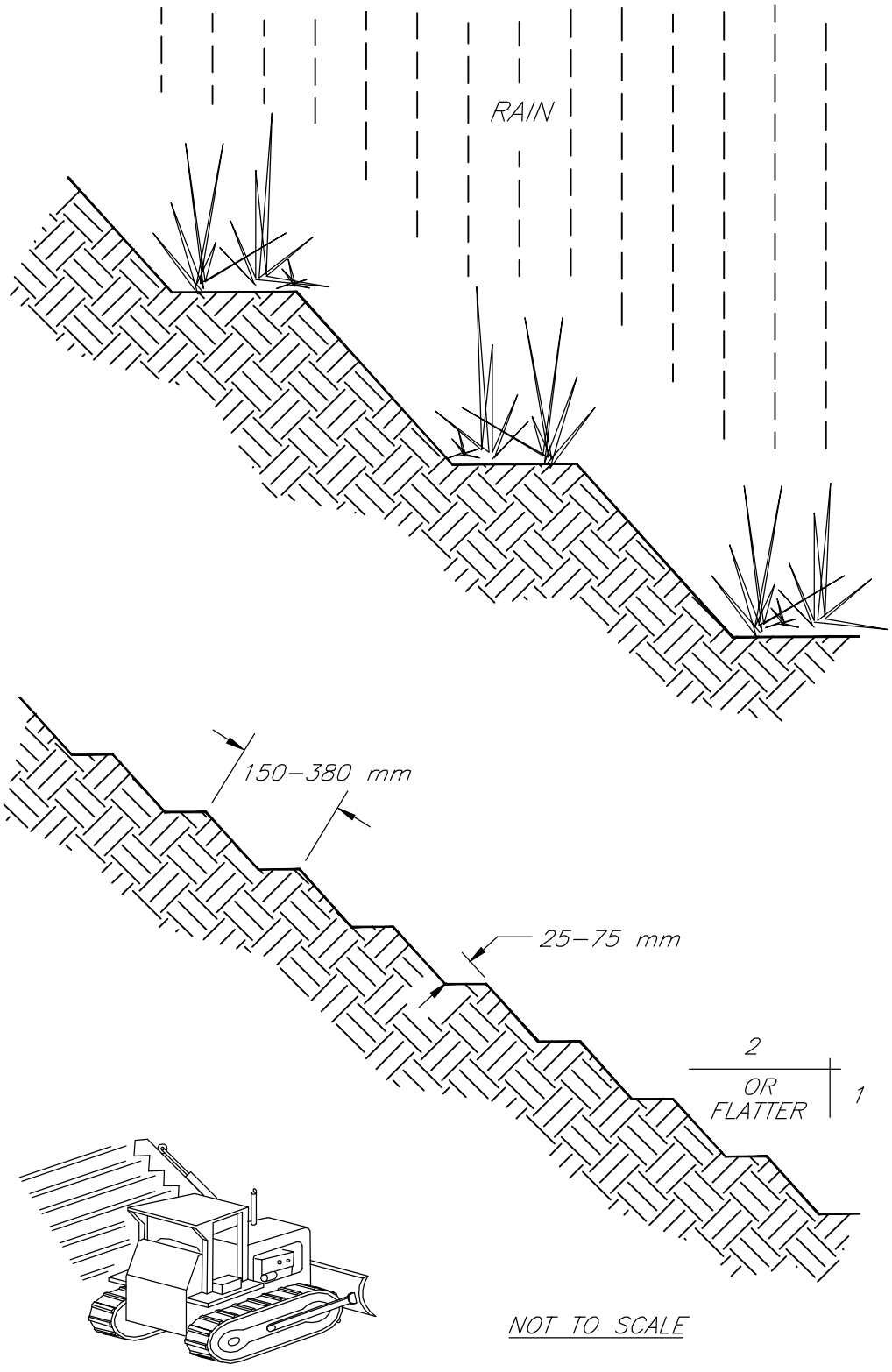
CONTOUR FURROWS

SURFACE ROUGHENING

FILE: SRFROUGH

Government of Alberta ■ Transportation

B.M.P. #34a
Typical Section



NOT TO SCALE

NOTE:

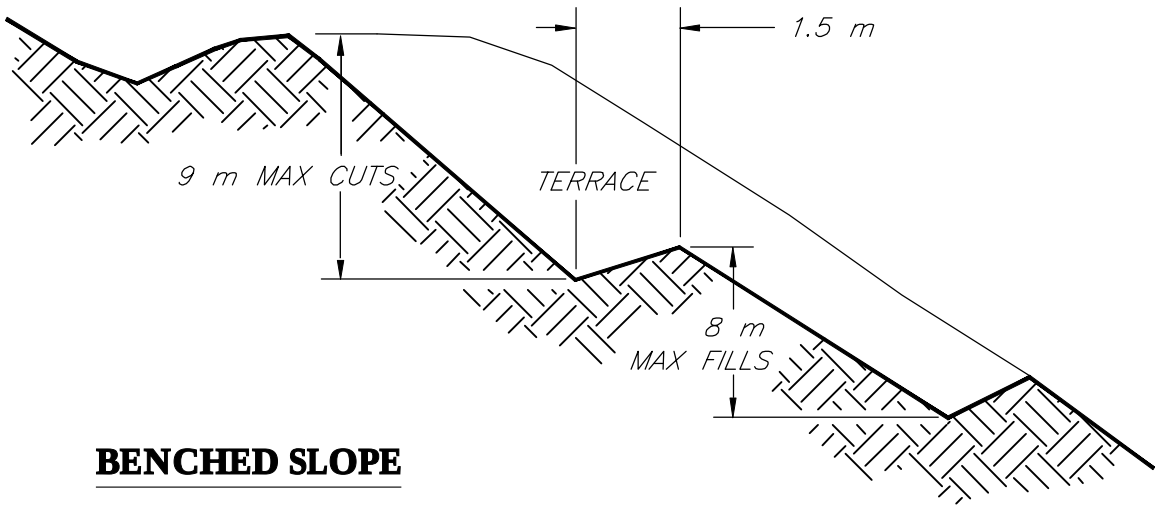
GROOVE BY CUTTING SERRATIONS ALONG THE CONTOUR. IRREGULARITIES IN THE SOIL SURFACE CATCH RAINWATER, SEED, MULCH AND FERTILIZER.

GROOVED OR SERRATED SLOPE

FILE: SERSLOPE

Government of Alberta ■ Transportation

B.M.P. #34b
Typical Section



BENCHED SLOPE

NOT TO SCALE

BENCHED SLOPE

FILE: STPSLOPE

Government of Alberta ■ Transportation

B.M.P. #34c
Typical Section

Compost Blanket Erosion Control	B.M.P. #37

Description and Purpose

- Compost is the product resulting from the controlled biological decomposition of organic material, occurring under aerobic conditions
- Compost has been sanitized through the generation of heat and stabilized to the point that it is appropriate for its particular application
- Active composting is typically characterized by a high temperature phase that sanitizes the product and allows a high rate of decomposition
- It is followed by a lower temperature phase that allows the product to stabilize while still decomposing at a slower rate
- Compost should possess no objectionable odours or substances toxic to plants
- Compost contains plant nutrients but is typically not characterized as a fertilizer
- May derive from agricultural, forestry, food or industrial residues, bio-solids, leaf and yard trimmings, manure, tree wood, or source-separated or mixed solid waste

Applications

- Compost blanket are commonly used for temporary erosion and sediment control
- The technique is appropriate for slopes up to 2H:1V grade and on level surface
- Only used in areas that have sheet flow drainage patterns (not for areas that receive concentrated flows)
- Compost used on AT projects must meet Canadian Council of Ministers of the Environment (CCME) Guidelines for Compost Quality (trace elements, maturity/stability, pathogens), which are adopted by Alberta Transportation and found on AT Products List (www.transportation.alberta.ca)

Installation

- Slightly roughen (scarify) slopes and remove large clods, rocks, stumps, roots larger than 50 mm in diameter and debris on slopes where vegetation is to be established
- Apply compost at the rates as follows:

Annual Rainfall/Flow Rate	Total Precipitation	Application Rate for Vegetated Compost Surface	Application Rate for Unvegetated Compost Surface
Low	25 mm – 635 mm	12.5 mm – 19 mm	25 mm – 37 mm
Medium	635 mm – 1270 mm	19 mm – 25 mm	37 mm – 50 mm
High	>1270 mm	25 mm – 50 mm	50 mm – 100 mm

- Compost shall be uniformly applied using an approved spreader, e.g., bulldozer, site discharge manure spreaders
- A pneumatic blower unit propels the compost directly at the soil surface, thereby preventing water from moving between the soil-compost interface
- Seeding can be incorporated during the compost application

Construction Considerations

- Use higher blanket application rate in high rates of precipitation and rainfall intensity, and snow melt
- Compost may be used in conjunction with a compost blanket, especially in regions with spring melt, and sites with severe grades and long slopes
- In regions subjecting to wind erosion, a coarser compost product or higher blanket application rate is preferred
- Use lower blanket application rate in lower precipitation rates and rainfall intensity regions

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Areas damaged by washout or rilling should be regraded if necessary and re-covered with compost immediately

Silt Fence Sediment Control	B.M.P. #1

Description and Purpose

- Permeable fabric barriers installed vertically on support posts along contours to collect sediment laden sheet flow runoff
- Causes water to pond allowing sediment to settle out as water filters through fabric
- Entraps and minimizes coarse sediment from sheet flow or overland flow from entering waterbodies
- Perimeter control for sediment transport and deposition

Applications

- Temporary measure
- Used at bottom of cut or fill slopes to collect sediment laden runoff
- Used along streams (or channels) banks
- Used around stockpiles
- Midslope grade-break (using "J-hook" or "smile" pattern to effect ponding, filtering and sedimentation)

Construction

- Two methods of installation are commonly used
  - Trench method
  - Mechanical (slicing) installation method (e.g. Tommy Silt Fence Machine or equivalent)
- Trench Method
  - Select location of silt fence (usually along contours)
  - Drive support posts a minimum of 0.3 m into ground, spaced a maximum of 2 m apart
  - Excavate trench approximately 0.15 m deep by 0.15 m wide for entire length of fence along upstream side of posts
  - Attach the wire mesh or snow fencing, if used as reinforcement, to upstream side of posts with staples
  - Extend filter fabric to base of trench and attach over wire mesh or snow fence, if used, on upstream side of posts
  - Backfill and compact soil in trench, being careful not to damage fence

- Mechanical Installation Method
  - Select location of silt fence (usually along contours)
  - Use mechanical installation machine to embed the fabric a minimum of 0.15 m into the ground. One mechanical installation method is by slicing (with special equipment) the geotextile fabric embeds into the ground without excavation and backfill. There is only minor disturbance of the ground. Tamping of ground is required for compaction.
  - Drive support posts a minimum of 0.3 m into ground, spaced a maximum of 2 m apart
  - Attach the wire mesh or snow fencing, if used as reinforcement to silt fence fabric, to upstream side of posts with staples
  - Extend filter fabric to base of trench and attach over wire mesh or snow fence, if used, on upstream side of posts

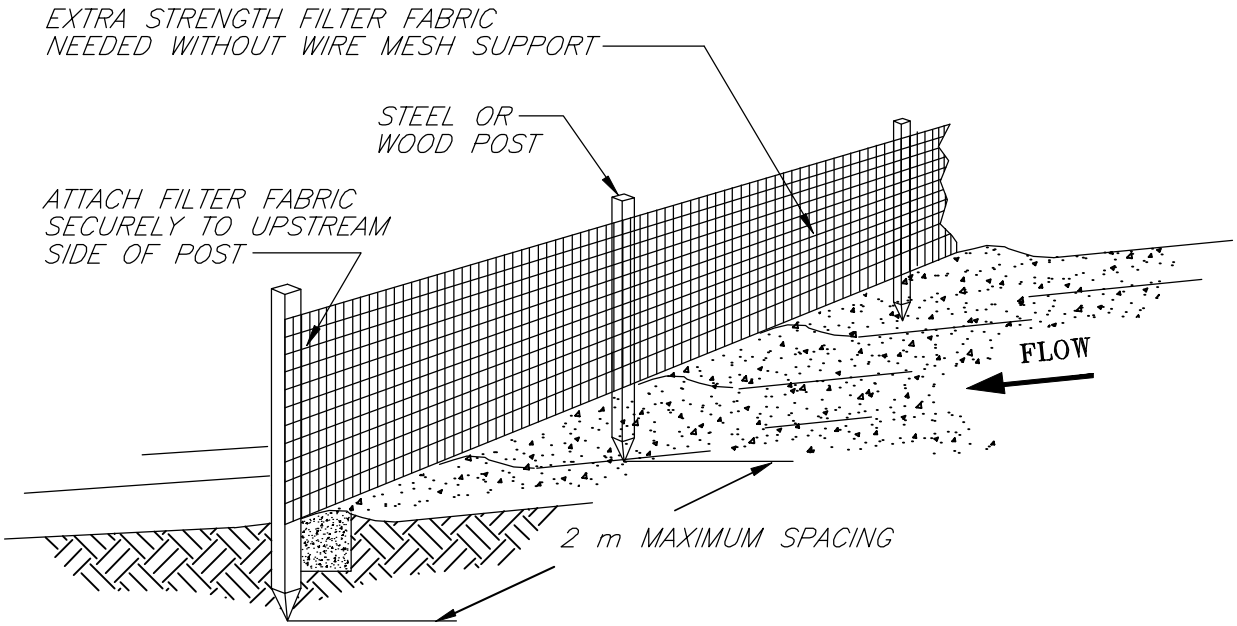
Construction Considerations

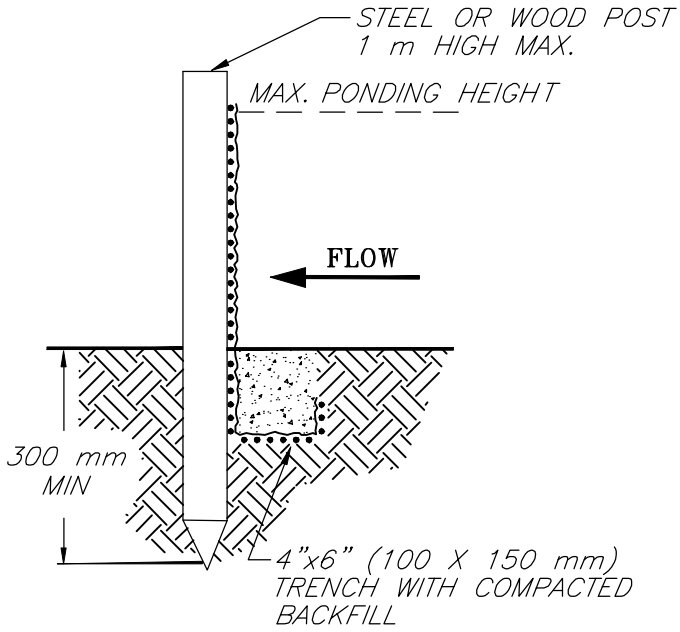
- Site Selection
  - Size of drainage area should be no greater than 0.1 ha per 30 m length of silt fence
  - Maximum flow path length above silt fence should be no greater than 30 m
  - Maximum slope gradient above the silt fence should be no greater than 2H:1V
- Fence should be placed on contour to produce proper ponding
- Fence should be placed far enough away from toe of slope to provide adequate ponding area (minimum of 1.8 m away from toe of slope is recommended)
- Ends of fence should be angled upslope to collect runoff
- Fence should not extend more than 0.6 m above grade
- Posts can be wood or metal material dependent on design and ground conditions
- Posts should be placed on downstream side of fence
- Posts should not be spaced greater than 2 m apart
- Wire mesh or standard snow fencing may be placed between the posts and fabric barrier to provide additional strength and support reinforcement
- Geotextile should be cut from a continuous roll to avoid joints (if joints are necessary, the wrapping of fabric around the fence post and a minimum overlap of 0.2 m with staples should be used to attach the fabric to the post)

- Fence (and wire mesh or snow fence, if used) should be attached to posts with heavy duty staples, tie wires, or hog rings
- Fence (and wire mesh or snow fence, if used) should be dug into a trench at least 0.15 m deep to prevent undercutting of fence by runoff
- Trench backfill should be compacted
- Long runs of silt fence are more prone to failure than short runs
  - Maximum length of each section of silt fence should be 40 m
  - Silt fence should be installed in 'J' hook or 'smile' configuration, with maximum length of 40 m, along contours allowing an escape path for ponded water (minimizes overtopping of silt fence structure)

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Repair undercut fences and repair or replace split, torn, slumping or weathered fabric immediately
- Sediment build up should be removed once it accumulates to a depth of 0.2 m
- Remove fence after vegetation is established
- Deactivate fabric by cutting-off top portion of fabric above ground; bottom trenched-in portion of fence fabric can be left in-ground thus minimizing ground disturbance





TRENCH METHOD DETAIL

NOTES:

1. SILT FENCE SHALL BE PLACED ON SLOPE CONTOURS TO MAXIMIZE PONDING EFFICIENCY.
2. INSPECT AND REPAIR FENCE DAILY AND AFTER EACH STORM EVENT AND REMOVE SEDIMENT WHEN ACCUMULATED SILT REACHES 200 mm.
3. REMOVED SEDIMENT SHALL BE DEPOSITED TO AN AREA WILL NOT CONTRIBUTE SEDIMENT OFF-SITE.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

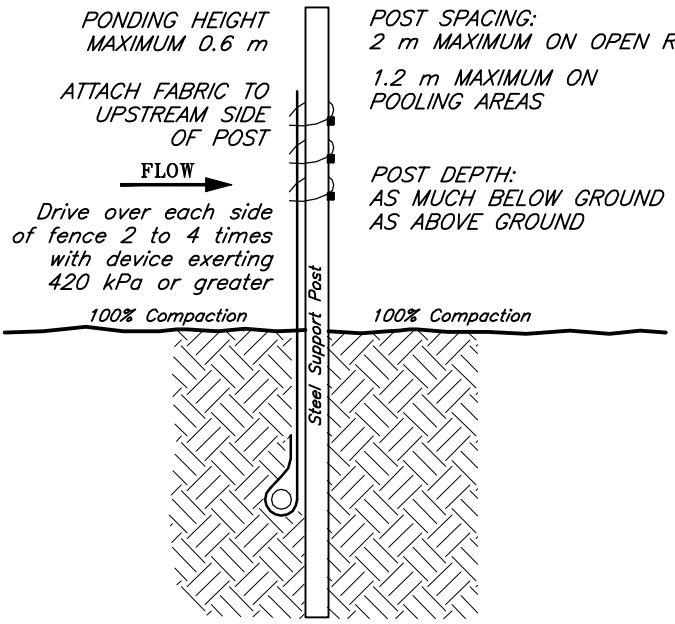
NOT TO SCALE

SILT FENCE

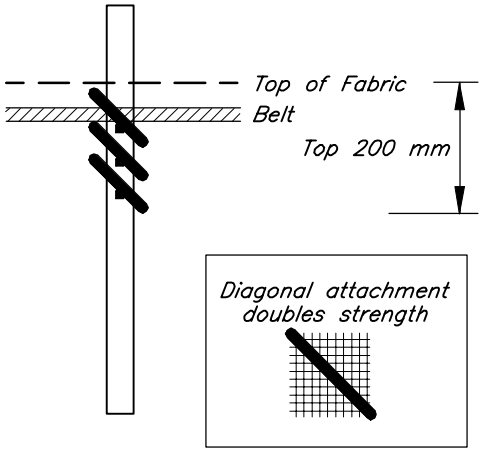
(TRENCH METHOD)

FILE: SILTFENC

Government of Alberta ■
Transportation



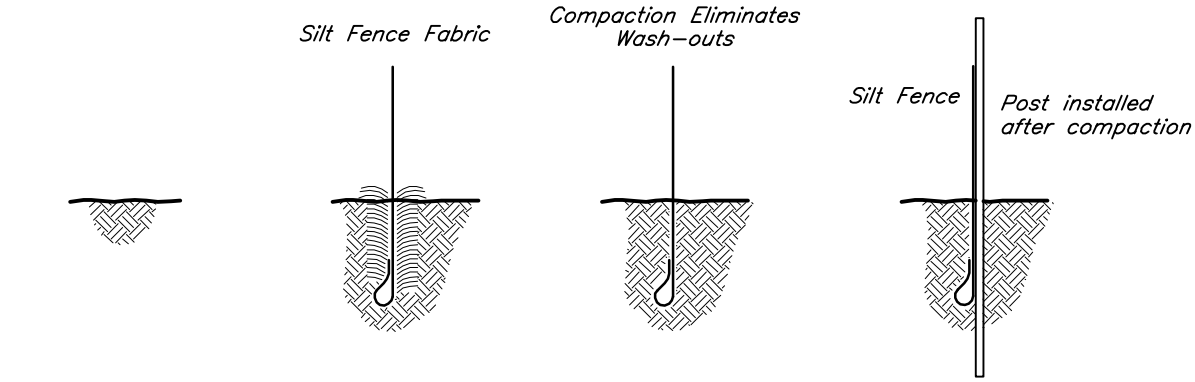
NO MORE THAN 0.6 m OF A 0.9 m FABRIC
IS ALLOWED ABOVE GROUND



ATTACHMENT DETAILS:

- Gather fabric at posts, if needed.
- Utilize three ties per post, all within top 200 mm of fabric.
- Position each tie diagonally, puncturing holes vertically a minimum of 25 mm apart.
- Hang each tie on a post nipple and tighten securely.
- Use cable ties (50 lbs) or soft wire.

MECHANICAL (SLICING) METHOD



a) Before Installation

b) During fabric insertion. Disrupted soil.

c) After Compaction. Greater stability.

d) Completed Installation

MECHANICAL (SLICING) METHOD INSTALLATION SEQUENCE

NOTES:

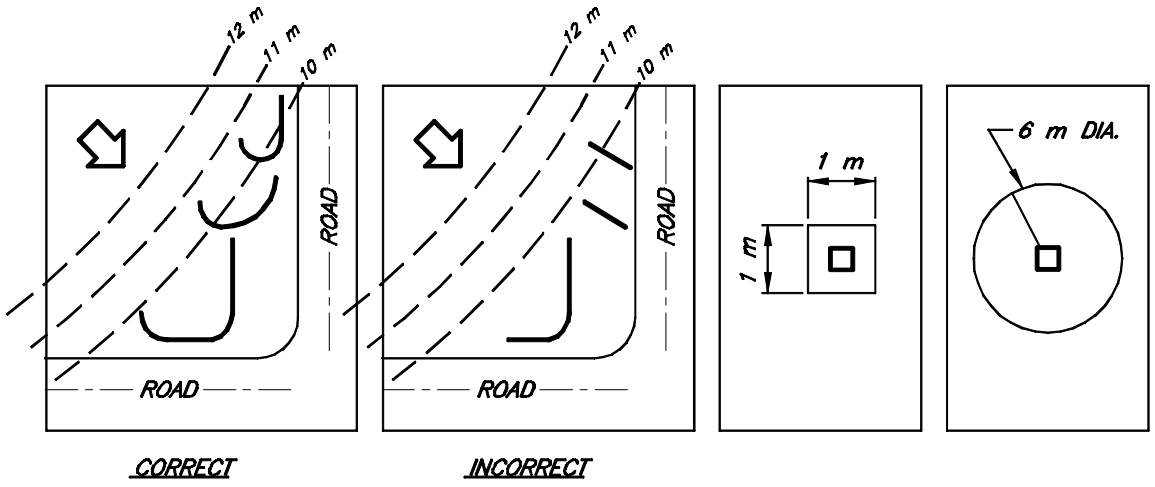
1. INSTALLATION MACHINE MUST ALLOW CONTINUOUS SLICING AND EMBEDMENT OF GEOTEXTILE INTO GROUND WITH MINOR GROUND DISTURBANCE.
2. INSTALLATION MACHINE TYPES WILL VARY WITH MANUFACTURER.
3. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

NOT TO SCALE

SILT FENCE

(MECHANICAL METHOD)

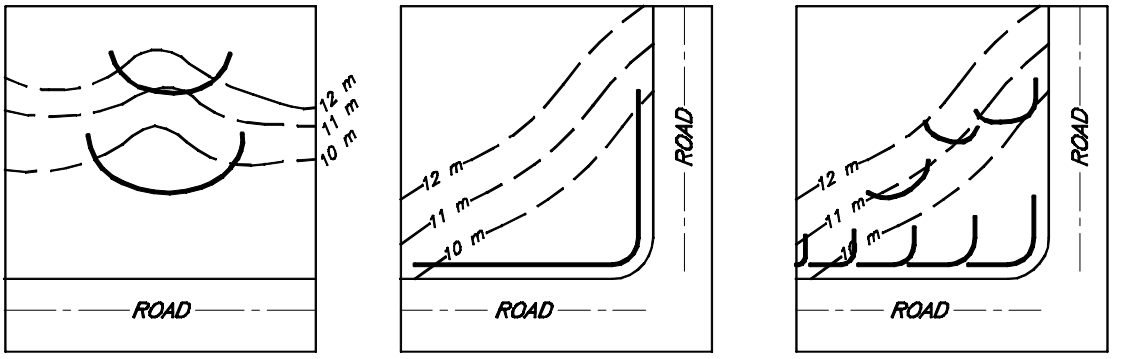
SOURCE: CARPENTER T. 2000



CORRECT INCORRECT

"J" CONFIGURATION

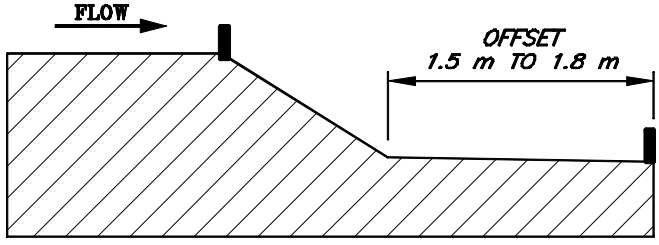
SILT FENCE BARRIER AT STORM INLET



"SMILE" CONFIGURATION

AVOID LONG INSTALLATION

COMBINATION OF "SMILE" AND "J" CONFIGURATIONS



LOCATION AT TOP AND BOTTOM OF SLOPE

NOT TO SCALE

NOTE:

1. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

SOURCE: CARPENTER T. 2000

SILT FENCE
(CONFIGURATION PLAN)

Gabions (a - c) Erosion Control and Sediment Control	B.M.P. #2 (a-c)

Description and Purpose

- Consist of rock placed inside wire baskets to protect steep or erodible slopes from sheet flow erosion
- Protects erodible stream channel banks from potentially high erosive concentrated flow velocities or high tractive forces

a) Slope and Banks

b) Single Gabion Drop Structure for Ditch Channel

c) Double Gabion "Energy Dissipator" Drop Structure for Ditch Channel

Applications

- Permanent measure
- May be used on stream bank aprons and blankets where flow velocities do not exceed 6 m/s
- May be constructed to 0.5H:1V as a low height slope toe protection structure
- May be used on slopes up to 1.5H:1V as slope protection, a grade break and flow check
- Gabion matting is an alternative to riprap armouring of channels
- May be used to construct dikes or weirs
- Used as a drop structure (check structure) to reduce grade between structures and as flow check in channels
- Used as a splash pad to slow down flow velocity and dissipate flow energy

Construction

- Prepare subgrade at designated gabion location on mineral soil
- Excavate trench a minimum of 0.15 m deep to 'key-in' gabion structure
- Construct gabion basket as per manufacturer’s recommendations
- Line interior of basket with non-woven geotextile OR a gravely sand filter layer (if required by design) along areas where the basket is in contact with soil
  - Geotextile must be non-woven fabric to act as a separator (filter) between rock-infill and subgrade soils to minimize infiltration of fine grained particles into the gabion structure
- Backfill basket with rock with wire bracing at 1/3 points (or 0.3 m spacings)

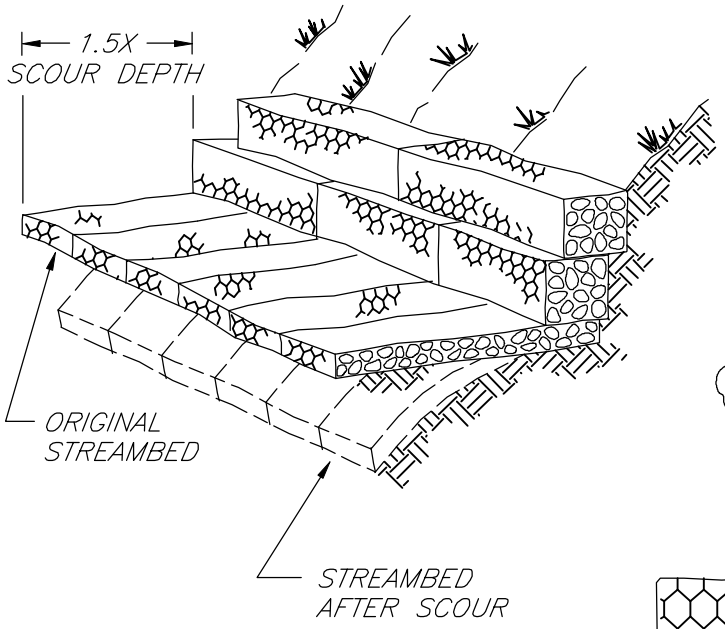
- Install gabion basket top
- Backfill trench and compact soil around edges of completed basket

Construction Considerations

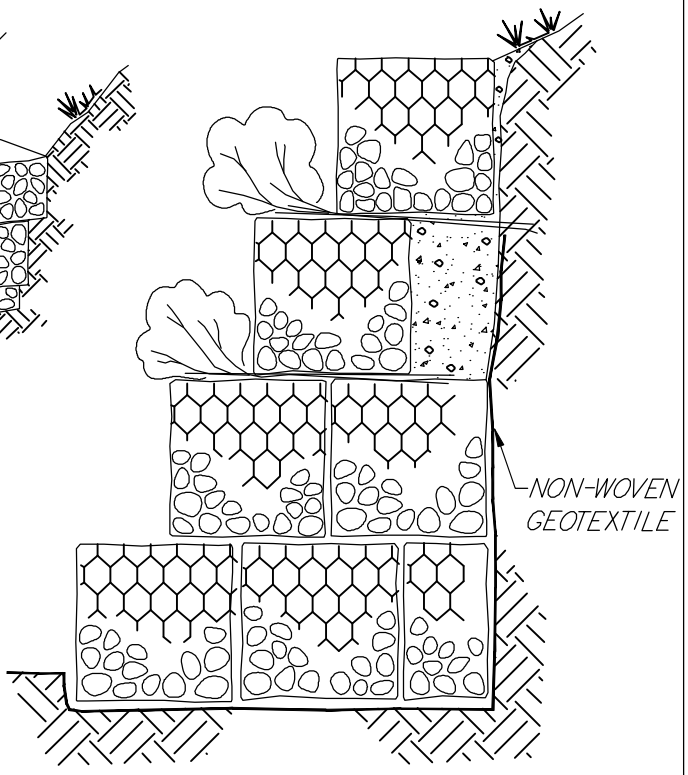
- Gabions should be placed on a properly graded surface
- Non-woven geotextile should be used to prevent loss of underlying material and infiltration of fine grained particles into the gabion structure
- Rock in the baskets may be placed by hand to enhance dense packing of stones and decrease void spaces
- Construct gabions with internal wire diaphragms to maintain structural stability and shape

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans and should be inspected after major storm events, especially where undermining at the toe of the gabion is a concern
  - Repair as necessary; repair may include hand grading and/or infilling undermined area with rocky material
- Removal of silt should be determined based on depth of siltation, channel erosion and establishment of vegetation

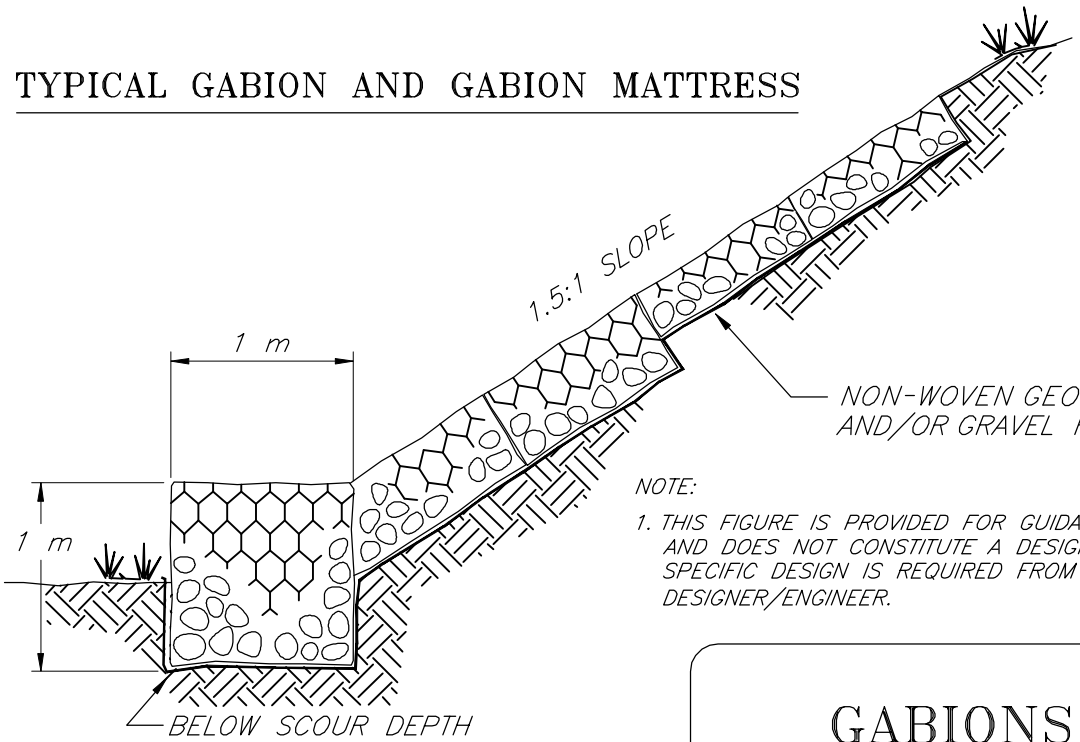


TYPICAL GABION APRON



TYPICAL VEGETATED ROCK GABION

TYPICAL GABION AND GABION MATTRESS



NOTE:

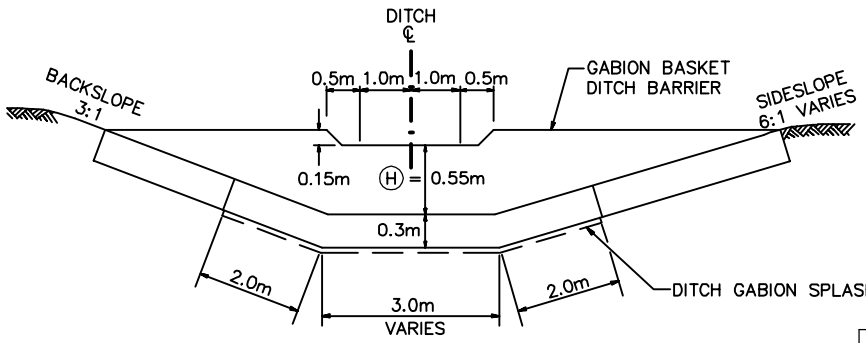
1. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

GABIONS
(SLOPE AND BANK)

FILE: GABIONS

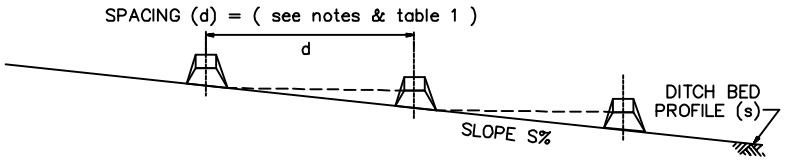
Government of Alberta ■
Transportation

B.M.P. #2a
Typical Section



FRONT VIEW FROM DOWNSTREAM
TYPICAL DITCH CROSS–SECTION
GABION BASKET DITCH BARRIER

N.T.S.

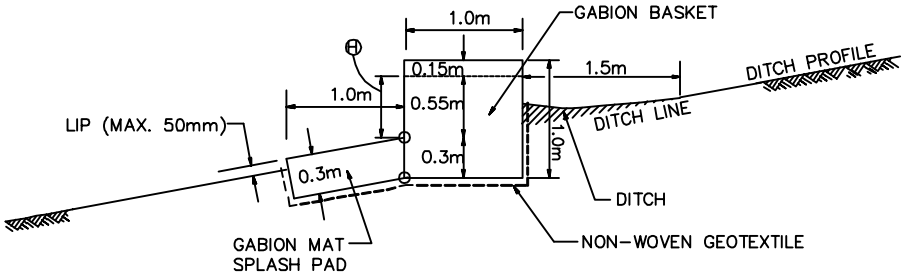


TYPICAL BARRIER SPACING

N.T.S.

SUGGESTED SPACING (d)		
S (%)	(m)	REMARKS
5–7	30	OPTION TO INSTALL A GRADE BREAK (s.a. WEAVE BARRIER) BETWEEN STRUCTURES.
7–8	25	A DOUBLE GABION FOLLOWS EVERY 2 SINGLE GABIONS.
>8%	≤15	DESIGN BY ENGINEER REQUIRED.

TABLE 1



CROSS–SECTION VIEW
"SINGLE GABION" BASKET DITCH BARRIER
& GABION MAT SPLASH PAD

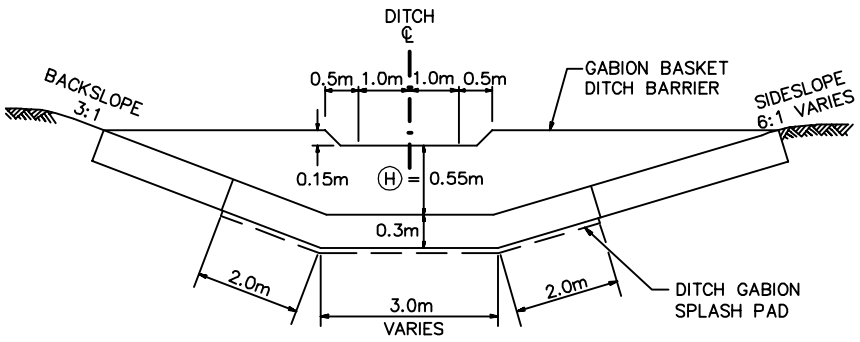
N.T.S.

NOTES:

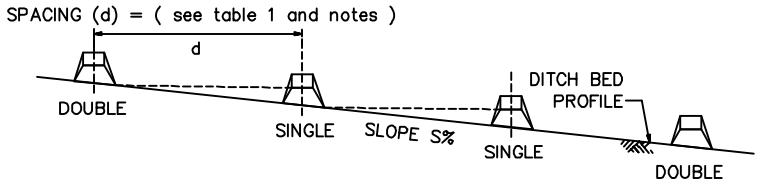
1. SUITABLE FOR MEDIUM TO STEEP GRADES AND CHANNELS LEADING TO WATER COURSE 4% < S < 10%.
2. i) SPACING TO BE DETERMINED BY ENGINEER BASED ON HYDRAULIC CONDITIONS.

   ii) USE IN CONJUNCTION WITH DOUBLE GABIONS OR OTHER BARRIER STRUCTURES.
3. SOIL COVERING BETWEEN STRUCTURES SUGGESTED FOR STEEP GRADE SOIL DITCH.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

GABIONS
SINGLE GABION DROP STRUCTURE FOR DITCH CHANNEL



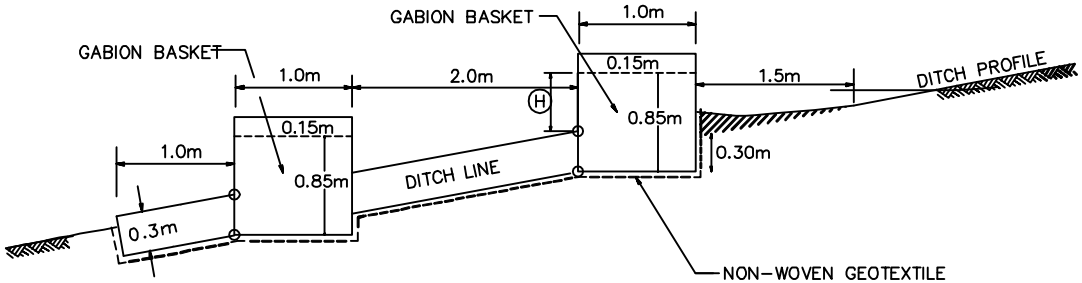
FRONT VIEW FROM DOWNSTREAM
TYPICAL DITCH CROSS–SECTION
GABION BASKET DITCH BARRIEP
N.T.S.



TYPICAL BARRIER SPACING
N.T.S.

SUGGESTED SPACING (d)		REMARKS
S (%)	(m)	
6–8	25	INTER–SPACED WITH 2 SINGLE GABIONS BETWEEN STRUCTURES
	35*	*SEE NOTES
>8%	≤15	DESIGN BY ENGINEER REQUIRED

TABLE 1



CROSS–SECTION VIEW
"DOUBLE GABION" ENERGY DISSIPATION GABION STRUCTURE
(TWO SINGLE GABIONS COMBINED)
N.T.S.

NOTES:

1. SUITABLE FOR STEEP GRADES (6%<S<12%) AND CHANNELS LEADING TO WATER COURSE
2. i) SPACING (d) TO BE DETERMINED BY ENGINEER BASED ON HYDRAULIC CONDITIONS.
   ii) USE IN CONJUNCTION WITH SINGLE GABION AND/OR OTHER GRADE BREAK STRUCTURES.
3. SUGGESTED TWO SINGLE GABIONS AT INTERVAL BETWEEN DOUBLE GABIONS.
4. SOIL COVERING BETWEEN STRUCTURES SUGGESTED FOR STEEP GRADE SOIL DITCH.
5. IF d* = 35 m at 7 to 8% GRADE
   - GRADE BREAK (s.a. PERMEABLE WEAVE BARRIER) SHOULD BE PLACED BETWEEN STRUCTURES.
   - LONG SPACING ALLOWABLE WHEN HYDRAULIC CONDITIONS NOT SEVERE.
6. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

GABIONS
DOUBLE GABION "ENERGY DISSIPATOR" DROP STRUCTURE FOR DITCH CHANNEL

Berm Interceptor Sediment Control	B.M.P. #5

Description and Purpose

- Earth dyke barrier constructed of compacted soil to intercept and divert flow of runoff water away from erodible slopes, sensitive areas or water bodies
- A spillway outlet of erosion-resistant granular material constructed to allow exit of diverted water to less sensitive areas

Applications

- Temporary or permanent measure
- Used instead of, or in conjunction with, diversion ditches
- Perimeter control
- Placed along contours and/or at toe of slope to divert run-off from sensitive areas
- Used to divert water to sediment control structures

Construction

- Construct barrier from bottom up by placing and compacting subsequent lifts of soil
- Degree of compaction of each lift to be specified by the design engineer based on consequences of failure

Construction Considerations

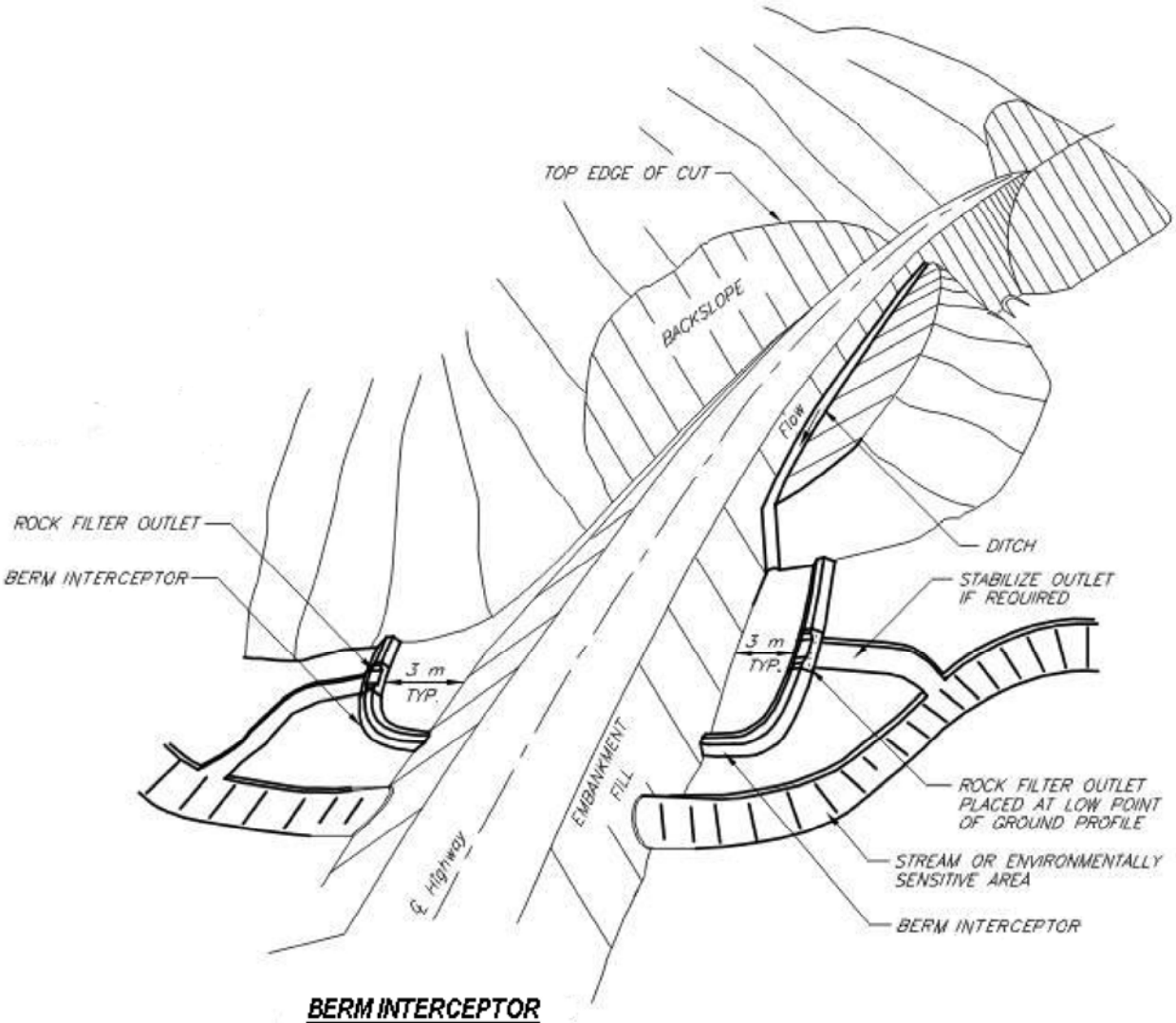
- The barrier should be trapezoidal in cross-section
- Low barriers should have the slopes suited to the construction material used
  - 1.5H:1V for granular soils
  - 2H:1V or flatter for compacted mixed or fine grained soils
    - Slope should be flattened to a minimum of 3H:1V for uncompacted fine grained soils

Inspection and Maintenance

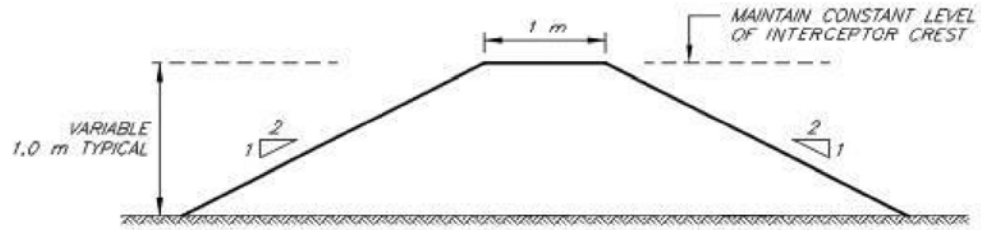
- The degree and extent of inspection and maintenance performed on a earth dyke barrier is directly related to the consequences of failure. An engineer experienced in embankment design and inspection may be required for design, inspection, design of remedial measures, and supervision of their implementation
- Inspection frequency should be in accordance with the PESC and TESC Plans

Berm Interceptor Sediment Control	B.M.P. #5

- Piping failures may be remedied by replacing saturated soils with drier compacted soil and/or by placement of geotextile over the failed area and placing a stabilizing toe berm constructed of granular materials
- Inspect for sediment accumulation and remove sediment when depths reach approximately one-half the barrier height
- Deactivate and remove barrier once slope soils have stabilized and return barrier location to an acceptable condition



BERM INTERCEPTOR
TYPICAL LOCATION



TYPICAL SECTION
BERM INTERCEPTOR

NOTES:
1. SILT ACCUMULATION TO BE REMOVED WHEN HALF BERM INTERCEPTOR HEIGHT COVERED.
2. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

BERM INTERCEPTOR

Government of Alberta
Transportation

Storm Drain Inlet Sediment Barrier (a-f) Sediment Control	B.M.P. #6 (a-f)

Description and Purpose

- Temporary devices constructed to minimize the amount of sediment entering a storm drain by ponding sediment laden runoff at the inlet
- Storm Drain Inlet protection can consist of the following measures:

a) Block and Gravel Sediment Barrier – Option 1

b) Block and Gravel Curb Inlet Sediment Barrier – Option 2

c) Sand Bag Curb Inlet Sediment Barrier – Option 1

d) Sand Bag Curb and Gutter Sediment Barrier – Option 2

e) Straw Bale / Gravel Sediment Barrier - Option

f) Silt Fence Sediment Barrier - Option

Applications

- Temporary measure
- Used where storm drains are operational prior to establishing vegetation on disturbed drainage areas
- Can be effective where drainage enters municipal sewers or watercourses
- Used for small, nearly level (less than 5% grade) drainage areas
- Used as curb inlet barriers in gently sloping ditches and gutters
- Used where drainage area is 0.4 ha (1 ac) or less
- Used in open areas subjected to sheet flow and concentrated flows less than 0.014 m^3/s (0.5 cfs)
- Block and gravel bag barriers are applicable when sheet flows or concentrated flows exceed 0.014 m^3/s (0.5 cfs) and is necessary to allow for overtopping to prevent flooding
- Excavated drop inlet sediment traps are appropriate where relatively heavy flows are expected and overflow capacity is required

Construction

- Place inlet sediment barrier around entrance to drain/pipe. The option appropriate for use is dependent on site conditions.
- Silt fence barrier can be used for soil surfaces

- Gravel or aggregate filled sand bags should be used for asphalt or concrete surfaces
- Aggregate filled sand bags
  - Place sand bags stacked one or two bags high around inlet
- Gravel barriers
  - Place concrete blocks stacked one or two blocks high, with cavities of blocks aligned with direction of flow, around inlet
  - Wrap 13 mm (1/2 inch) wire mesh around concrete blocks
  - Place 25 mm to 38 mm diameter rock around block and wire mesh assembly ensuring rock extends down from top of blocks to asphalt or concrete surfacing
- Gravel filter curb inlet
  - Place concrete blocks stacked one or two blocks high around inlet, with cavities of blocks aligned with direction of flow, forming a 'U' shape
  - Wrap 13 mm (1/2 inch) diameter wire mesh around concrete blocks
  - Place 25 mm to 38 mm diameter rock around block and wire mesh assembly ensuring rock extends down from top of blocks to asphalt or concrete surfacing

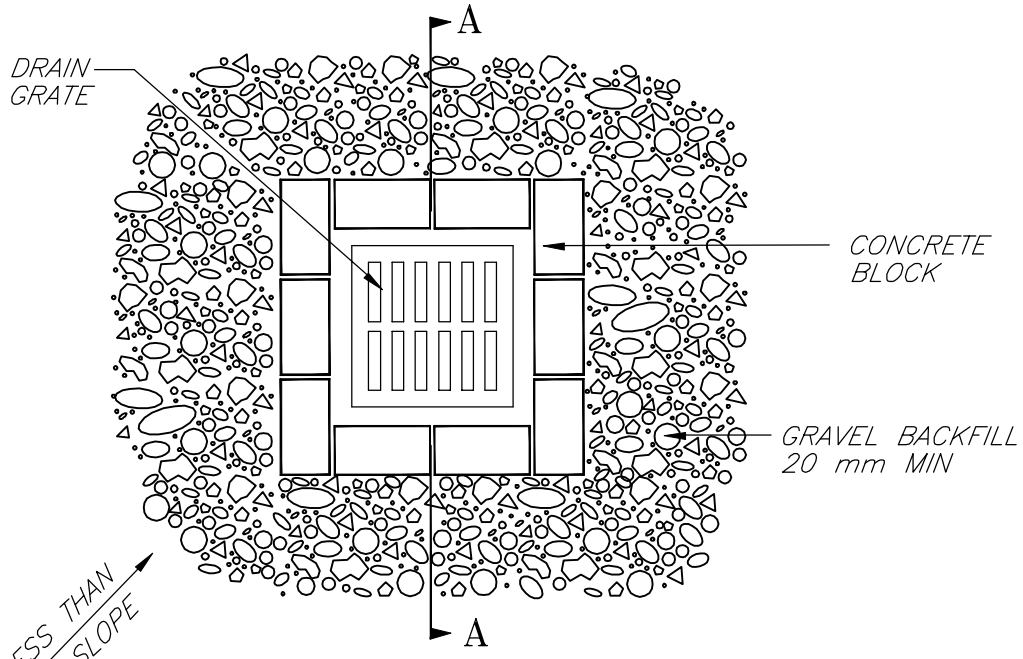
Construction Considerations

- Gravel or aggregate filled sand bags should be used for asphalt or concrete surfaces
- Aggregate filled sand bags
  - Sand bags should be filled with pea gravel, drain rock, or other free draining material
  - Gravel or aggregate filled sand bags should be filled only ¾ full to allow sand bag to be flexible to mould to contours, maintaining continuous contact with surface
  - Barrier should be placed at least 0.1 m from inlet to be protected
  - Several layers of sand bags should be overlapped and tightly packed against one another
  - A one sand bag wide gap should be left in the lowest point of the upper layer to act as an emergency spillway
- Gravel filter inlet berm and gravel filter curb inlet
  - Slope gravel towards inlet at a maximum slope of 2H:1V

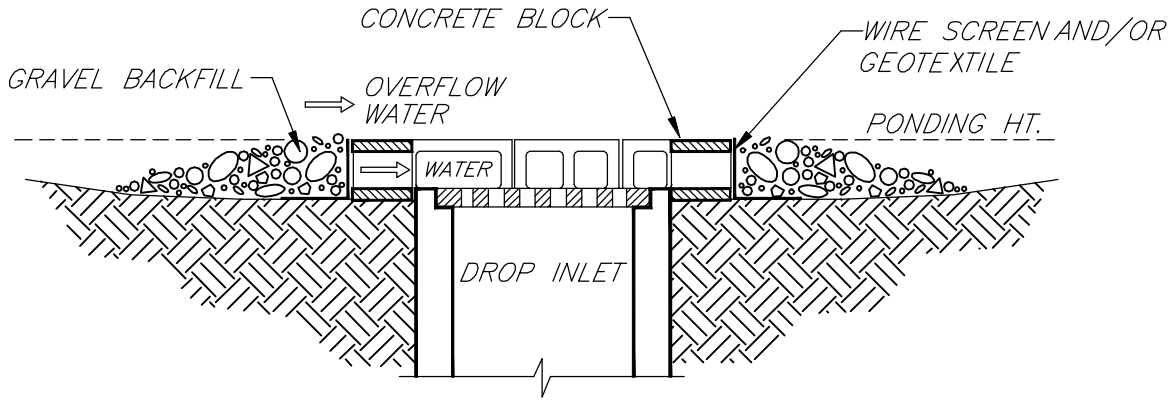
  - Maintain at least 0.3 m spacing between toe of gravel and inlet to minimize gravel entering inlet
  - 25 mm wire mesh may be placed over inlet to prevent gravel from entering inlet
- For drainage areas larger than 0.4 ha (1 ac) runoff should be directed towards a sediment retention device designed for larger flows before allowing water to reach inlet protection structure
- Use aggregate sand bags filled with 25 mm diameter rock in place of concrete blocks for gravel filter inlet berm or gravel filter curb inlet

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Remove sediment build up after each storm event
  - Sediment and gravel should not be allowed to accumulate on roads
- Replace gravel if it becomes clogged with sediment
- Remove all inlet protection devices when inlet protection is no longer required



PLAN VIEW



SECTION A – A

NOTES:

1. STORM DRAIN DROP INLET SEDIMENT BARRIERS ARE TO BE USED FOR SMALL, NEARLY LEVEL DRAINAGE AREAS. (LESS THAN 5%).
2. EXCAVATE A BASIN OF SUFFICIENT SIZE ADJACENT TO THE STORM DRAIN DROP INLET.
3. THE TOP OF THE STRUCTURE (PONDING HEIGHT) MUST BE WELL BELOW THE GROUND ELEVATION DOWNSLOPE TO PREVENT RUNOFF FROM BYPASSING THE INLET. A TEMPORARY DYKE MAY BE NECESSARY ON THE DOWNSLOPE SIDE OF THE STRUCTURE.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

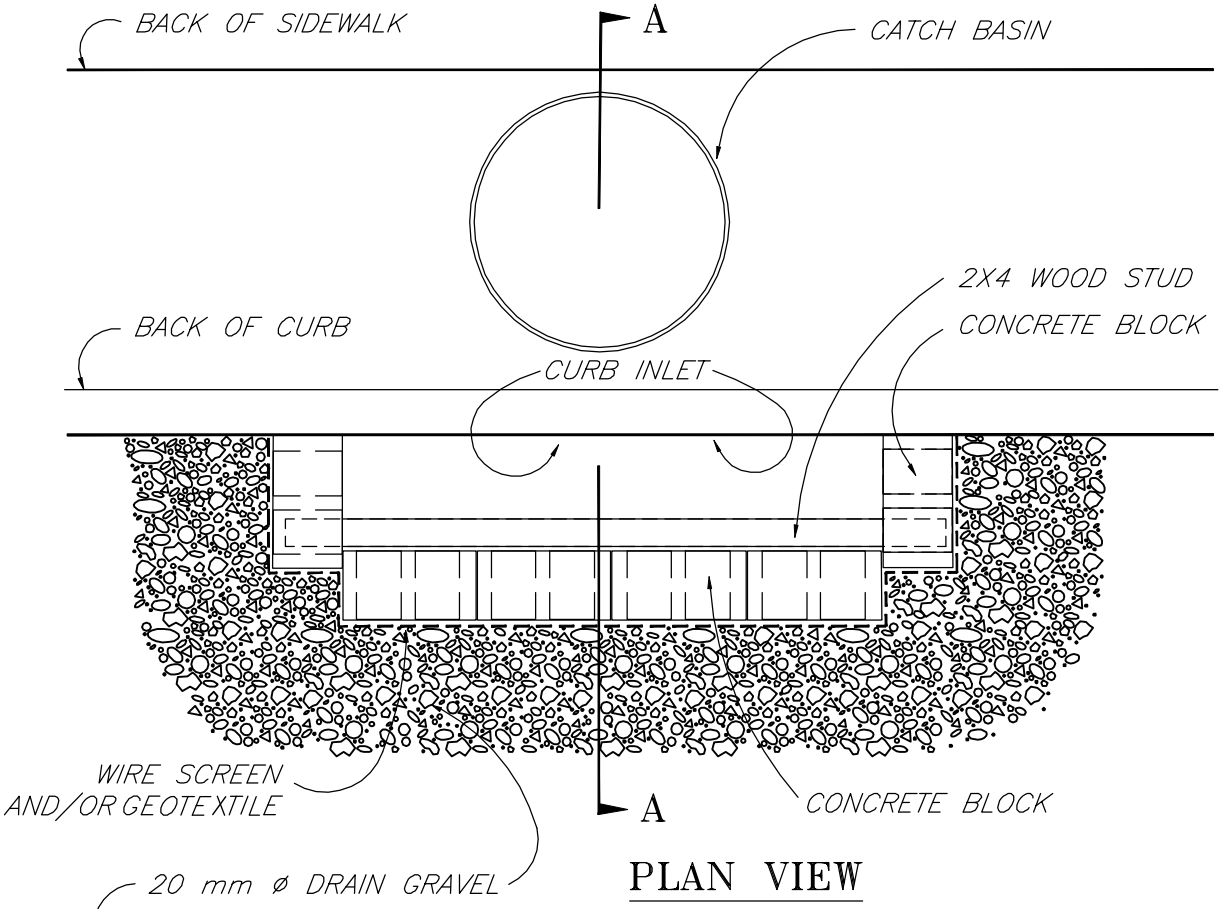
STORM DRAIN DROP INLET SEDIMENT BARRIER

(BLOCK AND GRAVEL – OPTION 1)

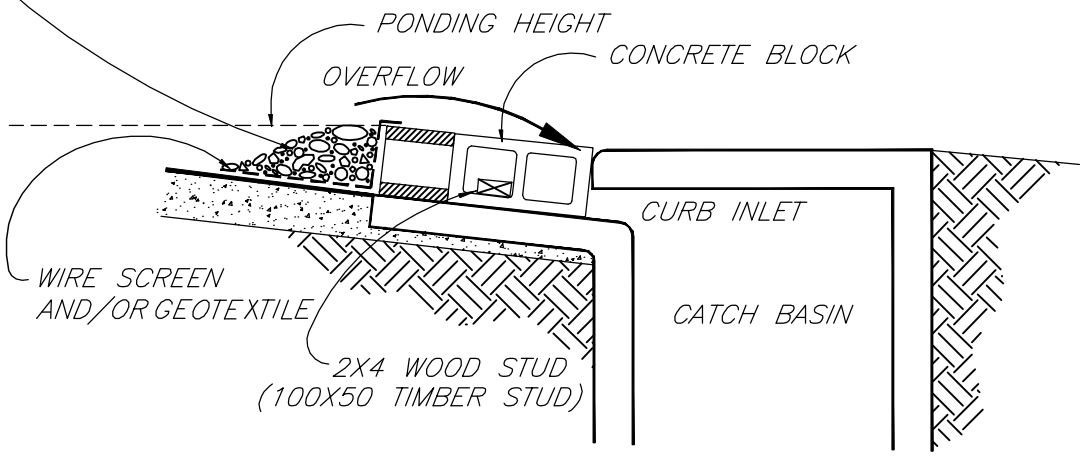
FILE: BGSEDBAR

Government of Alberta ■ Transportation

B.M.P. #6a
Typical Section



PLAN VIEW



SECTION A – A

NOTES:

1. USE BLOCK AND GRAVEL TYPE SEDIMENT BARRIER WHEN CURB INLET IS LOCATED IN GENTLY SLOPING STREET SEGMENT, WHERE WATER CAN POND AND ALLOW SEDIMENT TO SEPARATE FROM RUNOFF.
2. BARRIER SHALL ALLOW FOR OVERFLOW FROM SEVERE STORM EVENT.
3. INSPECT BARRIERS AND REMOVE SEDIMENT AFTER EACH STORM EVENT. SEDIMENT AND GRAVEL MUST BE REMOVED FROM THE TRAVELED WAY IMMEDIATELY.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

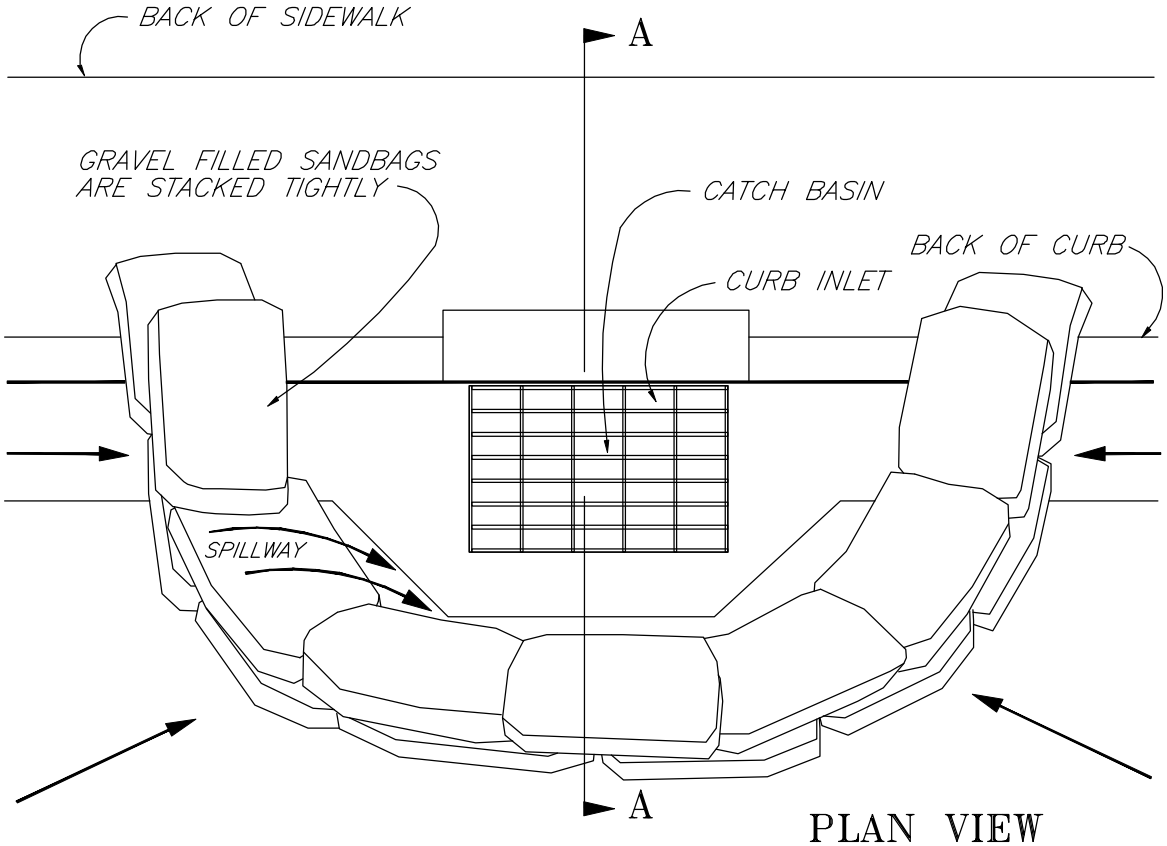
FILE: BLCKCURB

STORM DRAIN CURB INLET SEDIMENT BARRIER

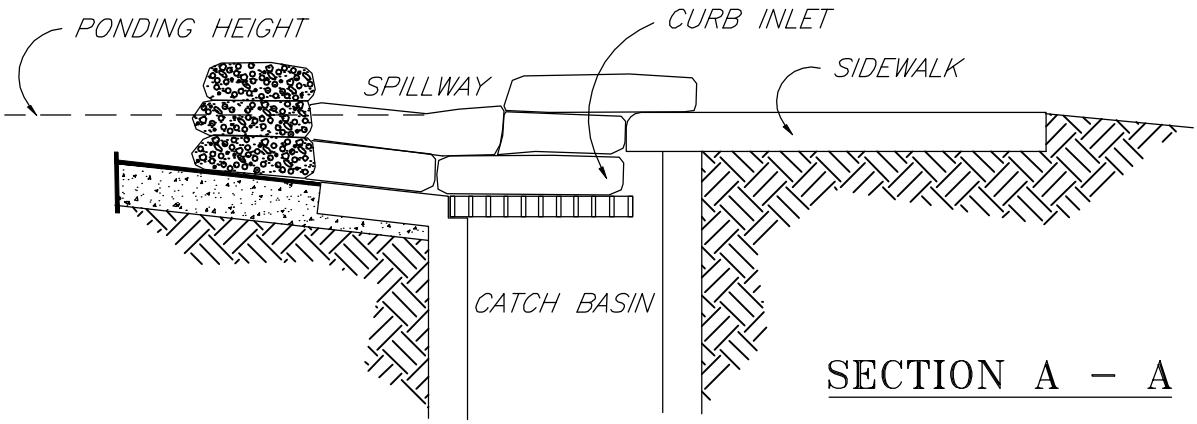
(BLOCK AND GRAVEL – OPTION 2)

Government of Alberta ■ Transportation

B.M.P. #6b
Typical Section



PLAN VIEW



SECTION A – A

NOTES:

1. PLACE CURB TYPE SEDIMENT BARRIERS ON GENTLY SLOPING STREET SEGMENTS WHERE WATER CAN POND AND ALLOW SEDIMENT TO SETTLE OUT.
2. SANDBAGS, OF EITHER BURLAP OR WOVEN GEOTEXTILE FABRIC, ARE FILLED WITH GRAVEL, LAYERED AND PACKED TIGHTLY.
3. LEAVE ONE SANDBAG GAP IN THE TOP ROW TO PROVIDE A SPILLWAY FOR OVERFLOW.
4. INSPECT BARRIERS AND REMOVE SEDIMENT AFTER EACH STORM EVENT. SEDIMENT AND GRAVEL MUST BE REMOVED FROM THE TRAVELED WAY IMMEDIATELY.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

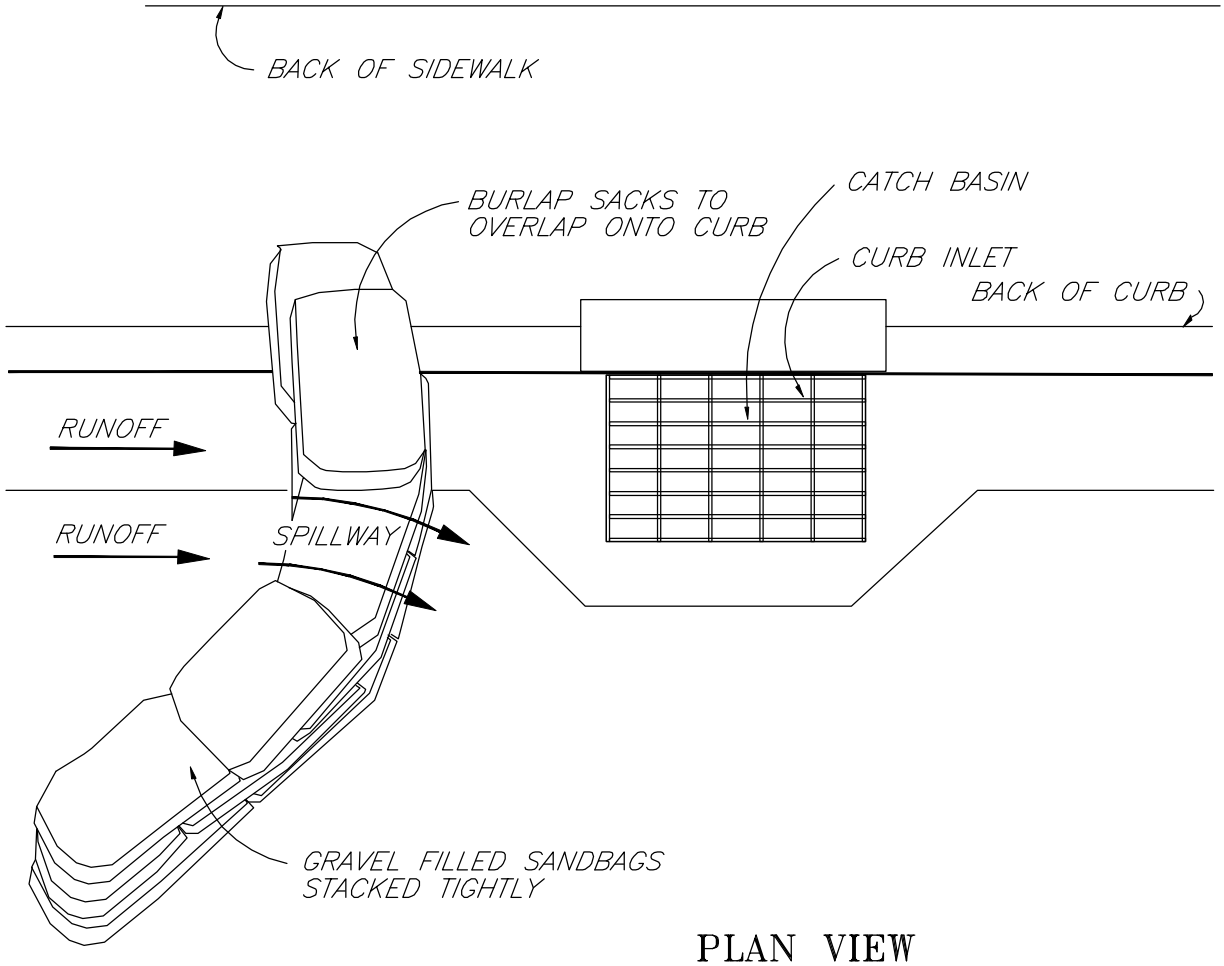
STORM DRAIN CURB INLET SEDIMENT BARRIER

(SANDBAGS – OPTION 1)

FILE: SANDCURB

Government of Alberta ■ Transportation

B.M.P. #6c
Plan View and Section



PLAN VIEW

NOTES:

1. PLACE CURB TYPE SEDIMENT BARRIERS ON GENTLY SLOPING STREET SEGMENTS, WHERE WATER CAN POND AND ALLOW SEDIMENT TO SETTLE OUT.
2. SANDBAGS OF EITHER BURLAP OR WOVEN 'GEOTEXTILE' FABRIC, ARE FILLED WITH GRAVEL, LAYERED AND PACKED TIGHTLY.
3. LEAVE A ONE SANDBAG GAP IN THE TOP ROW TO PROVIDE A SPILLWAY FOR OVERFLOW.
4. INSPECT BARRIERS AND REMOVE SEDIMENT AFTER EACH STORM EVENT. SEDIMENT AND GRAVEL MUST BE REMOVED FROM THE TRAVELED WAY IMMEDIATELY.
5. DESIGN CENTRE SPILLWAY LOWER THAN OUTSIDE EDGE TO MINIMIZE FLOW OUTFLANGING.
6. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

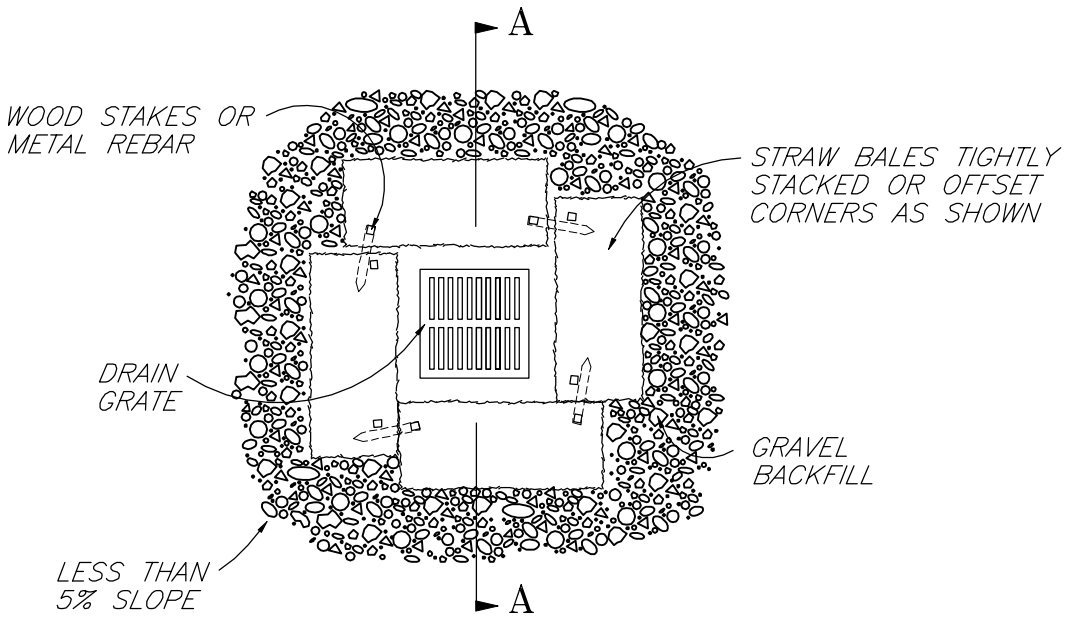
STORM DRAIN INLET CURB AND GUTTER SEDIMENT BARRIER

(SANDBAGS – OPTION 2)

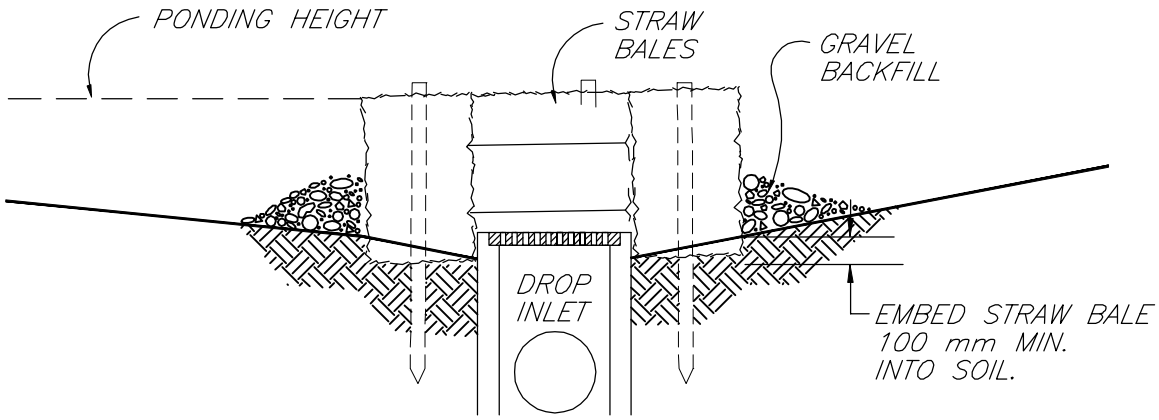
FILE: CURBGTTR

Government of Alberta ■ Transportation

B.M.P. #6d
Plan View



PLAN VIEW



SECTION A–A

NOTES:

1. DROP INLET SEDIMENT BARRIERS ARE TO BE USED FOR SMALL, NEARLY LEVEL DRAINAGE AREAS. (LESS THAN 5%)
2. EMBED THE BALES 100 mm INTO THE SOIL AND OFFSET CORNERS OR PLACE BALES WITH ENDS TIGHTLY ABUTING. GRAVEL BACKFILL WILL PREVENT EROSION OR FLOW AROUND THE BALES.
3. THE TOP OF THE STRUCTURE (PONDING HEIGHT) MUST BE WELL BELOW THE GROUND ELEVATION DOWNSLOPE TO PREVENT RUNOFF FROM BYPASSING THE INLET. EXCAVATION OF A BASIN ADJACENT TO THE DROP INLET OR A TEMPORARY DIKE ON THE DOWNSLOPE OF THE STRUCTURE MAY BE NECESSARY.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

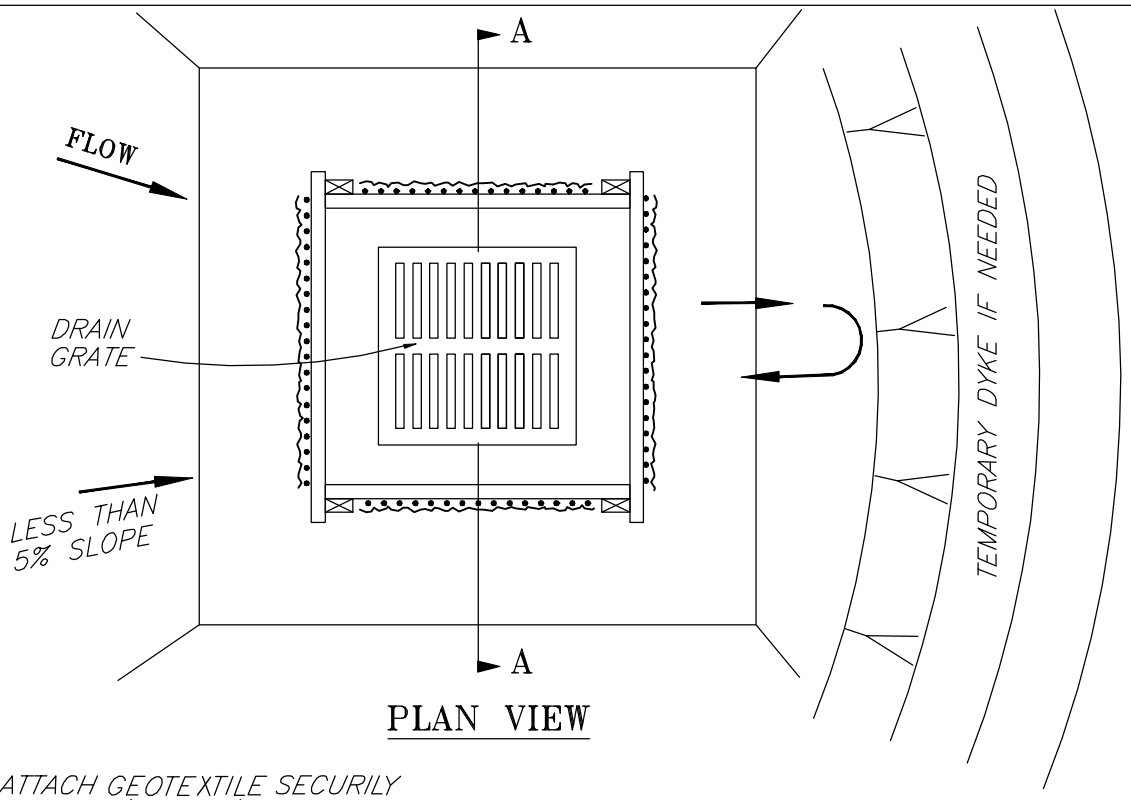
STORM DRAIN DROP INLET SEDIMENT BARRIER

(STRAW BALE / GRAVEL – OPTION)

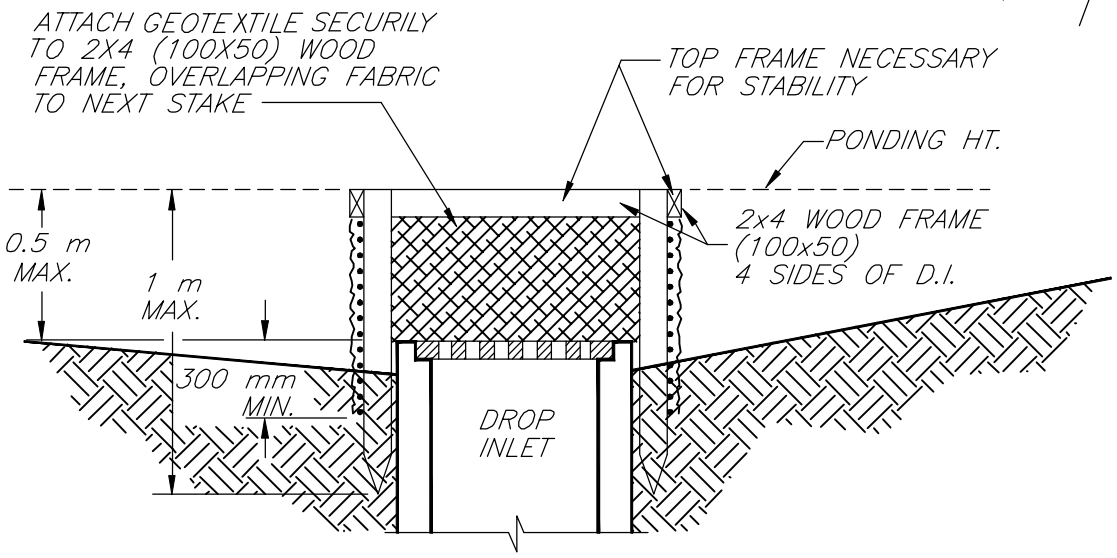
FILE: STRWGRVB

Government of Alberta ■ Transportation

B.M.P. #6e
Typical Section



PLAN VIEW



SECTION A–A

NOTES:

1. DROP INLET SEDIMENT BARRIERS ARE TO BE USED FOR SMALL, NEARLY LEVEL DRAINAGE AREAS. (LESS THAN 5%)
2. USE 2"X4" (100X50mm) WOOD OR EQUIVALENT METAL STAKES, 1 m MINIMUM LENGTH.
3. INSTALL 2"X4" (100X50mm) WOOD TOP FRAME TO INSURE STABILITY.
4. THE TOP OF THE FRAME (PONDING HEIGHT) MUST BE WELL BELOW THE GROUND ELEVATION DOWNSLOPE TO PREVENT RUNOFF FROM BY–PASSING THE INLET. A TEMPORARY DYKE MAY BE NECESSARY ON THE DOWNSLOPE SIDE OF THE STRUCTURE.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

NOT TO SCALE

STORM DRAIN DROP INLET SEDIMENT BARRIER

(SILT FENCE – OPTION)

FILE: SILTFDIB

Government of Alberta ■ Transportation

B.M.P. #6f
Typical Section

Rock Check Dam Erosion Control and Sediment Control	B.M.P. #7

Description and Purpose

- Small dam constructed of rock placed across steep channel
- Decrease flow velocities to reduce erosion caused by storm runoff
- Sediment laden runoff is detained allowing sediment to settle out

Applications

- Temporary or permanent measure
- Reduces long steep grade to intervals of gentle grades between successive structures
- Reduces flow velocities and kinetic energy to decrease erosion potential caused by runoff
- Sediment laden runoff is retained behind structure allowing sediment to settle out
- May be used in channels that drain 4 ha (10 ac) or less
- May be used in steep channels where storm water runoff velocity is less than 1.5 m/s (5 fps)

Construction

- Excavate a trench key a minimum of 0.15 m in depth at the rock check structure location
- Place non-woven geotextile fabric over footprint area of rock check
- Construct structure by machine or hand
- Structure should extend from one side of the ditch or channel to the other
- Structure should be constructed so that centre of the crest is depressed to form a centre flow width which is a minimum of 0.30 m lower than the outer edges
- Height of structures should be less than 0.8 m in height to avoid impounding large volumes of runoff
- Downstream slope of the check dam should be 5H:1V (minimum)
- Upstream slope of the check dam should be 4H:1V (minimum)

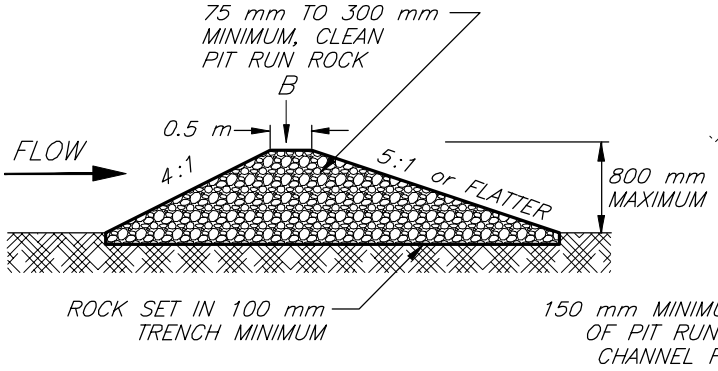
Construction Considerations

- Should be designed with roadside design clear zone requirements in mind.
- Height and spacing between structures should be designed to reduce steep channel slope to intervals of flatter gradient

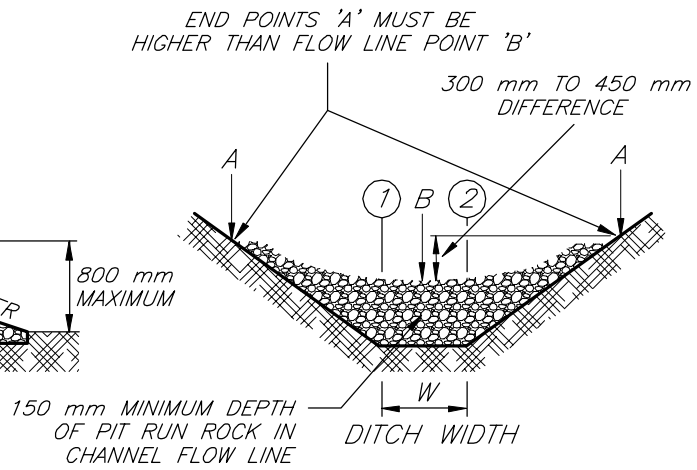
- Rock check structures should be constructed of free draining aggregate
- Aggregate used should have a mean diameter (D_{50}) of between 75 mm and 150 mm and must be large enough to remain in place during high velocity flow situations. Maximum rock diameter should not exceed 150 mm if the structure is to be used as a sediment trap.
- If rock check structures are to be placed in channels with significant high flows, they must be properly designed for stone size and structure spacings

Inspection and Maintenance

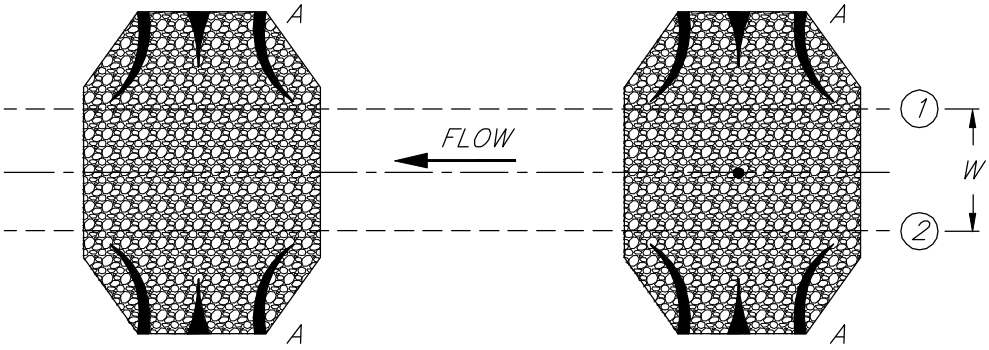
- Inspection frequency should be in accordance with the PESC and TESC Plans
- Remove sediment build up before it reaches one half the check structure height
- Erosion repairs should be made immediately to prevent failure of the structure
- Replace dislodged aggregate immediately with heavier aggregate or gabion structures

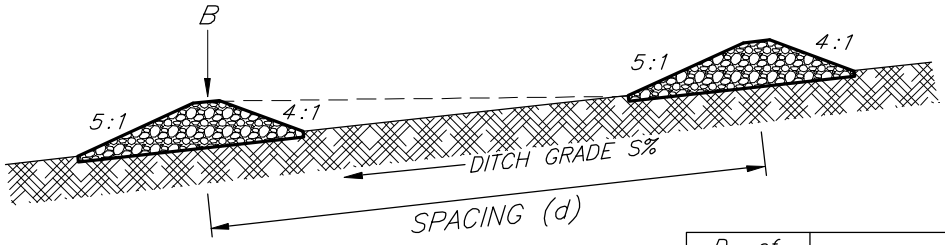


SIDE VIEW



FRONT VIEW





D_{50} of ROCK (mm)	MAXIMUM FLOW DEPTH OVER ROCK (mm)
75	50
150	100

SUGGESTED ROCK DIAMETER AND OVERFLOW DEPTHS

NOTES:

1. SUITABLE FOR FLOW VELOCITY ≤ 1.5 m/s.
2. SUITABLE FOR DRAINAGE AREA ≤ 4 ha.
3. SUITABLE FOR GRADES FROM 5% TO 8%.
4. SPACING (d) AND ROCK SIZE (D_{50}) TO BE DETERMINED BY ENGINEER BASED ON HYDRAULIC CONDITIONS.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

NOT TO SCALE

ROCK CHECK DAM

Government of Alberta ■ Transportation

B.M.P. #7
Typical Section

Synthetic Permeable Barrier Erosion Control and Sediment Control	B.M.P. #10

Description and Purpose

- Double panel, low profile, uni-body porous synthetic barriers used to dissipate flow energy and reduce velocity
- Barriers of patented design constructed of lightweight and durable synthetic materials
- May be used to create a grade break to reduce flow energy and velocities allowing some sediment to settle out at the upstream barrier panel of the barrier structure
- Can be used to dissipate flow energy and trap sediment during the period of revegetation; should be removed at successful re-establishment of vegetation

Applications

- Temporary structure
- May be placed across trapezoidal ditch to dissipate flow energy and reduce flow velocities
- Can be used to supplement as grade breaks along ditch interval between permanent drop structures along steep ditch grades
- May be used as midslope grade breaks along contours of midslope or at toe of disturbed slopes
- Usually used as grade breaks along ditch (3 to 7% grade) in conjunction with erosion control matting or non-woven geotextile as soil covering mattings; usually used in conjunction with permanent gabion structure (i.e., gabion) at steep grade (+6%) areas
- Designed to be reusable

Construction

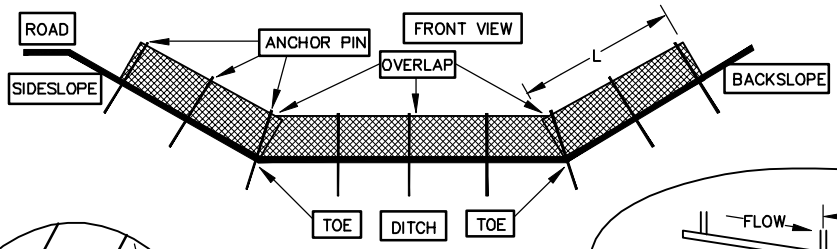
- Install as per manufacturers recommended installation instructions
- Normally installed in conjunction with erosion control matting in ditches and channels
- Prepare soil surface
- Install basal layer of erosion mat or geotextile fabric; key-in basal mat/fabric at upstream end
- Place and anchor barrier panels with adequate pin anchors to basal soils

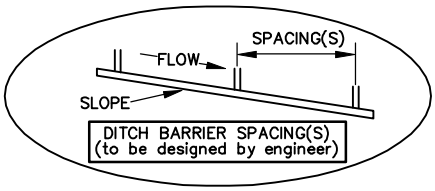
Construction Considerations

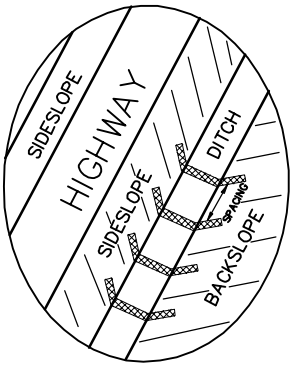
- Maintain intimate contact between base of barrier and soil with laying of basal matting/fabric intimate to ground surface
- Ensure side panel of barrier is extended to outer edges of channel to sufficient height to provide freeboard of channel flow

Inspection and Maintenance

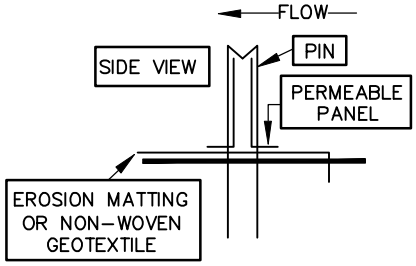
- Inspection frequency should be in accordance with the PESC and TESC Plans
- Remove sediment build-up before it reaches one-half the check structure height
- Do not damage barrier panel during removal of sediment
- Partial or non-removal of sediment build-up will create a non-permeable barrier and low level earth mini-drop structure which will force water flow over-topping the barrier. The option of non-removal of sediments may be open to converting the sediment build-up into a "vegetated earth mini-drop structure" along the ditch with the non-removal of synthetic permeable barrier in-place. This will require topsoil and seeding (or intensive mulch seeding) to promote vegetation growth
- If erosion is noted at the toe or upslope edges of the structure, hand regrading or suitable repairs should be made immediately to prevent failure of the structure
- Remove and deactivate at 1 year after vegetation is established



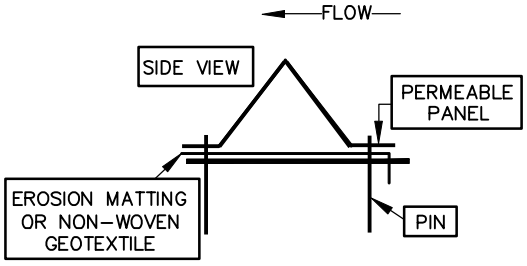




MINIMUM INSTALLATION LENGTH UP SLOPES	
SLOPE	LENGTH: L (m)
2:1	0.55
2.5:1	1.1
3:1	1.1
3.5:1	1.1
4:1	1.1
5:1	1.3
6:1	1.5



1) DOUBLE PANEL



2) TRIANGLE PANEL

SYNTHETIC PERMEABLE DITCH BARRIER

N.T.S.

NOTES:

1. *FOR USE MAINLY AS A GRADE BREAK STRUCTURE FUNCTIONING AS A FLOW ENERGY DISSIPATOR AND VELOCITY RETARDER.*
2. *FOR SECONDARY USE AS SEDIMENT BARRIER.*
3. *REQUIRES NON-WOVEN GEOTEXTILE FABRIC OR BIODEGRADABLE (COCONUT FIBRE PREFERABLE) EROSION BLANKET MAT AT BASE AND KEY-IN TO SOIL AT UPSTREAM END.*
4. *MAY BE INSTALLED AS GRADE BREAK AT GRADE TRANSITION AREAS TO CREATE DISSIPATION OF FLOW ENERGY AND A MORE LAMINAR FLOW REGIME DOWNSTREAM OF STRUCTURE.*
5. *THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.*

SYNTHETIC PERMEABLE BARRIERS

Straw Bale Barrier Sediment Control	B.M.P. #12

Description and Purpose

- A barrier of strawbale primarily used as a perimeter sediment control measure
- May be used to intercept and detain sediment laden runoff allowing a portion of the sediment load to settle out

Applications

- Temporary measure
- Suitable for flow velocities of 0.3 m/s or less
- Usually placed at 1m to 2 m offsets from toe of disturbed slopes
- Size of drainage area should be no greater than 0.1 ha per 30 m length of straw bale sediment barrier
- Maximum flow path length upstream of barrier should be less than 30 m
- Maximum slope gradient above the barrier should be no greater than 2H:1V
- May be used in conjunction with filter fabric as external wrap to encapsulate the bale

Construction

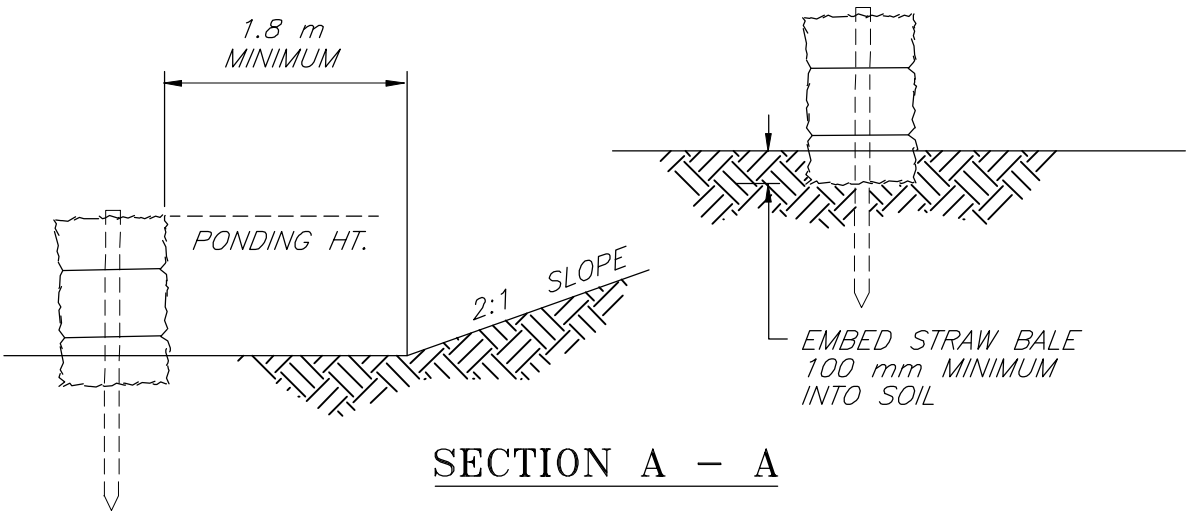
- Straw bale barrier should be located a minimum distance 1.8 m away from the toe of the slope to provide adequate ponding and sedimentation area
- Excavate a trench approximately 0.10 m deep with a width of one straw bale at the straw bale barrier location
- Place straw bales in excavated trench along contour, perpendicular to flow direction
  - Ensure twine or wire is not in contact with the soil
  - Ensure straw bale is in continuous contact with base of trench
  - Ends of barrier should be angled upslope to form enclosure to contain runoff
- Infill all joints with loose straw
- Drive two 50 mm by 560 mm section wooden stakes 1.2 m long through each straw bale, ensuring each stake is embedded a minimum of 0.15 m into soil
- Backfill and compact the upstream and downstream edges of the check structure to seat the straw bales into the subgrade

Construction Considerations

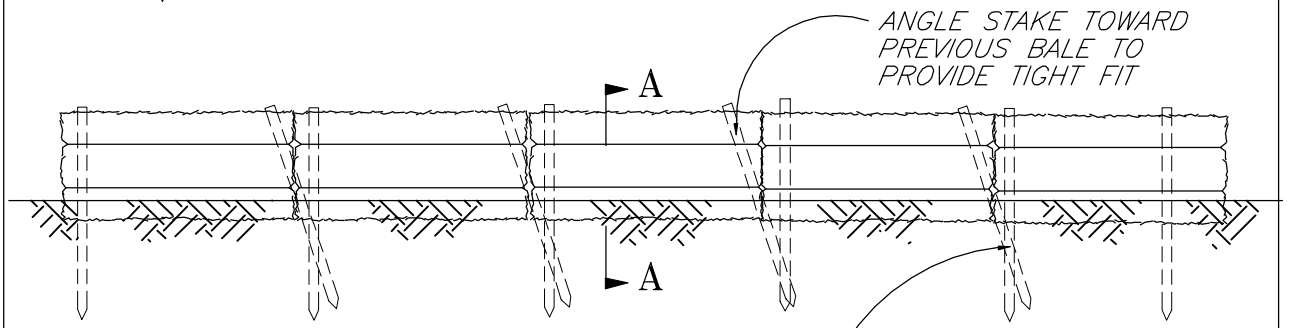
- Maximum lengths of barriers should be 40 m, including ‘J-hook’ or ‘smile’ (similar to silt fence in BMP #1) configuration, to allow escape route for excess runoff
- Barrier should be placed far enough away from toe of slope to provide adequate ponding and sedimentation area (minimum of 1.8 m away from toe of slope is recommended)
- Ends of barriers should be angled upslope (in a ‘J-hook’ or ‘smile’ configuration) to form enclosure to collect runoff
- Straw bales should be:
  - Machine-made
  - Weed free cereal crop straw such as wheat, oats, rye, or barley
  - Tightly compacted and bound with two rows of wire or synthetic string and shall show no signs of weathering
  - No more than one year old

Inspection and Maintenance

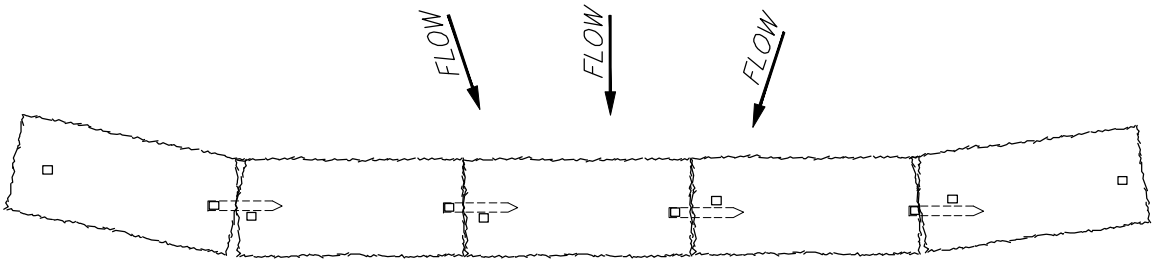
- Inspection frequency should be in accordance with the PESC and TESC Plans
- Remove sediment build up before it reaches one half the check barrier height
- Erosion repairs should be made immediately to prevent failure of the structure
- Replace damaged, decayed or dislodged straw bales immediately



SECTION A – A



SECTION B – B



PLAN

NOTES:

1. THE STRAW BALES SHALL BE PLACED ON SLOPE CONTOUR.
2. BALES TO BE PLACED IN A ROW WITH THE ENDS TIGHTLY ABUTTING.
3. KEY IN BALES TO PREVENT EROSION OR FLOW UNDER BALES.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

STRAW BALE BARRIER

FILE: STRWDIKE

Rolled Erosion Control Products (RECP)

a) Channel Installation
b) Slope Installation
c) Straw Rolls

Erosion Control

B.M.P. #13

Description and Purpose

- Biodegradable or synthetic soil coverings used for temporary or permanent protection of disturbed soils at slopes and channels
- Categories of Rolled erosion control products (RECP) can be:
  - Erosion control blankets (ECB) (generally biodegradable and temporary)
  - Turf reinforcement mats (TRM)
  - Composite turf reinforcement mats (C-TRM)
- RECP may be manufactured of organic material, synthetic material, or as a composite of organic and synthetic materials
- Protect disturbed soils from raindrop impact and surface runoff erosion, increase water infiltration into soil, retains soil moisture and decreases evaporation loss
- Protect seeds from raindrop impact, runoff, and predators
- Stabilizes soil temperature to promote seed germination and enhance vegetation growth

Applications

- Temporary or permanent measure
- May be used to protect disturbed, exposed soils for cut or fill slopes at gradients of 2.5H:1V or steeper
- May be used on slopes where erosion potential is high
  - Silts and sands have higher erosion potential than high plastic clays
- May be used on slopes where vegetation is likely to be slow to develop
- May be used to protect disturbed exposed soils in ditches and channels (with high flow velocities) by providing additional tractive resistance cover in conjunction with a successful high density vegetative growth established

Construction (Slopes)

- RECP should be installed in accordance with manufacturer's directions

The following is a general installation method:

- Prepare surface and place topsoil and seed

- Surface should be smooth and free of large rocks, debris, or other deleterious materials
- Blanket should be anchored at top of slope in a minimum 0.15 m by 0.15 m trench for the entire width of the blanket
- The blanket should be rolled out downslope
  - (1) Where the blanket roll is not long enough to cover the entire length of the slope, a minimum 0.15 m by 0.15 m check slot should be excavated at the location of the lap, and the downslope segment of blanket anchored in the check slot, similar to the method used for the top of the slope, or (2) when blankets must be spliced down the slope, place blanket end over end (shingle style with approximately 0.10 m overlap. Staple through overlapped area at 0.3 m intervals.
  - The upslope portion of blanket should overlap the downslope portion of blanket, shingle style, at least 0.15 m with staple anchors placed a maximum 0.3 m apart
  - Adjacent rolls of blanket should overlap a minimum 0.1 m
  - Anchors should be placed along central portion of blanket spaced at $4/m^2$ minimum (0.5 m spacing) for slopes steeper than 2H:1V and $1/m^2$ (1 m spacing) for slopes flatter than 2H:1V
  - Anchors along splices between adjacent rolls should be placed 0.9 m apart

Construction (Channels)

- **A Blanket should be installed in accordance with manufacturers directions**

The following is a general installation method

- Prepare surface and place topsoil and seed
  - Surface should be smooth and free of large rocks, debris, or other deleterious materials
- Begin by excavating a minimum 0.15 m deep and 0.15 m wide trench at the upstream end of channel and place end of RECP into trench
  - Use a double row of staggered anchors approximately 0.1 m apart (i.e., 0.2 m linear spacing) to secure RECP to soil in base of trench
  - Backfill and compact soil over RECP in trench
- Roll centre RECP in direction of water flow on base of channel
- Place RECP end over end (shingle style) with a minimum 0.15 m overlap downgrade

- Use a double row of staggered anchors approximately 0.1 m apart to secure RECP to soil

– Full length edge of RECP at top of sideslopes must be anchored in a minimum 0.15 m deep and 0.15 m wide trench

- Use a double row of staggered staple anchors a maximum of 0.1 m apart (i.e., 0.2 m linear spacing) to secure RECP to soil in base of trench
- Backfill and compact soil over RECP in trench

– Overlap RECP on sideslopes (shingle style down channel) a minimum of 0.1 m over the centre RECP and secure RECP to soil with anchors spaced a maximum of 0.2 m apart

– In high flow channels, a check slot across the width of the channel is recommended at a maximum spacing of 10 m to anchor the ends of the RECP to the underlying soil

- Use a double row of staggered staple anchors a maximum of 0.1 m apart (0.2 m linear spacing) to secure RECP to soil in base of check slot
- Backfill and compact soil over RECP in check slot

– Anchor terminal ends of RECP in a minimum 0.15 m deep and 0.15 m wide trench

- Use a double row of staggered anchors a maximum of 0.1 m apart (i.e., 0.2 m linear spacing) to secure RECP to soil in base of trench
- Backfill and compact soil over RECP in trench

Construction Considerations

- Slopes should be topsoiled and seeded prior to placing RECP
- Ensure blanket is in intimate contact with the soil by properly grading soil, removing rocks or deleterious materials, prior to placing blanket
- In channels, blankets should extend to above the anticipated flow height, with a minimum 0.5 m of free board
- For turf reinforcement mat (TRM), blanket should be placed immediately after topsoiling
- Blanket should be anchored by using wire staples, metal geotextile stake pins, or triangular wooden stakes

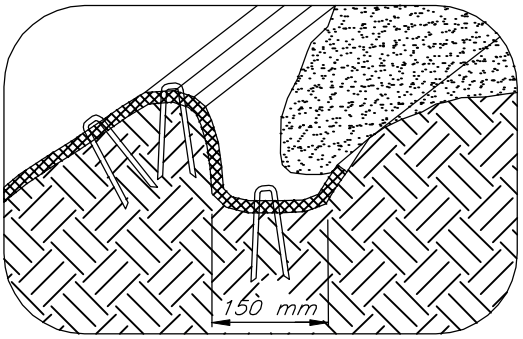
  – All anchors should be a minimum of 0.15 to 0.2 m in length

  - For loose soils, use longer anchors

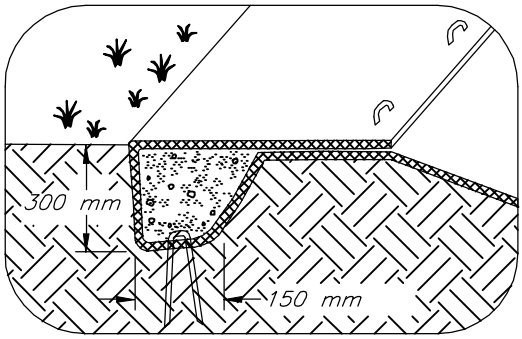
- Blankets should be placed longitudinal to direction of flow, with fabric not stretched but maintaining contact with underlying soil
- It is essential to understand product specifications and follow manufacturers instructions on installation methods

Inspection and Maintenance

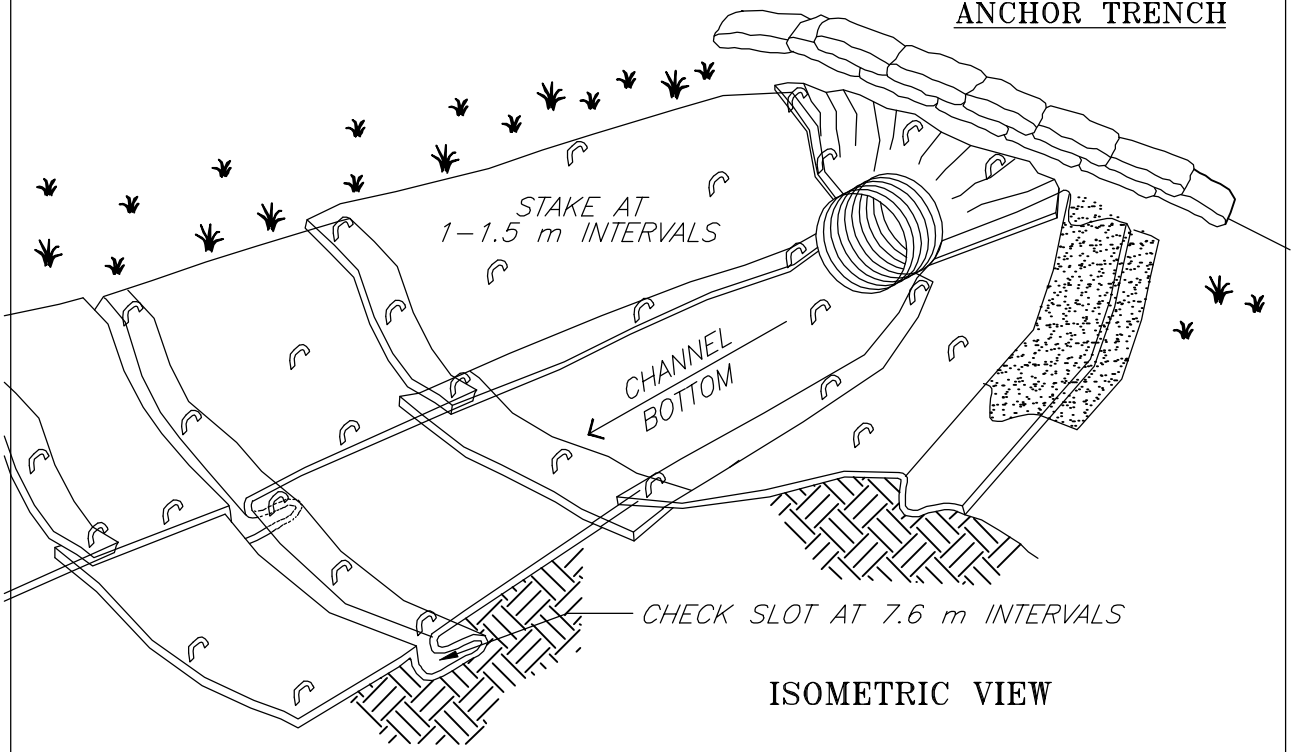
- Areas covered with blankets should be inspected/remediated regularly or in accordance with the PESC and TESC Plans, especially after periods of severe rainfall or storm events, to check for blanket separation or breakage
- Any damaged or poorly performing areas should be repaired/remediated immediately. Regrading of the slope by hand methods may be required in the event of rill or gully erosion.
- Inspection and maintenance should continue until dense vegetation is established
- Areas with low vegetation density should be reseeded
- After approximately one year, a top dressing of fertilizer may be applied to improve vegetation cover and assist degradation of temporary blankets



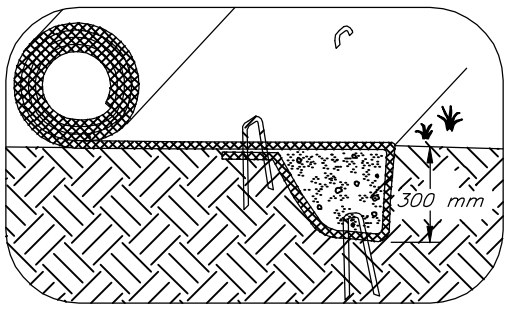
LONGITUDINAL ANCHOR TRENCH



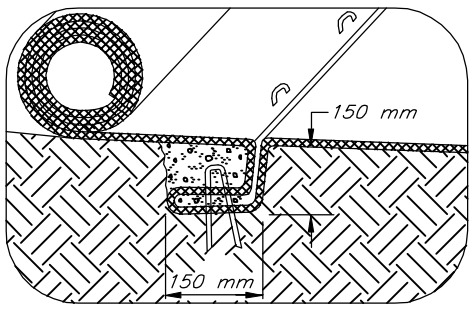
TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH



ISOMETRIC VIEW



INITIAL CHANNEL ANCHOR TRENCH



INTERMITTENT CHECK SLOT

NOTES:

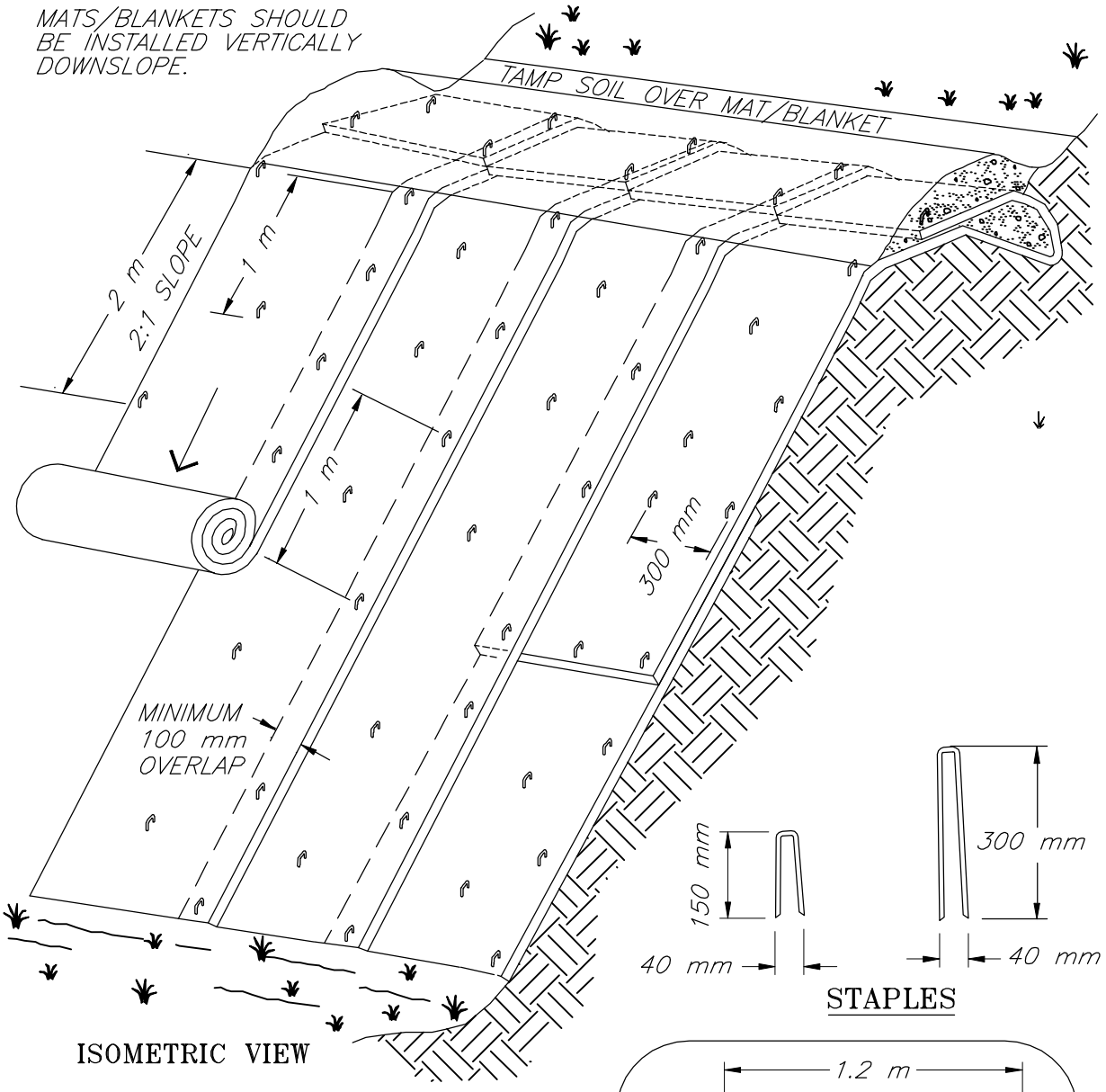
1. CHECK SLOTS TO BE CONSTRUCTED PER MANUFACTURERS SPECIFICATIONS.
2. STAKING OR STAPLING LAYOUT PER MANUFACTURERS SPECIFICATIONS.
3. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

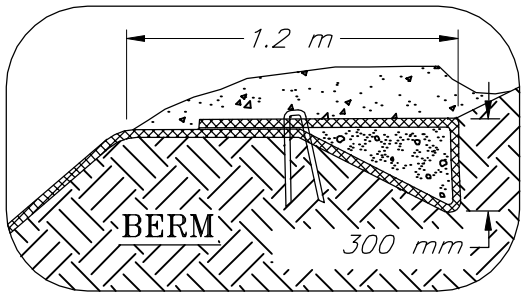
ROLLED EROSION CONTROL PRODUCTS (RECP)

CHANNEL INSTALLATION

Government of Alberta ■
Transportation

B.M.P. #13a
Typical Section





NOT TO SCALE

TYPICAL SLOPE SOIL STABLIZATION

NOTES:

1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS AND GRASS. MATS/ BLANKETS SHALL HAVE GOOD SOIL CONTACT.
2. APPLY PERMANENT SEEDING BEFORE PLACING BLANKETS.
3. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH THE SOIL. DO NOT STRETCH.
4. CHECK SLOTS, STAKING, STAPLING AND OTHER CONSTRUCTION DETAILS PER MANUFACTURES SPECIFICATIONS.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

ROLLED EROSION CONTROL PRODUCTS (RECP) SLOPE INSTALLATION

Riprap Armouring
a) Slope Protection
b) Channel Protection

Erosion Control

B.M.P. #14
(a & b)

Description and Purpose

- Large, loosely placed cobbles or boulders placed along channel banks or slopes to protect underlying soil from erosion due to flowing water
- Can protect slopes and channel banks against erosion

Applications

- Permanent measure
- May be used on channel banks and slopes with flow velocities ranging from 2 m/s to 5 m/s (dependent on rock size and thickness); appropriate for slopes that do not exceed 2H:1V
- Riprap only needs to be placed at lower portion of channel section to the anticipated flow height (mean annual peak flow) plus freeboard
  - Other form of soft armouring (RECP blankets, seeding) can be used to promote vegetation to protect soil at upper portion of channel slopes, above riprap
- Must be used in conjunction with a non-woven geotextile underlay acting as a filtration separator with basal soil
- For fluctuating high flow channel, the riprap should be underlain by a layer of granular filter material for cyclic drawdown long-term performance with/without an extra layer of non-woven geotextile as underlay

Construction

- Grade the slope or channel to final design grade
- Place filter (underlay) layer on prepared slope
  - Filter layer can consist of non-woven geotextile underlay and/or well graded granular material dependent on hydraulic conditions
- Place riprap layer
- Riprap should consist of a graded mixture of sound, durable stone with at least 50% of the riprap material being larger than 200 mm in diameter
- Riprap should be sized according to the following gradation and mass:

		Riprap Class			
		1M	**1**	**2**	**3**
Nominal Mass **Nominal Diameter**	**kg** **mm**	**7** **175**	**40** **300**	**200** **500**	**700** **800**
None heavier than:	kg	40	130	700	1800

	or mm	300	450	800	1100
No less than 20% or more than 50% heavier than:	kg or mm	10 200	70 350	300 600	1100 900
No less than 50% or more than 80% heavier than:	kg or mm	7 175	40 300	200 500	700 800
100% heavier than:	kg or mm	3 125	10 200	40 300	200 500

Percentage quoted are by mass.
Sizes quoted are equivalent spherical diameters, and are for guidance only.

Source: AT Bridge Spec. 2010

- Non-woven geotextile fabric underlay below riprap should meet the following specifications and physical properties:

Non-Woven Geotextile Filter Fabric
Specifications and Physical Properties

	Class 1M, 1 and 2	**Class 3**
Grab Strength	650 N	875 N
Elongation (Failure)	50%	50%
Puncture Strength	275 N	550 N
Burst Strength	2.1 MPa	2.7 MPa
Trapezoidal Tear	250 N	350 N
Minimum Fabric Overlap to be 300 mm		

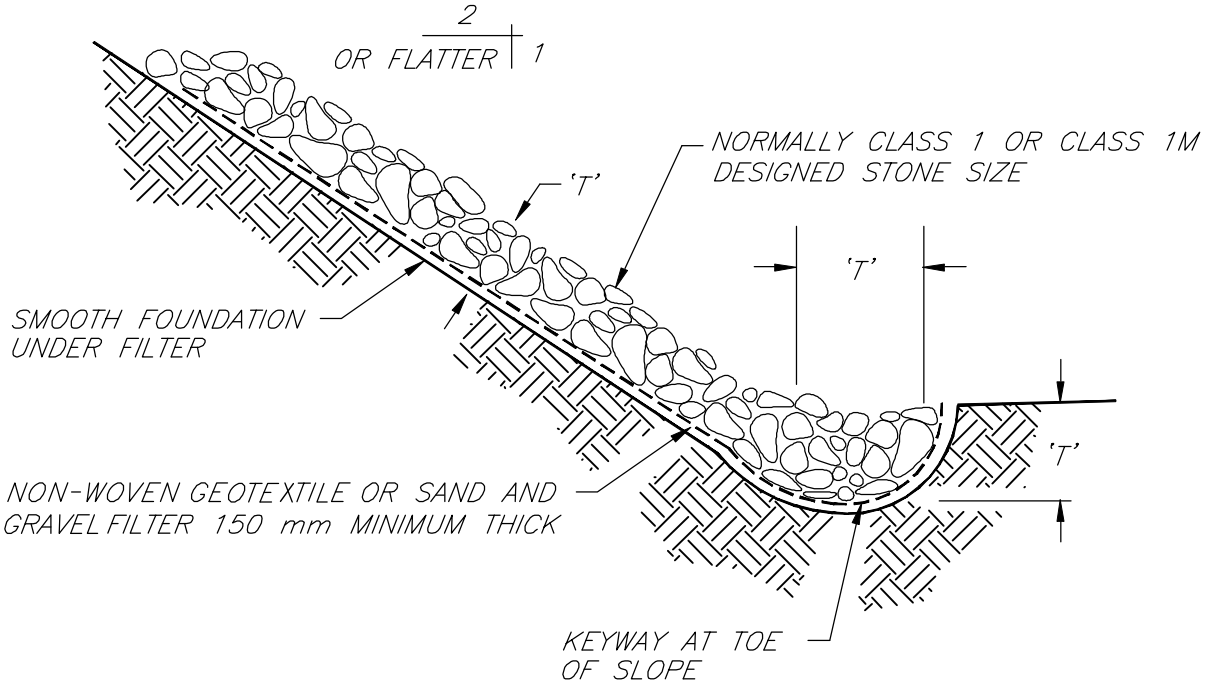
Source: AT Bridge Spec. 2010

Construction Considerations

- Riprap should be placed in a uniform thickness across the channel so as not to constrict channel width
- Blasted rock is preferred (if available)
- Riprap layer should be 1.5 to 2 times the thickness of the largest rocks used, 1.5 to 3 times the thickness of the D_{50} material, and not less than 300 mm in thickness

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Periodic inspections to check for erosion of protected material or movement of riprap



TYPICAL SECTION

NOTE:

1. 'T' = THICKNESS: THICKNESS SHALL BE DETERMINED BY THE ENGINEER.
   MINIMUM THICKNESS = 300 mm. (i.e. 1.5x D_{50}) FOR D_{50} = 200 mm.
2. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

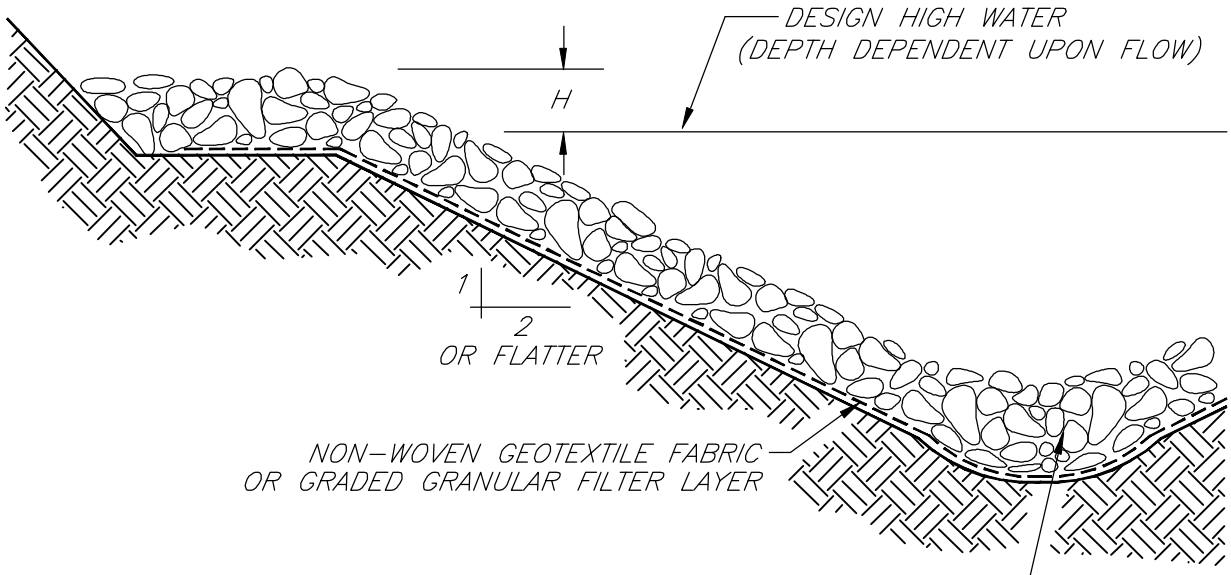
RIPRAP ARMOURING FOR SLOPE

FILE: RIPRAP

Government of Alberta ■ Transportation

B.M.P. #14a
Typical Section

DESIGN HEIGHT (H), WIDTH AND STONE SIZE SHALL
BE DETERMINED BY THE ENGINEER



MINIMUM 300 mm THICK LAYER OF 50 mm MINIMUM DIAMETER DRAIN ROCK. D_{50} =200 mm. LARGER STONE SHALL BE USED DEPENDENT UPON GRADIENT, SOIL TYPE, AND DESIGN FLOW.

TYPICAL SECTION

NOTES:

1. RIPRAP GRADATION AND THICKNESS SHALL BE DETERMINED BY THE ENGINEER IN ACCORDANCE WITH HYDRAULIC CONDITIONS.
2. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

RIPRAP ARMOURING FOR CHANNEL

FILE: RCKCHNEL

Government of Alberta ■ Transportation

B.M.P. #14b
Typical Section

Energy Dissipators a) for Culvert Outlet b) for Trough at Bridge Headslope Sediment Control	B.M.P. #17

Description

a) Hard armour (riprap, gravel, concrete) placed at pipe outlets, in channels, and at downstream side of check structures to reduce velocity and dissipate energy of concentrated flows (BMP 17a)

b) Standard Drain Trough Terminal Protection Structure generally used at bridge headslope (BMP 17b)

- Minimizes scour at flow impact location with dissipated flow energy

Applications

- Permanent measure
- May be used at outlets of pipes, drains, culverts, conduits, or channels with substantial flows
- May be used at slope drain outlets located at the bottom of mild to steep slopes
- May be used where lined channels discharge into unlined channels
- May be used as splash pad on downstream side of gabions, check structures, berms, barriers, and silt fences to prevent erosion caused by overtopping of structure

Construction

- Grade the area to final design grades and elevations
- Sub-excavate energy dissipator location to thickness of energy dissipator
- Place filtration bedding material on base of excavation
  - Bedding can be comprised of well graded sand and gravel or non-woven geotextile
  - Acts as separating filter between fine grained subgrade and riprap size energy dissipator material
- Place energy dissipator material (riprap, gravel, concrete) over filtration bedding material
  - Top of energy dissipator should be flush with surrounding grade

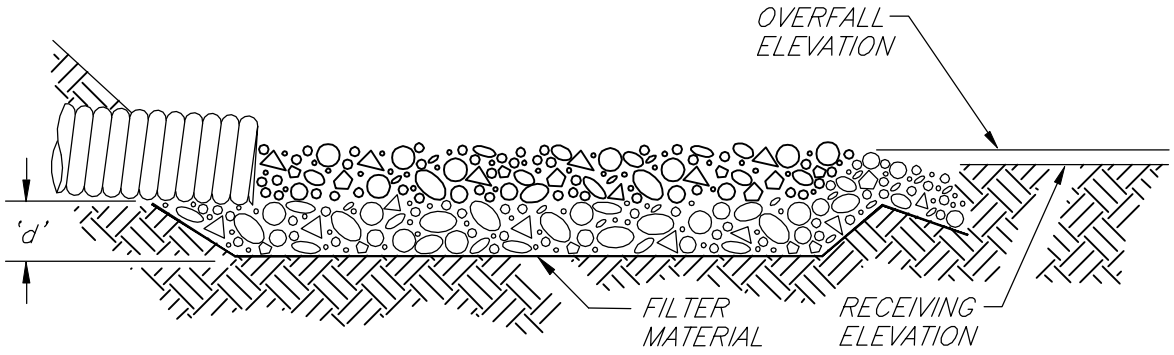
Construction Considerations

- Length of energy dissipator (L_a) at outlets shall be of sufficient length to dissipate energy

  - L_a = 4.5 x D (where D is the diameter of the pipe or channel at the outlet)
  - Energy dissipator should extend upstream of the outlet approximately a minimum distance of 0.5 x D
- Width of energy dissipator (W_a) at outlets shall be of sufficient width to dissipate energy
  - W_a = 4 x D
- Thickness of energy dissipator (d_a) at outlets shall be of sufficient thickness to dissipate energy
  - d_a = 1.5 x maximum rock diameter (with a minimum thickness of 0.30 m)
- Energy dissipator (splash pad, apron) shall be set at zero grade and aligned straight, with the direction of flow at the outlet
- Bedding (filtration) layer can comprise either non-woven geotextile or a minimum of 0.15 m well graded sand and gravel layer
- Energy dissipator should be constructed of well-graded riprap
  - Minimum D_{50} = 150 mm. Preferable D_{50} = 300 mm
  - Minimum thickness = a) 1.5 x D_{50} or b) 0.30 m to 0.45 m thickness (a or b whichever is greater)
- Energy dissipator shall be designed to accommodate a 10-year peak runoff or the design discharge of the upstream channel, pipe, drain, or culvert, whichever is greater
- The energy dissipator shall be constructed flush with the surrounding grade and shall be directly in line with direction of outlet flow

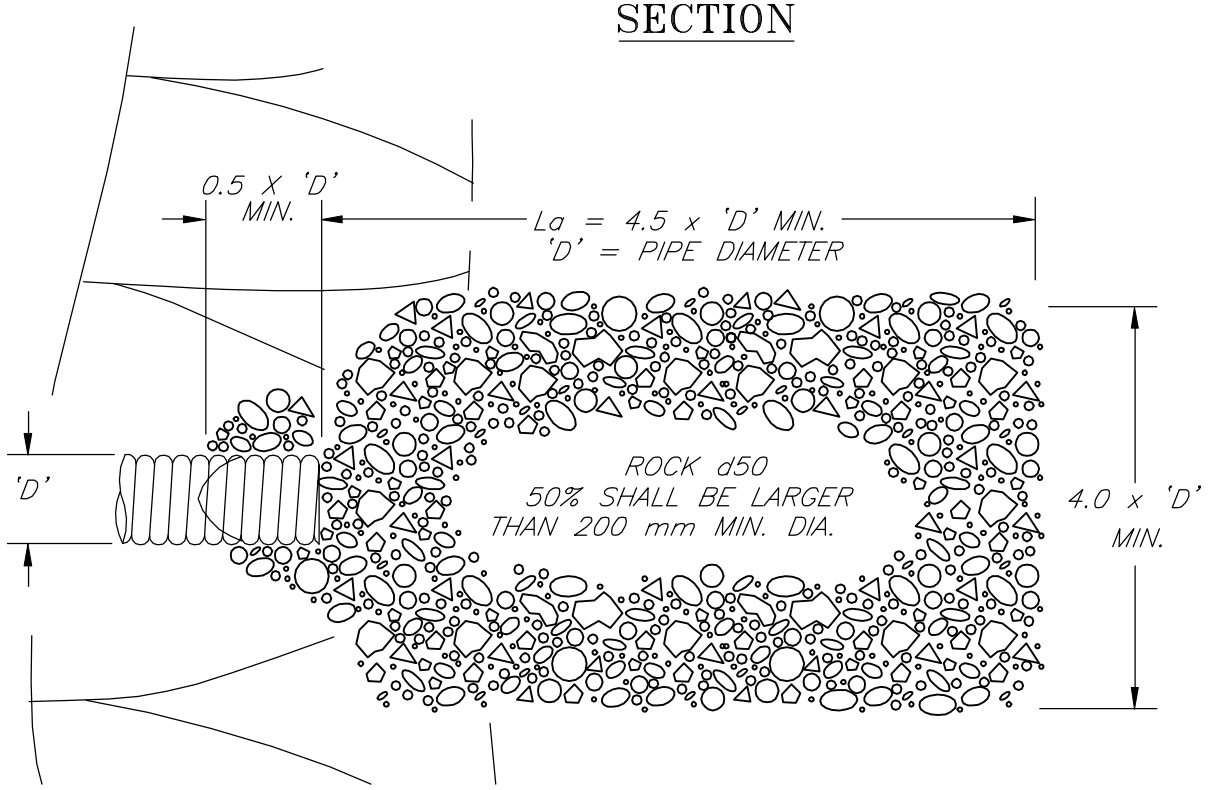
Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Any damage should be repaired immediately



B) MINIMUM THICKNESS = 300 mm. (i.e. 1.5x D_{50}) FOR D_{50} = 200 mm.

SECTION



PLAN

NOTES:

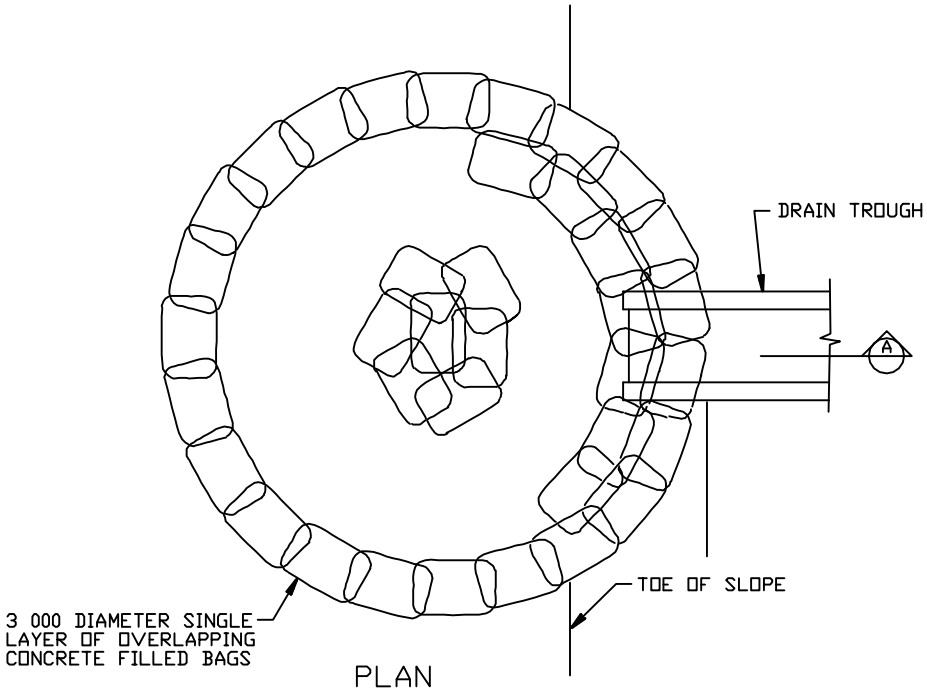
1. 'La' = LENGTH OF APRON. DISTANCE 'La' SHALL BE OF SUFFICIENT LENGTH TO DISSIPATE ENERGY.
2. APRON SHALL BE SET AT A ZERO GRADE AND ALIGNED STRAIGHT.
3. FILTER MATERIAL SHALL BE FILTER FABRIC OR 150 mm THICK MINIMUM GRADED GRAVEL LAYER.
4. FOR PIPE DIAMETER > 600 mm, DESIGN BY ENGINEER IS REQUIRED.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

ENERGY DISSIPATOR FOR CULVERT OUTLET

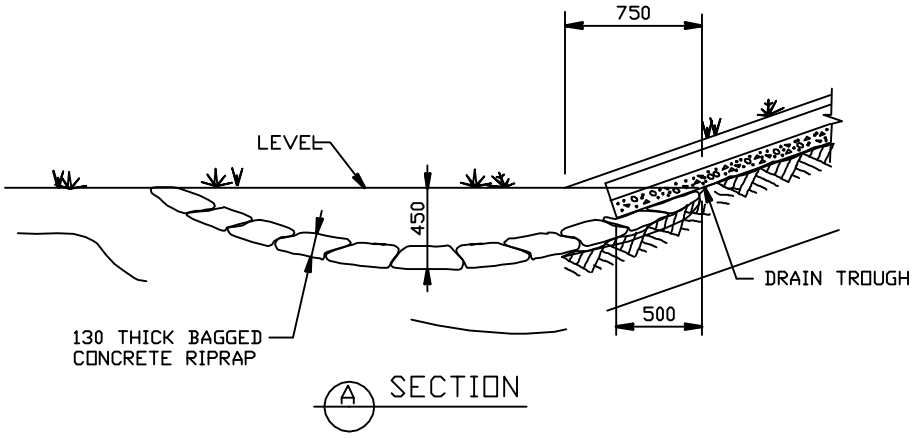
FILE: ENRGYDIS

Government of Alberta ■ Transportation

B.M.P. #17a
Typical Section



PLAN



A SECTION

GENERAL NOTES

- DIMENSIONS ARE GIVEN IN mm. DETAILS ARE NOT TO SCALE.
- PLACING OF BAGGED CONCRETE RIPRAP SHALL START AT THE BOTTOM CENTRE OF THE DISHED AREA AND SHALL PROCEED IN A CONTINUOUS SPIRAL FASHION OUTWARD UNTIL THE ENTIRE DISH IS COVERED. EACH CONCRETE FILLED BAG SHALL LAP OVER THE EDGES OF THE PREVIOUSLY PLACED BAGS.

  SOURCE: ALBERTA TRANSPORTATION: SPECIFICATIONS FOR BRIDGE CONSTRUCTION
  DRAWING: S-1410-91

- THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

ENERGY DISSIPATOR

FOR SEMI-CIRCULAR TROUGH DRAIN TERMINAL PROTECTION FOR BRIDGE HEADSLOPE

Government of Alberta ■
Transportation

B.M.P. #17b
Typical Section

Sediment Traps and Basins a) Riser Outlet Option b) Permeable Rock Berm Outlet Option Sediment Control	B.M.P. #18

Description and Purpose

- Low height dam enclosure for impoundment of sediment laden storm water, sedimentation of silt size particles and release of treated storm water
- Used to trap sediment laden run off and promote settlement of sediment prior releasing to enter downstream or watercourses
- Constructed by excavating a pond or building embankments above the original ground surface
- Sediment traps and basins can be divided on size of pond impoundment enclosure
  - Basin (Type I) for pond area $\geq$500 m²
  - Trap (Type II) for pond area $\leq$500 m²

Applications

- Permanent measure
- Used at terminal or selective intermediate points of concentrated runoff for impoundment of runoff and sedimentation of silt prior to release of treated runoff downstream
- Used as sedimentation control measure at perimeter of construction sites where sediment laden run off may enter watercourses, storm drains, or other sensitive areas
- Used where there is a need to impound a significant amount of sediment from significant areas of land disturbance
- Sediment basins (Type I) used for disturbed drainage areas greater than 2.0 ha
- Sediment traps (Type II) used for disturbed drainage areas of 2.0 ha, or less
- Where practical, contributing drainage areas should be subdivided into smaller areas and multiple sedimentation impoundment installed

Construction

- The consequences of failure for any water retaining structure will determine the level of effort in the design and construction phases. The construction guidelines presented herein are minimum requirements. A geotechnical engineer should design water retaining structures if the consequences of failure warrant.
- All footprint area for embankment dyke should be stripped of vegetation, topsoil, and roots to expose mineral subgrade soils

- Embankment fill material should be clean mineral soil with sufficient moisture to allow proper compaction
  - Fill should be placed in lifts not exceeding 150 mm in compacted thickness and should be compacted to a minimum of 95% Standard Proctor maximum dry density (SPD)
- The main outlet structure should be installed at farthest possible point from inlet
  - Outlet should be placed on firm, smooth ground and should be backfilled to 95% SPD
  - Proper inlet and outlet protection should be installed to protect from scour
  - Outlet pipe should consist of corrugated steel pipe to protect (against pinching and blockage)
- The embankment should be topsoiled, seeded or protected with gravel or riprap immediately after construction
- Construct an emergency spillway to accommodate flows not carried by the principle outlet
  - Emergency spillway should consist of an open channel (earth or vegetated) over native undisturbed soil (not fill)
  - If spillway is elevated, it should be constructed of riprap
  - Spillway crest should be depressed at least 0.15 m below embankment

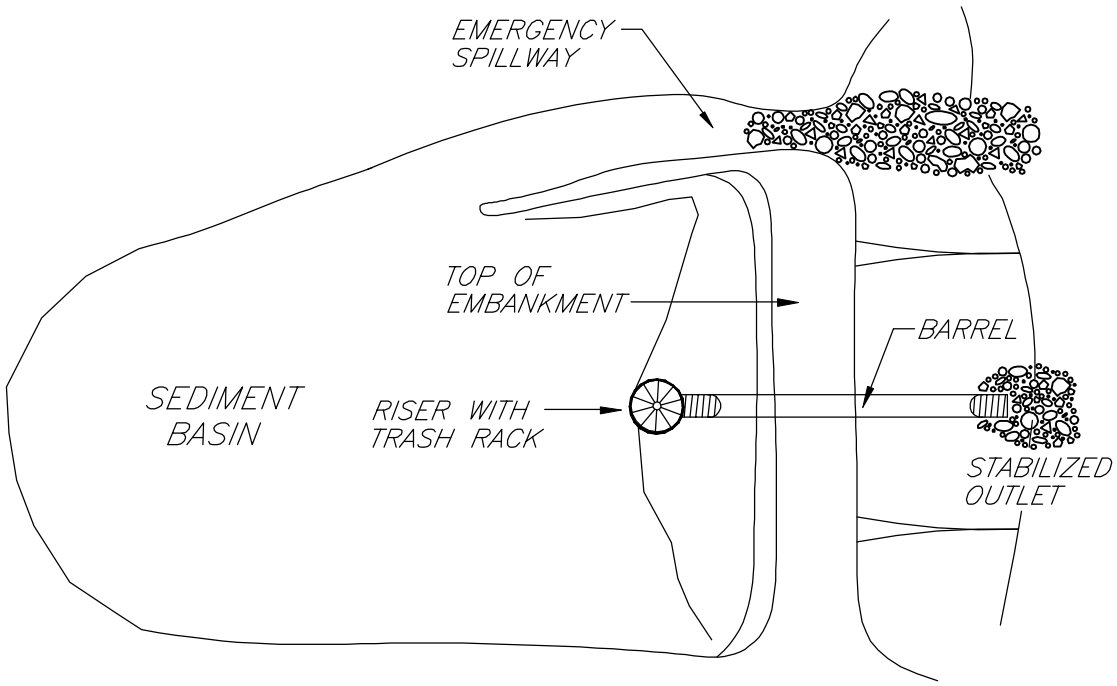
Construction Considerations

- Preferable to strip to mineral soil only along the footprint area required for dyke construction; can leave pond floor centre area cleared but unstripped
- Can be constructed by excavating, constructing embankments, or a combination of the two methods
- Baffles should be provided to prevent short-circuiting of flow from inlet to outlet
- Construct sediment ponds and basins at site perimeter and environmentally sensitive areas prior to wet season and construction activities
- Sediment pond/basin bottom should be flat or gently sloping towards outlet
- Dyke slopes should not be steeper than 2H:1V and should be compacted
- Basins should be located where:
  - Low embankment can be constructed across a swale or low natural terrain

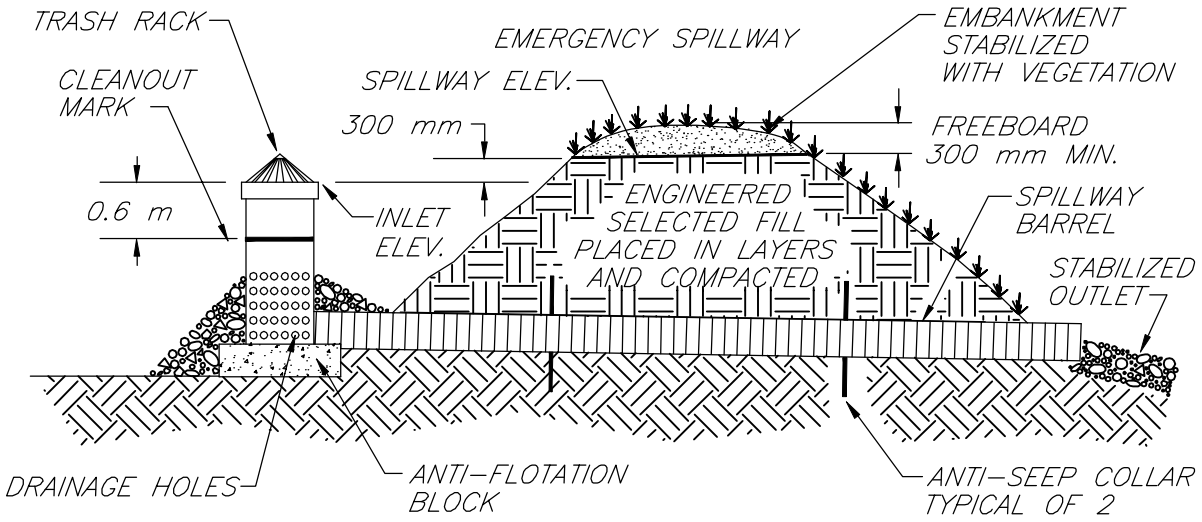
- It is accessible for maintenance work, including sediment removal

Inspection and Maintenance

- Regular inspection is required to identify seepage, structural soundness, outlet damage or obstruction and amount of sediment accumulation
- Inspection frequency should be in accordance with the PESC and TESC Plans
- Sediment should be removed upon reaching 1/2 height of the containment berm or within 0.4 m of crest of embankment
- Sediment traps may be deactivated or removed after vegetation of previously disturbed upstream areas has been established



PLAN



SECTION

NOTES:

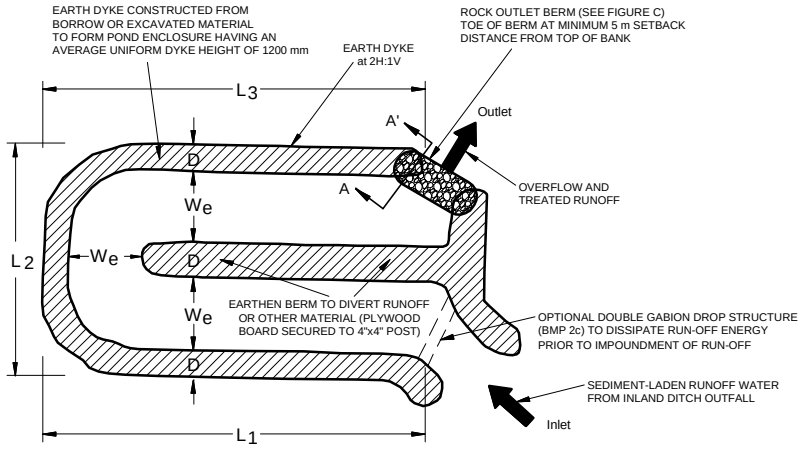
1. THE TEMPORARY SEDIMENT BASIN, DESIGNED BY A QUALIFIED PROFESSIONAL, IS REQUIRED FOR DISTURBED AREAS GREATER THAN 2.02 HECTARES (5 ACRES) WITH A DRAINAGE AREA LESS THAN 40.4 HECTARES (100 ACRES).
2. THE SEDIMENT BASIN MAY BE REMOVED WITHIN 3 YEARS.
3. HEIGHT OF ENGINEERED SELECTED FILL EQUAL TO 1 m.
4. FOR CONFIGURATION AND FLOW CHAMBER DESIGN (i.e. LENGTH(L) & WIDTH(W_e) OF BASIN), REFER TO BMP 18b.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

TYPICAL SEDIMENT BASIN (RISER OUTLET OPTION)

FILE: SEDBASIN

Government of Alberta ■ Transportation

B.M.P. #18a
Typical Section

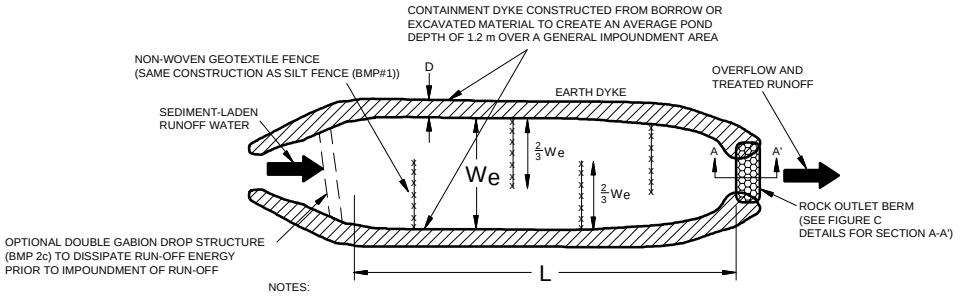


NOTES:

1. CONTRIBUTING RUNOFF AREA CAN BE LARGER THAN 2.0 ha BUT LESS THAN 40.0 ha.
2. EFFECTIVENESS APPROPRIATE FOR REMOVING MEDIUM TO COARSE SILT PARTICLES SUSPENDED IN RUNOFF.
3. FLOW PATH L = $L_1 + L_2 + L_3$ FLOW WIDTH W $_e$ 6 m MINIMUM
4. PROVIDE 1 TO 2 m (1 TO 2% GRADE) ELEVATION DROP BETWEEN INLET AND OUTLET GRADES.
5. SHAPE OF POND TO CONFORM TO TOPOGRAPHY WITH OUTLET AT MINIMUM 5 m FROM TOP OF BANK.
6. CONSTRUCTION TO ENSURE SWALES AND BAFFLES ARE TO CHANNEL WATER INTO THE PROPOSED SEDIMENTATION PONDS.

Plan View

Figure A Type 1 Sedimentation Pond Containment Structure (Sediment Basin)

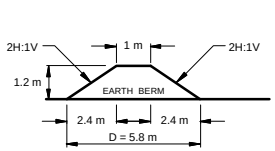


NOTES:

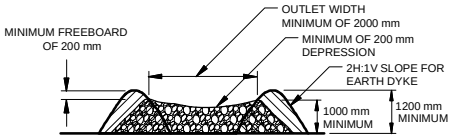
1. CONTRIBUTING RUNOFF AREA SHOULD BE OR SMALLER THAN 2.0 ha.
2. EFFECTIVENESS APPROPRIATE FOR REMOVING MEDIUM TO COARSE SILT PARTICLES SUSPENDED IN RUNOFF.
3. L/W_e RATIO 3:1 CAN BE APPROPRIATE.
4. W_e = 8 m MINIMUM BOTTOM WIDTH.
5. NON-WOVEN GEOTEXTILE FABRIC WITH A0S 0.15mm.

Plan View

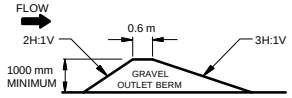
Figure B Type II Containment Structure (Sediment Trap)



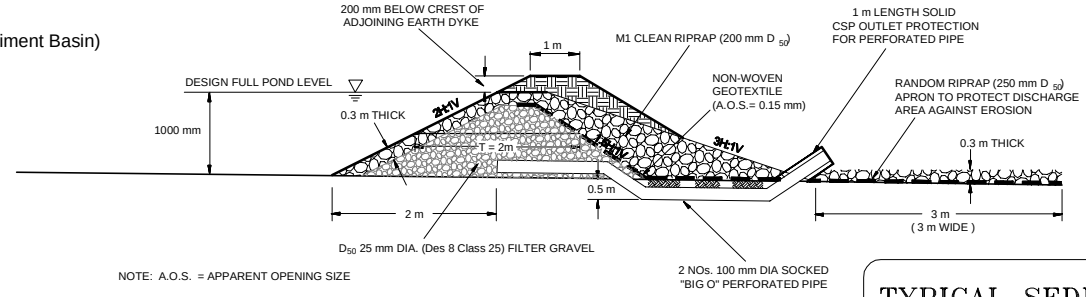
EARTH DYKE (D)



OUTLET FRONT VIEW



SECTION A-A' (SIMPLIFIED)



NOTE: A.O.S. = APPARENT OPENING SIZE

Figure C Section A-A' - Details for Sedimentation Pond
(Permeable Structure with Rock Filter Barrier and Perforated Pipe)

NOTES:

1. *DEACTIVATED WITHIN 3 YEARS AFTER SATISFACTORY FULL REVEGETATION OF THE DISTURBED AREA OF POTENTIAL EROSION SOURCES UPSTREAM.*
2. *THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.*

SOURCE: 1) FIFIELD (2001) FOR STRUCTURE PLAN
2) EBA FOR OTHER DESIGN DETAILS

TYPICAL SEDIMENT BASIN (PERMEABLE ROCK BERM OUTLET OPTION)

Slope Drains
a) Slope Drain
b) Overside Drain

Sediment Control

B.M.P. #19

Description and Purpose

- Heavy duty, flexible pipe "Big O" that carries water from top to bottom of fill or cut slope to prevent concentrated water flowing downslope and eroding face of slope

Applications

- Temporary or permanent measure
- Used on cut or fill slopes where there is a high potential for upslope runoff waters to flow over the face of the slope causing erosion, especially at areas where runoff converges resulting in concentrated runoff flows (e.g., possible breach of low catchwater ditch at top of a cut slope)
- Used in conjunction with some form of water containment or diversion structures, such as diversion channels, berms, or barriers, to convey upslope runoff water and direct water towards slope drain

Construction

- Construct diversion or intercept channel, ditch block, barrier, or other inflow apron structure at crest of slope to channel flow toward the slope drain inlet
- Install slope drain through inlet berm or barrier with a minimum of 0.45 m of soil cover above top of drain pipe to secure the inlet
  - Install scour inlet protection (such as riprap, sand bags)
- Install energy dissipator (such as riprap, gravel, concrete) at downslope outlet end of slope drain
  - Outlet must not discharge directly onto unprotected soil
- Secure the pipe from movement by tying to steel anchor stakes, hold-down grommets, or other approved anchor method
  - Space anchors on each side of drain pipe at maximum 3 m intervals along entire length of drain pipe
  - Anchor stakes should have a minimum 1 m embankment

Construction Considerations (For guidance only)

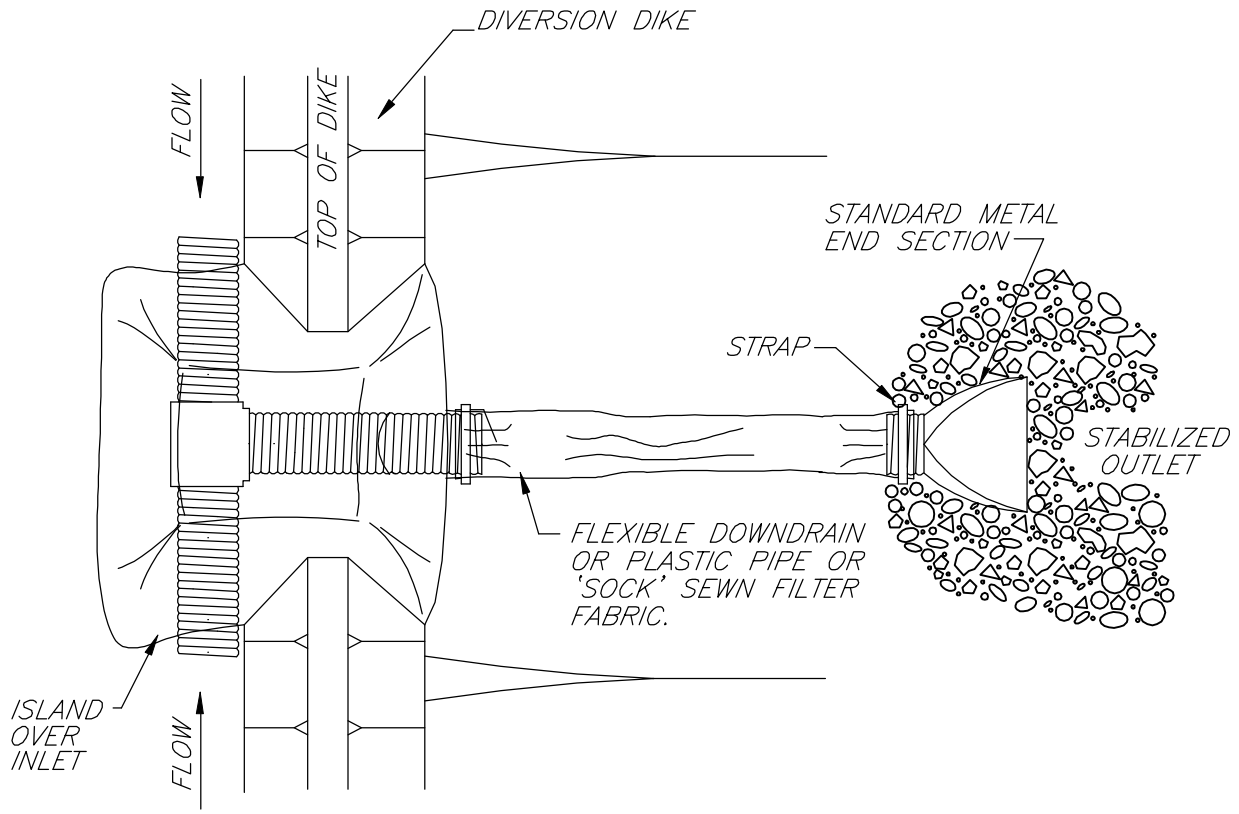
- Use coiled drain pipe for low flows only
- If constructing inflow apron at crest of slope out of sandbags, only fill each sandbag ¾ full, this will allow sandbag to be flexible enough to mould around drain pipe and remain in continuous contact with the ground

- Several slope drains may be required if upslope drainage areas are too large for one drain pipe

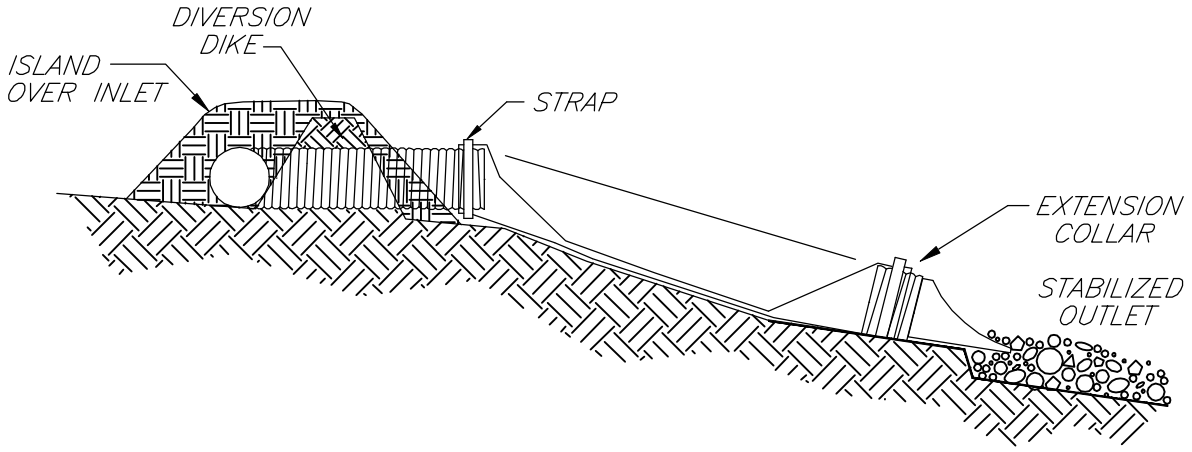
Size of Slope Drain	
Maximum Drainage Area (ha)	**Pipe Diameter (mm)**
0.2	300
0.6	450
1.0	530
1.4	600
2.0	760

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Repair any damaged section of pipe immediately
- **If evidence exists of pipe movement, install additional anchor stakes to secure and anchor at zones of movement**
- Remove sediment from upslope inflow apron area after each storm event otherwise either downslope sediment transport will occur or cause the drainpipe to be plugged which could result in overtopping of inflow apron structure and sheet flow over slope face



PLAN VIEW



SECTION

NOTE:

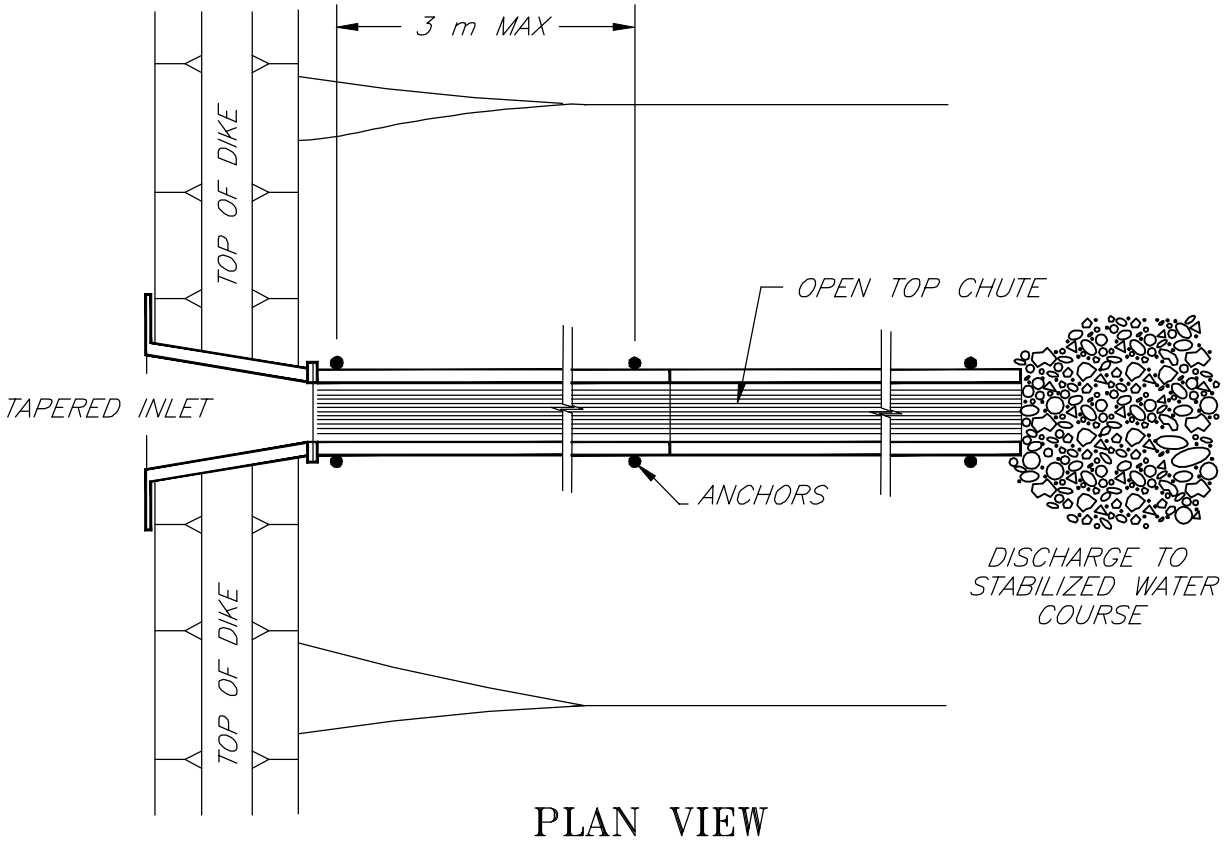
1. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

SLOPE DRAIN

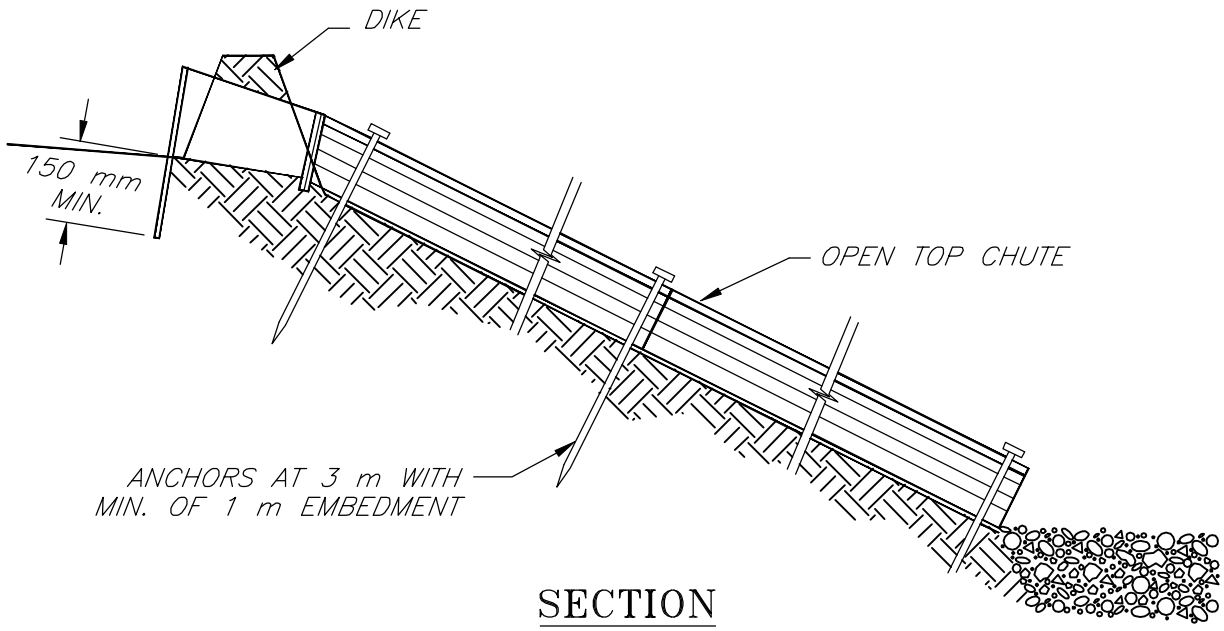
FILE: SLOPEDRN

Government of Alberta ■ Transportation

B.M.P. #19a
Typical Section



PLAN VIEW



SECTION

NOTE:

1. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

OVERSIDE DRAIN

FILE: OSDRAIN

Government of Alberta ■ Transportation

B.M.P. #19b
Typical Section

Offtake Ditch (Intercept Ditch) Erosion Control	B.M.P. #21

Description and Purpose

- Channels or swales commonly located along the crest of cuts slopes to intercept and convey runoff away from flowing down a newly excavated bare soil slope and to minimize erosion of slope from overlanding sheet flow
- Can be tied to outfall to slope drains (or downdrains) which carry water from higher slope elevations to lower elevation of a slope

Applications

- Permanent measure
- Effective method of intercepting runoff to avoid excessive sheet flow over slope and causing erosion, especially on cut slopes in highly erodible soils (sand and silt)
- Can be used in conjunction with slope drains which was installed down a large cut slope
- May be lined with vegetation, rip rap, erosion control blankets, or some other erosion protection measure, but this requirement may be appropriate only at highly sensitive and high risk environmental areas
- Can be used in conjunction with sediment control measures, such as check structures or permeable synthetic barriers as normal channel design, but this requirement may be appropriate only at highly sensitive and high risk environmental areas

Construction

- Use backhoe to form ditch a minimum offset distance of 2 m between crest of highway slope and top of offtake ditch sideslope, thus providing a dyke width of 1 m
  - Place and compact excavated soil to form a dyke between crest of highway slope and offtake ditch channel to provide adequate depth (1 m) of the offtake ditch
    - The consequence of failure on this dyke will determine the level of compaction effort required
  - Sideslopes of ditch should not be steeper than 2H:1V (depending upon material type)
  - Depth of ditch (from base of ditch to top of embankment) should be a minimum of 1 m in depth; width of ditch should be 1 m minimum
  - Ditch grade should be graded a minimum of 1% to promote positive drainage and outfall

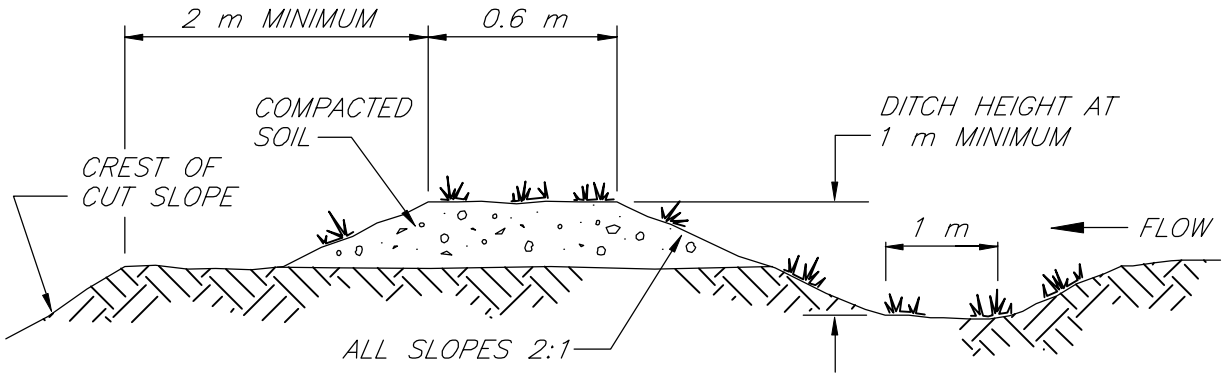
Offtake Ditch (Intercept Ditch) Erosion Control	B.M.P. #21

Construction Considerations

- Channel should be graded towards nearest outfall (draw) or drainage pipe

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Repair any damage to channel immediately



TYPICAL OFFTAKE DITCH

NOTES:

1. THE DITCH BEHIND THE DYKE SHALL HAVE POSITIVE GRADE TO A STABILIZED OUTLET.
2. THE DYKE SHALL BE ADEQUATELY COMPACTED TO PREVENT FAILURE.
3. FOR SENSITIVE HIGH RISK AREAS, THE DITCH SHALL BE STABILIZED WITH TEMPORARY OR PERMANENT SEEDING OR RIPRAP.
4. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

OFFTAKE DITCH
(INTERCEPT DITCH)

FILE: TEMPDIKE

Government of Alberta ■ Transportation

B.M.P. #21
Typical Section

Seeding Erosion Control	B.M.P. #22

Description and Purpose

- The planting or placing seed into soils of cut slope or fill embankment slopes after a layer of organic topsoil is spread over the slope
- Provides erosion protection through development of a shallow root structure from seed germination and plant growth

Applications

- Permanent or temporary measure
- Temporary seeding with rapidly growing plants may be applied to interim stockpile/excavation areas which will be exposed for more than 30 days
- Permanent seeding may be applied to exposed bare soil areas which have been graded to final contours
- Permanent seeding may be applied to landscape corridors, slopes and channels by broadcasting, furrowing or spraying on with mulch tackifier
- Provides habitat for wildlife after vegetation establishment
- Can be enhanced with a protective layer of mulches or rolled erosion control products (RECPs) to improve growth environment

Construction

- The site to be seeded should be prepared prior to seeding
- Surface should be graded to design grades and then topsoiled
- Seedbed should be 75 to 150 mm deep, with the top 75 mm consisting of topsoil free of large clods or stones
- Seed should be applied immediately after seedbed preparation using broadcast seed spreaders, cyclone (broadcast) spreaders, or seed drills to ensure uniformity of application
- Seedbed should be harrowed, raked, or chain-dragged to ensure proper seed-soil contact
- Fertilizer should then be applied after seeding

Seeding Erosion Control	B.M.P. #22

Construction Considerations

- Seeding rate for all mixes should be 25 kg/ha minimum
- Fall rye may be added to each mix to provide early growth and protection from soil erosion.
- Fall rye seeding rate is 5 kg/ha
- Selection of proper vegetation seed mix depends on soil conditions, climate conditions, topography, land use, and site location
- Planting of seeds by hydraulic seeding and mulching techniques should be considered for slopes steeper than 3H:1V where seedbed preparation is difficult, or where application of seed, mulch, and fertilizer in one continuous operation is desirable
- Sod may be installed for faster results, however it is very costly but essential for high risk sensitive areas
- If mulch is placed as a germination medium for seeds, the mulch layer may be further protected with a biodegradable matting to prevent mulch from being washed or blown away

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Freshly seeded areas should be inspected frequently to ensure growth is progressing
- Additional stormwater control measures should be considered for areas damaged by runoff
- Reseedings may be required within 1 to 5 year intervals after initial seeding
- Small bare spots may need to be reseeded several times at subsequent years after initial application
- Larger areas may need to be completely retreated
- Cutting or mowing grasses will encourage the establishment and spread of the grass

Alberta Transportation has adopted seed mixes (provided below) depending on site location. The various areas of the province used in selecting the seed mix are presented (Alberta Transportation Seed Mixture Zones Map).

Alberta Transportation
Grass Seed Mixtures used on Highway and Bridge Projects

*This Special Provision (*Spc_G039.wpd (2005)) *is to be used in conjunction with AT Standard Specification 2.20 "Seeding" and Design Bulletin No. 25. The Consultant must perform the vegetation assessment and the soil testing for fertilizer (if required) as part of his design work.*

Zone 1 - Peace River District - north and west of High Level:

Seed Mix Zone	Native Seed Mix - Zone 1		% by Dry Weight
	Common Name	Latin Name	
1 Wetland Mixedwood	Slender Wheat Grass	*Agropyron trachycaulum*	40%
	Fringed Brome (1)	*Bromus ciliatus*	15%
	Tufted Hairgrass	*Deschampsia cespitosa*	15%
	Northern Wheat Grass	*Agropyron dasystachyum*	10%
	Rocky Mountain Fescue	*Festuca saximontana*	10%
	Fowl Bluegrass	*Poa palustris*	10%

Note (1): Fringed Brome seed shall be coated.

Agronomic Seed Mix - Zone 1		
Common Name	Latin Name	% by Dry Weight
Pubescent Wheat Grass	*Agropyron trichophorum*	40%
Dahurian Wildrye	*Elymus dahuricus*	22%
Sheep Fescue	*Festuca ovina*	30%
Perennial Ryegrass	*Lolium perenne*	8%

Zone 2 - Athabasca District (south of Athabasca) and Grande Prairie District

Seed Mix Zone	Native Seed Mix - Zone 2		% by Dry Weight
	Common Name	Latin Name	
2 Dry Mixedwood	Slender Wheat Grass	*Agropyron trachycaulum*	35%
	Fringed Brome (1)	*Bromus ciliatus*	20%
	Tufted Hairgrass	*Deschampsia cespitosa*	10%
	Northern Wheat Grass	*Agropyron dasystachyum*	15%
	Rocky Mountain Fescue	*Festuca saximontana*	10%
	Fowl Bluegrass	*Poa palustris*	10%

Note (1): Fringed Brome seed shall be coated.

Agronomic Seed Mix - Zone 2		
Common Name	**Latin Name**	**% by Dry Weight**
Pubescent Wheat Grass	*Agropyron trichophorum*	40%
Dahurian Wildrye	*Elymus dahuricus*	22%
Sheep Fescue	*Festuca ovina*	30%
Perennial Ryegrass	*Lolium perenne*	8%

Zone 3 - Athabasca District (north of Athabasca) and Hwy. Nos. 88, 750, 986

Seed Mix Zone	**Native Seed Mix - Zone 3**		**% by Dry Weight**
	Common Name	**Latin Name**	
3 Central Mixedwood	Slender Wheat Grass	*Agropyron trachycaulum*	35%
	Fringed Brome (1)	*Bromus ciliatus*	10%
	Tufted Hairgrass	*Deschampsia cespitosa*	10%
	Canada Wildrye	*Elymus canadensis*	10%
	Rocky Mountain Fescue	*Festuca saximontana*	20%
	Tickle Grass	*Agrostis scabra*	10%
	Fowl Bluegrass	*Poa palustris*	5%

Note (1): Fringed Brome seed shall be coated.

Agronomic Seed Mix - Zone 3		
Common Name	**Latin Name**	**% by Dry Weight**
Pubescent Wheat Grass	*Agropyron trichophorum*	40%
Dahurian Wildrye	*Elymus dahuricus*	22%
Sheep Fescue	*Festuca ovina*	30%
Perennial Ryegrass	*Lolium perenne*	8%

Zone 4 - Lethbridge District (east of Hwy 22), Calgary District (east of Hwy 22), and Hanna District

Seed Mix Zone	Native Seed Mix - Zone 4		% by Dry Weight
	Common Name	Latin Name	
4 Mixedgrass and Dry Mixedgrass	Slender Wheat Grass	*Agropyron trachycaulum*	30%
	Canada Wildrye	*Elymus canadensis*	15%
	Mountain Brome	*Bromus carinatus*	15%
	Northern Wheat Grass	*Agropyron dasystachyum*	10%
	Western Wheat Grass	*Agropyron smithii*	5%
	Indian Rice Grass	Orzyopsis hymenoides	5%
	Alkali Grass	Puccinellia distans	10%
	Needle and Thread Grass	Stipa comata	10%

Agronomic Seed Mix - Zone 4		
Common Name	Latin Name	% by Dry Weight
Pubescent Wheat Grass	*Agropyron trichophorum*	32%
Dahurian Wildrye	*Elymus dahuricus*	30%
Sheep Fescue	*Festuca ovina*	30%
Cereal Rye	*Secale cereale*	8%

Zone 5 - Stony Plain, Vermillion, and Red Deer (east of Hwy 22) Districts:

Seed Mix Zone	Native Seed Mix - Zone 5		% by Dry Weight
	Common Name	Latin Name	
5 Central Parkland	Slender Wheat Grass	*Agropyron trachycaulum*	25%
	Northern Wheat Grass	*Agropyron dasystachyum*	10%
	Fringed Brome [(1)]	*Bromus ciliatus*	15%
	Green Needle Grass	*Stipa viridula*	15%
	Canada Wildrye	*Elymus canadensis*	10%
	Indian Rice Grass	*Orzyopsis hymenoides*	10%
	Nuttall's Alkali Grass	*Puccinellia nuttalliana*	10%
	Western Wheat Grass	*Agropyron smithii*	5%

Note [(1)]: Fringed Brome seed shall be coated.

Agronomic Seed Mix - Zone 5		
Common Name	**Latin Name**	**% by Dry Weight**
Pubescent Wheat Grass	Agropyron trichophorum	32%
Dahurian Wildrye	Elymus dahuricus	30%
Sheep Fescue	Festuca ovina	30%
Cereal Rye	Secale cereale	8%

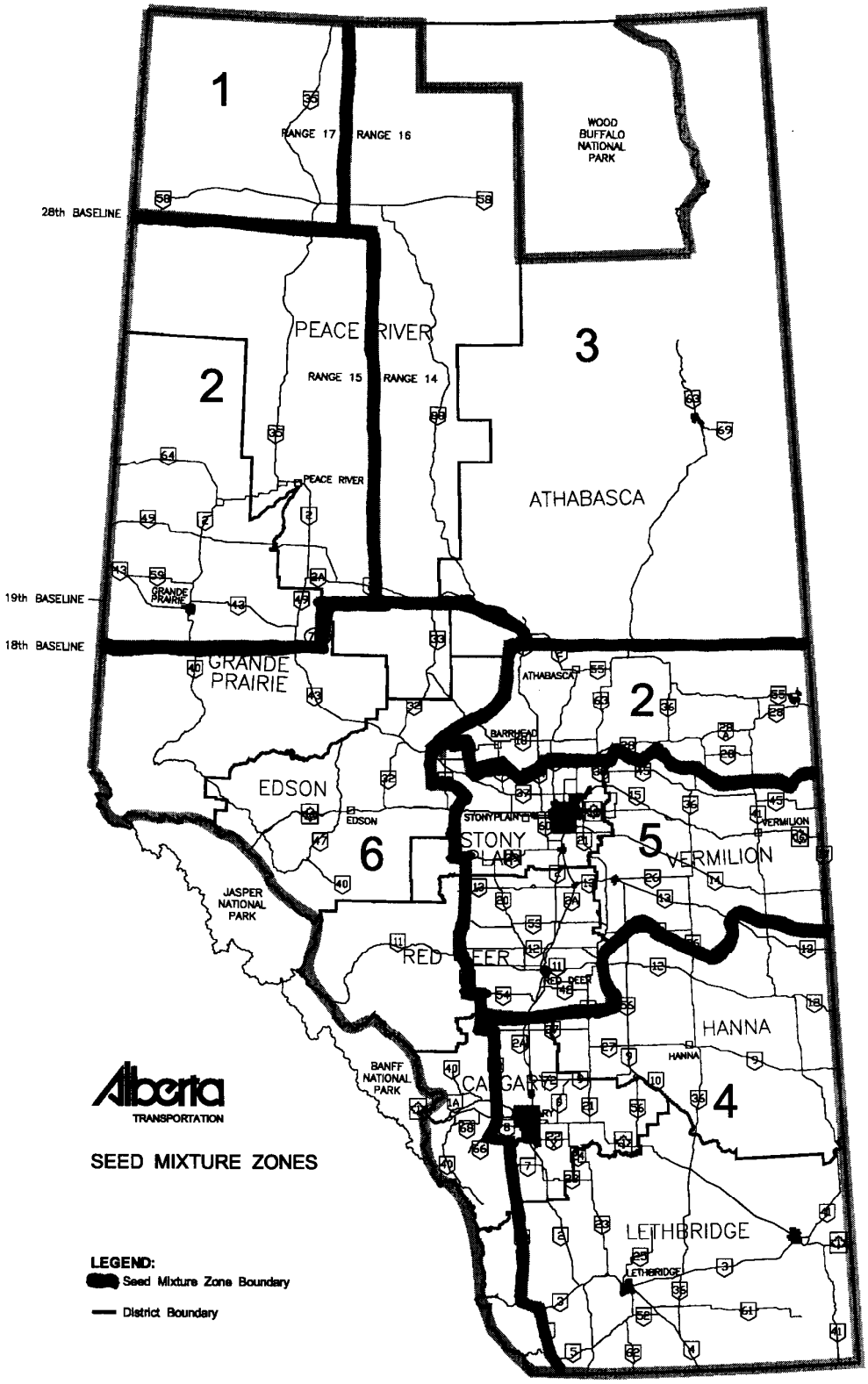
Zone 6 -Lethbridge, Calgary, and Red Deer Districts all located west of Hwy 22):

Seed Mix Zone	**Native Seed Mix - Zone 6**		**% by Dry Weight**
	Common Name	**Latin Name**	
6 Lower Foothills	Slender Wheat Grass	Agropyron trachycaulum	30%
	Smooth Wildrye	Elymus glaucus	20%
	Northern Wheat Grass	Agropyron dasystachyum	10%
	Tickle Grass	Agrostis scabra	10%
	Fringed Brome (1)	Bromus ciliatus	10%
	Tufted Hairgrass	Deschampsia cespitosa	10%
	Foothills Rough Fescue	Festuca campestris	10%

Note (1): Fringed Brome seed shall be coated.

Agronomic Seed Mix - Zone 6		
Common Name	**Latin Name**	**% by Dry Weight**
Pubescent Wheat Grass	Agropyron trichophorum	40%
Dahurian Wildrye	Elymus dahuricus	22%
Sheep Fescue	Festuca ovina	30%
Perennial Ryegrass	Lolium perenne	8%

Seeding Erosion Control	B.M.P. #22



Mulching Sediment Control and Erosion Control	B.M.P. #23

Description and Purpose

- Application of organic material or other normally biodegradable substances as a protection layer to the soil surface (i) to minimize raindrop/runoff erosion and conserve a desirable soil moisture property for plant growth, and/or (ii) to promote seed germination and plant growth
- Mulches conserve soil moisture, reduce runoff velocities and surface erosion, control weeds, help establish plant cover, and protect seeds from predators, raindrop impact, and wind/water erosion

Applications

- Temporary measure
- Can be used as an organic cover or growth medium for seeds where topsoil is not readily available
- Can be used to provide temporary and permanent erosion control
- May be used with or without seeding in areas that are rough graded or final graded
- May be applied in conjunction with seeding to promote plant growth
- May comprise organic mulches (such as straw, wood fibres, peat moss, wood chips, pine needles, compost) or chemical mulches (such as vinyl compounds, asphalt, rubber, or other substances mixed with water)
- Chemical mulches may be used to bind other mulches in a hydroseeding-hydromulching application

Installation

- Prepare soil surface by removing large rocks or other deleterious materials
- Apply topsoil and seed, if required, and if topsoil is readily available
- Apply mulch as per supplier's recommendations
- Certain mulches may require additional anchoring to minimize loss of mulch due to wind or water erosion

Construction Considerations

- Install mulches as per manufacturers' or suppliers' recommendations
- Organic Mulches
  - Straw

- Refers to stalks or stems of small grain (primarily wheat) after drying and threshing
- Straw should be free of weeds
- Loose straw is very susceptible to movement by blowing wind and water runoff and should be anchored either with chemical tackifier or some form of netting
- When properly secured to surface, straw is highly suitable for promoting good grass cover quickly, however, it may be a fire hazard in dry conditions

– Raw Wood Fibre

- Mixture of cellulose fibres; a minimum of 4 mm in length extracted from wood
- Wood fibres usually require a soil binder and should not be used as erosion control during periods of hot dry weather in the summer or for late fall seeding unless it is used in conjunction with another suitable mulch as it is prone to removal by blowing wind or water runoff
- Wood fibre is primarily used in hydroseeding-hydromulching operations where it is applied as part of a slurry and when used in conjunction with a tackifier; it is well suited for tacking straw mulch on steep slopes

– Peat Moss

- Comprises partly decomposed mosses and organic matter under conditions of excessive moisture
- Usually available in dried and compressed bundles
- Should be free of coarse material
- Useful soil conditioner to improve organic content of soil promoting plant growth
- Highly susceptible to removal by blowing wind and water runoff if dry and spread on top of soil

– Wood Chips

- By-products of timber processing comprised of small, thin pieces of wood
- Decompose slowly
- Suitable for placing around individual plants (shrubs and trees) and for areas that will not be closely mowed
- Highly resistant to removal by blowing wind and water runoff

– Bark Chips (Shredded Bark)

- By-products of timber processing comprised of small, thin pieces of tree bark

- Suitable for areas that will not be closely mowed
- Have good moisture retention properties and are resistant to removal by blowing wind and water runoff

– Pine Needles

- Comprise needles from coniferous trees (pine, spruce)
- Needles should be air dried and free of coarse material
- Decompose slowly
- Suitable for use with plants that require acidic soils
- Resistant to removal by blowing wind and water runoff

– Compost (Straw Manure)

- Comprised of organic residues and straw that have undergone biological decomposition until stable
- Should be well shredded, free from coarse material, and not wet
- Has good moisture retention properties and is suitable as a soil conditioner promoting plant growth
- Relatively resistant to removal by blowing wind and water runoff if not dried out completely

– Chemical Mulches

- Comprised of acrylic co-polymers, vinyl compounds, asphalt, rubber, or other substances mixed with water
- Usually used in hydroseeding-hydromulching applications
- Should be applied in accordance with suppliers' recommendations

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Areas damaged by washout or rilling should be regraded if necessary and recovered with mulch immediately
- Additional stormwater control measures should be considered for areas of severe rilling erosion damaged by runoff
- Small bare spots may need to be reseeding and recovered with mulch

Topsoiling Erosion Control	B.M.P. #25

Description and Purpose

- The covering of exposed mineral soils with soils of high organic content to minimize raindrop erosion potential
- Provides a medium for vegetation to grow

Applications

- Temporary or permanent measure
- May be used to provide a bedding medium for seed germination and a cover to exposed soil that is not suitable to promote vegetation growth
- May be used on slopes with a maximum gradient of 2H:1V
- Normally topsoil is placed prior to seeding, mulching, hydroseeding-hydromulching, seeding and installing rolled erosion control products (RECP), or planting of trees/shrubs

Construction

- Prepare ground surface to final grade by removing large rocks or other deleterious materials
- Apply topsoil with dozer or light track equipment to design thickness
- Track walk upslope or downslope (do not overcompact topsoil by heavy equipment; only track walk one pass) to provide a contour of roughness of topsoil to further minimize erosion

Construction Considerations

- Topsoil should be free of weeds which may inhibit re-vegetation of desirable plants (i.e., grass)
- Subgrade should be roughened by track walking up/down the slope prior to topsoiling to promote adhering of topsoil to subgrade (surface roughening of subgrade is especially required if topsoiling is not scheduled immediately after completion of the grade)
- Topsoil should be moistened regularly during periods of hot dry weather to minimize wind erosion
  - Hydroseeding-hydromulching topsoil will minimize wind erosion of topsoil

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans

- Areas damaged by washout or rilling should be regraded and re-topsoiled immediately

Sodding Erosion Control	B.M.P. #26

Description and Purpose

- Use of grass sod to cover and stabilize disturbed areas of bare soil
- Rapidly establishes vegetative cover in environmentally sensitive areas where complete cover of the disturbed soil surface is essential and conventional or hydroseeding and mulching may not be effective to erosion protection for high risk areas
- Acts as a vegetative buffer
- Sod may be nursery or field sod composed of one or more species/cultivars of grasses and may contain associated plants such as legumes

Applications

- Temporary or permanent measure
- Irrigation (watering) required after placement
- May be used to protect soil surface from water and wind erosion where adequate topsoil and fertilizer can be provided
- Best used for areas that have steep grades or require immediate protection, or at locations where aesthetic appearance is a priority

Construction

- Prepare smooth ground surface by removing large rocks or other deleterious materials
- Apply design thickness of topsoil and fertilizer (if required)
- Lay sod strips on prepared surface with long axis perpendicular to direction of slope (or in channels, perpendicular to anticipated direction of flow)
  - Butt-joint ends of adjacent sod strips tightly together
  - Roll or tamp each sod strip to ensure continuous contact between topsoil and underside of sod strip
  - Secure each strip of sod with an anchor embedded a minimum of 0.15 m into underlying soil
  - Anchors should be spaced a maximum distance of 0.6 m apart
- Adjacent rows of sod strips should have staggered joints

Construction Considerations

- Sod must not be placed on frozen ground
- During hot and dry periods, topsoil should be cool and wetted by irrigation prior to placing sod strips
- Freshly installed sod should be irrigated (watered) to moisten the topsoil to minimum depth of 0.1 m
  - Irrigation aids in the development of root matrix within the topsoil
- Successful installation requires the use of freshly cut, healthy sod
  - Storage time of cut sod on-site prior to installation should be kept to as short a time period as possible

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
  - Areas damaged by washout or rilling should be regraded and resodded immediately
- Additional erosion control measures should be considered for rilled or gullied areas
- Small bare spots may need to be resodded
- Sodded areas should be maintained by periodically fertilizing, irrigating (watering), mowing, and weed control, depending on location and maintenance plan
- Sod that is to be mowed periodically as part of its maintenance plan should not be mowed within one month of installation
- Grass clipping from mowing operations should be left on the sod unless they accumulate to a depth greater than 1 cm

Live Staking Streambank Stabilization Technique	B.M.P. #27a

Description and Purpose

- Consists of installing woody plantings (trees and shrubs) to develop a root matrix within the soil, increasing subsurface soil strength and stabilizing slopes with deeper root systems than grasses
- Reduces erosion potential of slopes and channel banks

Applications

- Temporary or permanent measure
- May be used on slopes stable enough to support vegetation; however, there is a low success rate for steep slopes and channel banks with gradients greater than 1H:1V
- May be used on slopes and channel banks with adequate sunlight, moisture, and wind protection to support vegetation
- May be used as bio-engineering stabilization in cases where there have been historical shallow slope instability, soil movements on eroded slopes and gullies
- May be used along channels to provide higher channel roughness to reduce flow velocity and in sedimentation ponds to provide higher sedimentation duration of runoff impoundment

Construction

- Used on cut or fill slopes or in ditches/channels
- Comprised of willow or poplar stakes inserted into the ground; other indigenous plants may be acceptable
- Individual dormant willow or poplar stakes should be cut to a minimum length of 0.5 m using pruning shears
  - Cuts should be made at a 45° angle a minimum of 0.05 m (5 cm) below a leaf bud
  - All side shutes should be trimmed to within 0.05 m of the main stem
- Install live stakes in a 1 m by 1 m grid
- Make a pilot hole a minimum of 0.3 m in depth to insert live stake into
  - Use iron bar, broom handle or other tool to make pilot hole
- Insert live stake into pilot hole and lightly tamp soil around live stake
- A minimum of two leaf buds should remain above grade

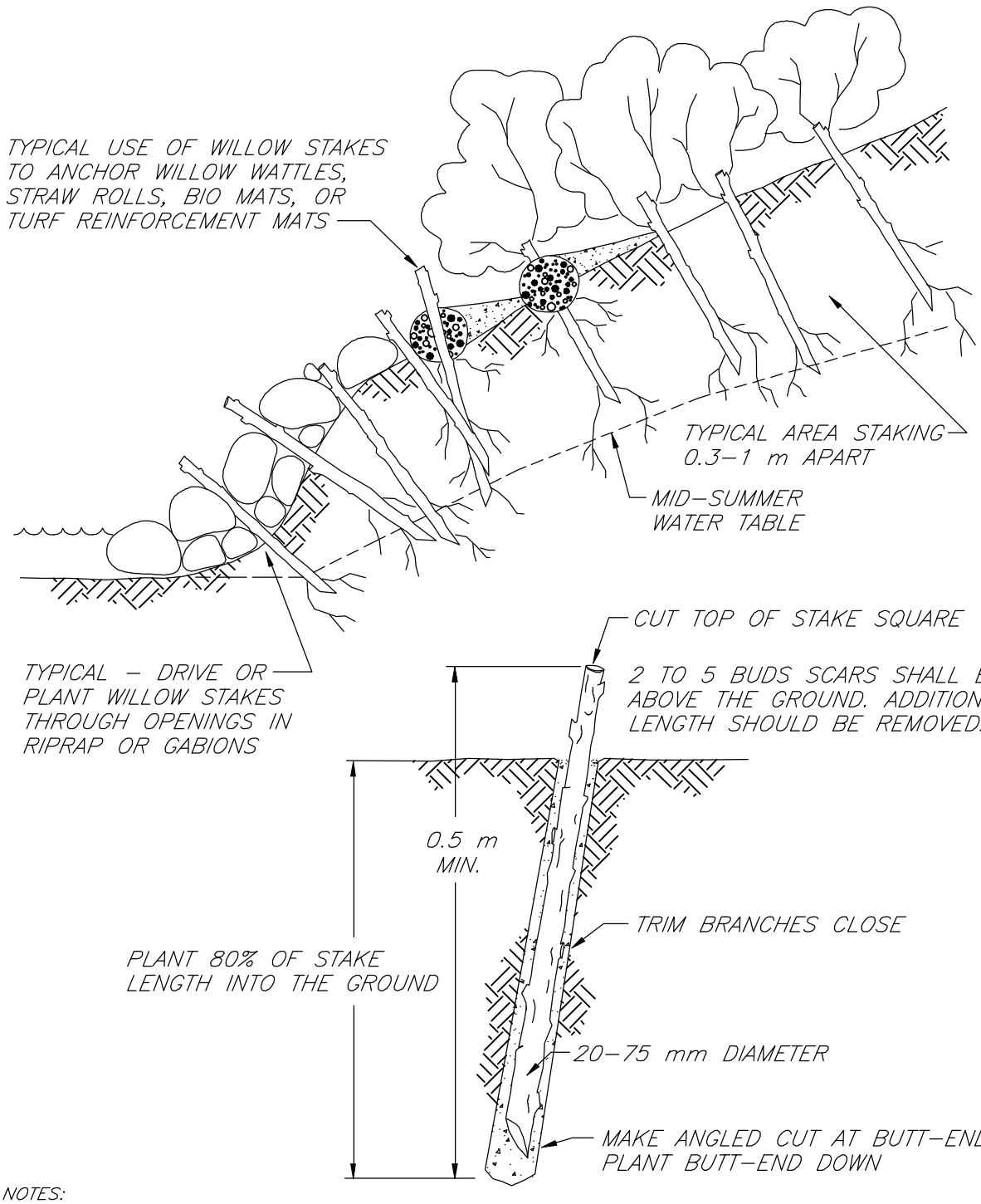
Live Staking Streambank Stabilization Technique	B.M.P. #27a

Construction Considerations

- Successful installation requires the use of freshly cut branches or stakes
  - Storage time of cut branches/stakes on-site prior to installation should be kept to as short a time period as possible
- Successful growth dependant on soil moisture and rainfall conditions
- Consultation with agrologist, greenhouse growers, local expertise can be beneficial in selecting and procuring appropriate species for planting

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
  - Areas damaged by washout or erosion rilling should be replanted immediately
- Additional stormwater control measures should be considered for severe rilling areas damaged by runoff
- Watering plants is required for first one to two months after planting



NOTES:
1. HARVEST AND PLANT STAKES DURING THE DORMANT SEASON.
2. USE HEALTHY, STRAIGHT AND LIVE WOOD AT LEAST 1 YEAR OLD.
3. MAKE CLEAN CUTS AND DO NOT DAMAGE STAKES OR SPLIT ENDS DURING INSTALLATION, USE A PILOT BAR IN FIRM SOILS.
4. SOAK CUTTINGS FOR 24 HOURS (MIN.) PRIOR TO INSTALLATION.
5. TAMP THE SOIL AROUND THE STAKE.
6. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

NOT TO SCALE

LIVE STAKING

FILE: LIVESTK

Description and Purpose

- Consists of installing woody plantings (trees and shrubs) to develop a root matrix within the soil, increasing subsurface soil strength and stabilizing slopes with deeper root systems than grasses
- Reduces erosion potential of slopes

Applications

- Temporary or permanent measure
- May be used on slopes stable enough to support vegetation; however, there is a low success rate for steep slopes with gradients greater than 1H:2V
- May be used on slopes with adequate sunlight, moisture, and wind protection to support vegetation
- May be used as bio-engineering stabilization in cases of historical shallow slope instability soil movements on eroded slopes and gullies
- May be used to reduce flow velocity and in sedimentation ponds to provide higher sedimentation duration of runoff impoundment
- Particularly appropriate for highway embankments that encroach upon riparian areas or floodways
- Slopes that need additional geotechnical and erosion reinforcement are good candidates for brushlayering
- Steeper slopes require the use of inert reinforcements such as geotextiles (ECBs, TRMs, coir netting), wire (twisted or welded gabion wire) or geogrids
- If either steady, long term seepage or temporary bank return flows after flood events are a problem, the brushlayers act as a horizontal drainage layer or conduits that relieve internal pore water pressure

Construction

- First construct any lower bank or in-stream stabilizing measures such as a rock or log toe structure
- Excavate the first horizontal bench, sloping back into the hillslope at about 10%
- Install any drainage required along the back of each bench
- Place branches that are at least 1.8 m long on the bench
- Branches should crisscross at random with regard to size and age
- Place 20 branches per linear m on the bench, with the butts of the branches along the inside edge of the bench
- 20-45 cm of the growing tip should protrude beyond the face of the slope
- Cover and compact (add water if necessary) the brushlayer with 15 cm lifts of soil to reach the designed vertical spacing, typically 0.5 m to 1.2 m apart

- Slope the top of each fill bench back into the hill
- Construct another brushlayer
- When placed, the protruding tips of the cuttings are above the butts due to the back slope of the bench
- Proceed up the bank as desired
- The erosion and failure potential of the slope (i.e., drainage, soil type, rainfall, and length and steepness of the slope) determine spacing between the brushlayers
- On long slopes, brushlayer spacing should be closer at the bottom and spacing may increase near the top of the slope

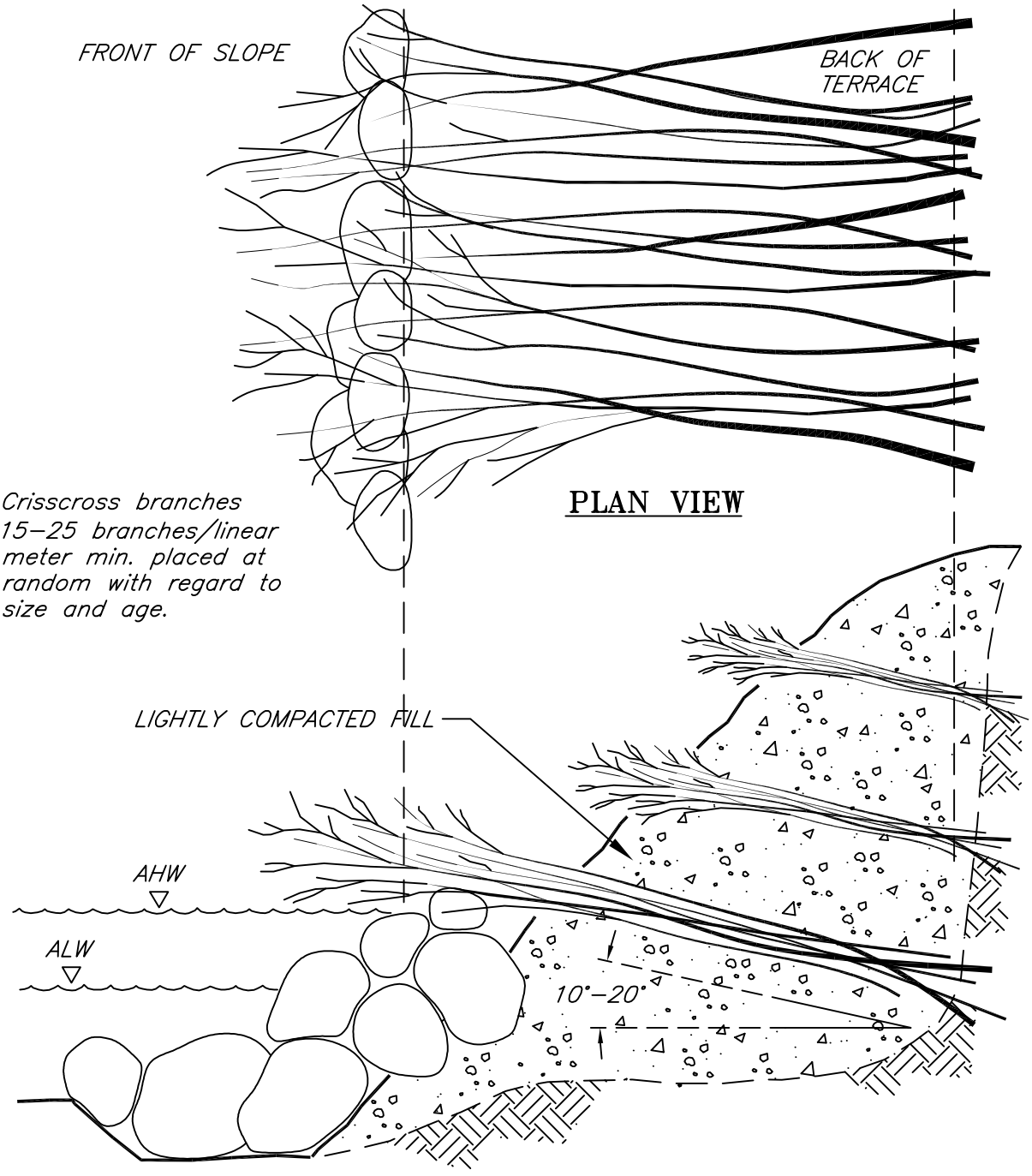
Construction Considerations

- Successful installation requires the use of freshly cut branches or stakes
  - Storage time of cut branches/stakes on-site prior to installation should be kept to as short a time period as possible
- Successful growth dependant on soil moisture and rainfall conditions
- Consultation with agrologist, greenhouse growers, local expertise can be beneficial in selecting and procuring appropriate species for planting
- Installed during soil fill operations which result in the branches being inserted deeply into the slopes and thereby increasing the likelihood that the branches will encounter optimum soil and moisture conditions
- Live cuttings are most effective when implemented during the dormancy period of chosen plant species
- Live willow branches (or cuttings of other adventitiously-rooting species) at least 1.8 m long, with a minimum diameter of 20 mm
- Heavy equipment is usually employed for the construction of embankments
- A bucket loader and/or backhoe or excavator can facilitate the work
- Water should be available for achieving optimum soil moisture

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Inspect planted areas at least twice per year or after significant storm events (1:2 year storm and/or 40 mm rainfall in 24 hours)
  - Areas damaged by washout or erosion rilling should be replanted immediately
- Additional stormwater control measures should be considered for severe rilling areas damaged by runoff
- Watering plants is required for first one to two months after planting
- The live cuttings or branches should establish successfully without irrigation requirements given the proximity to water

- Inspect the cuttings for adequate vegetative establishment (as evidenced by root and shoot production from the imbedded stems) and for signs of localized erosion such as rilling from runoff or sloughing from stream scour
- Brushlayer treated streambanks should also be inspected for localized slope movements or slumps
- These localized slope failures and/or areas of poor vegetative establishment can often be repaired by re-installing the brushlayers in these zones
- The site should be examined for possible signs of flanking erosion, which must be addressed with ancillary protective measures lest the flanking threatens the integrity and effectiveness of the protective brushlayer fill
- As with all resistive streambank structures, flanking is always a potential problem
- If frozen soil is employed in constructing the soil lifts between brushlayers, some settlement may occur when the soil thaws. This settlement may falsely signal a slope failure
- The most likely causes of failure are the following:
  - Inadequate reinforcement from the brushlayer inclusions, i.e., too large a vertical spacing or lift thickness for the given soil and site conditions, slope height, slope angle, and soil shear strength properties
  - Inadequate tensile resistance in the brushlayers as result of too small an average stem diameter and/or too few stems per unit width
  - Failure to properly consider seepage conditions and install adequate drainage measures, e.g., chimney drain, behind brushlayer fill, and conversely inadequate moisture applied during installation, and inadequate attention to construction procedures and details



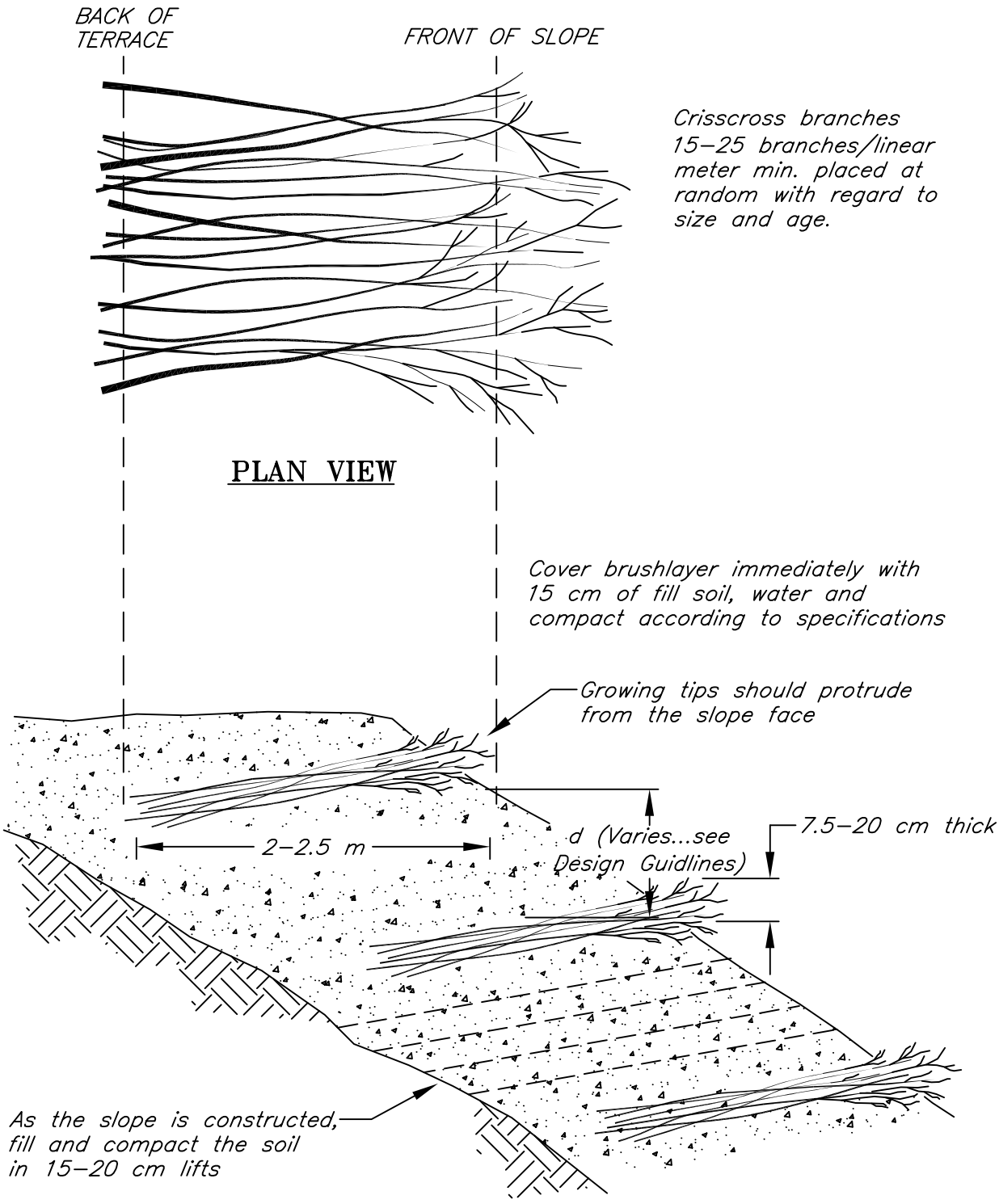
NOTES:
1. Tilt branches down into the slope 10°–20° min.
2. Brushlayering may be constructed with non–compacted or compacted backfill without damage to the brush layer.
3. Branches irrespective of length, should protrude 20–45 cm beyond the face of the slope.

BRUSHLAYERING WITH ROCK TOE PROTECTION

FILE: BRLAY–RT

Government of Alberta ■ Transportation

B.M.P. #27b1
Typical Section

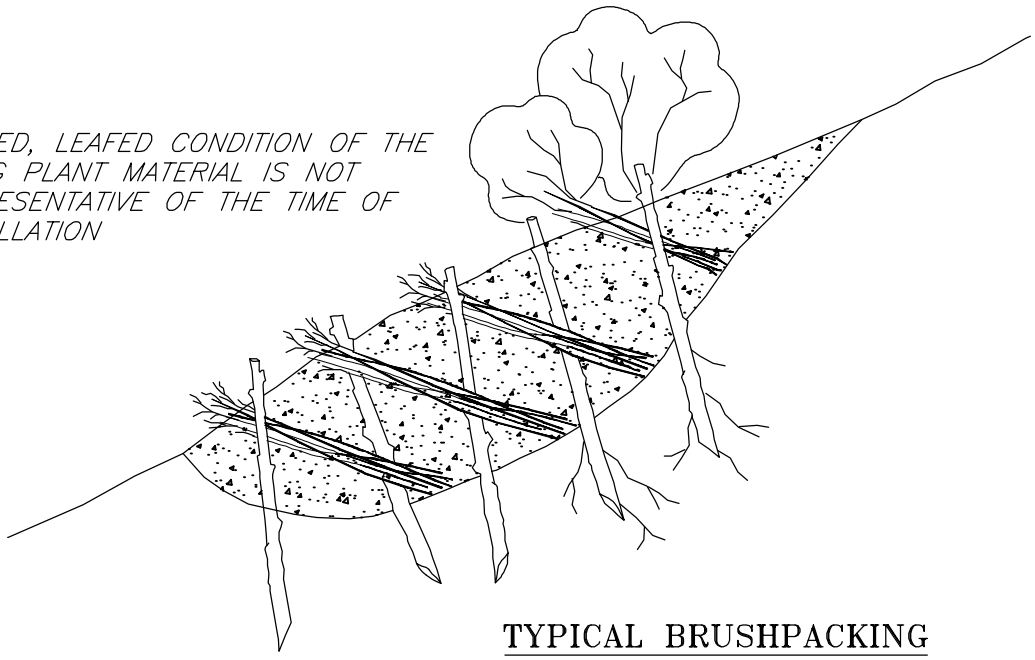


TYPICAL BRUSHLAYERING WITH SLOPE CONSTRUCTION

BRUSHLAYERING

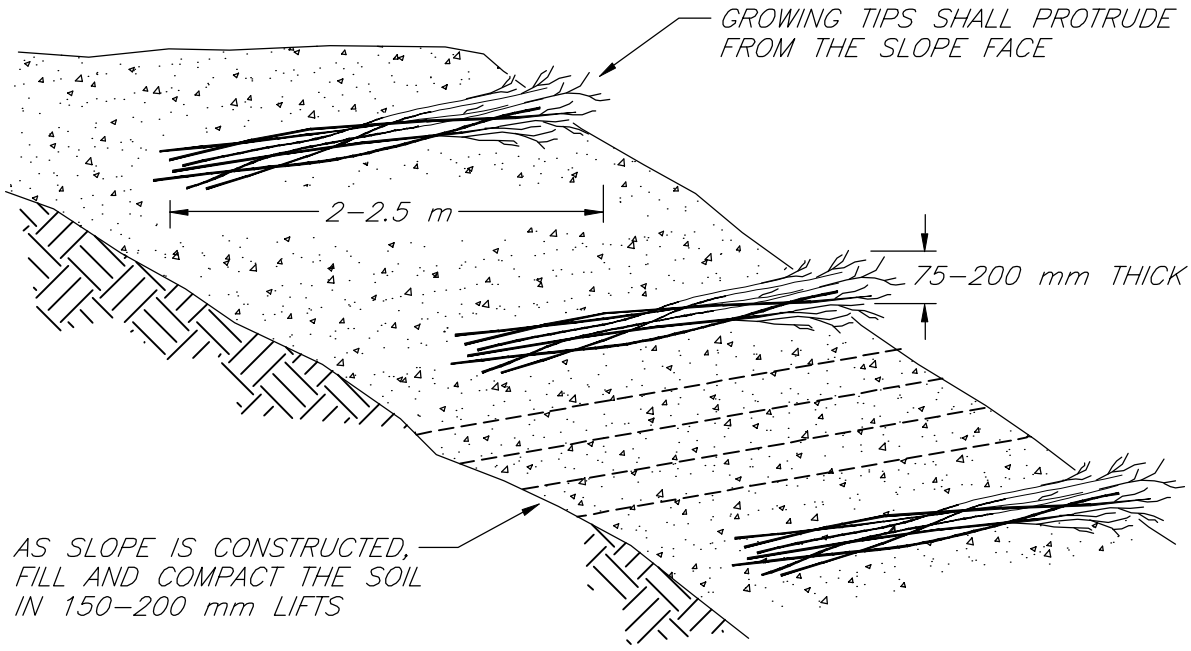
FILE: BRSHLAYR

NOTE:
ROOTED, LEAFED CONDITION OF THE LIVING PLANT MATERIAL IS NOT REPRESENTATIVE OF THE TIME OF INSTALLATION



TYPICAL BRUSHPACKING

COVER BRUSHLAYER IMMEDIATELY WITH 150 mm OF FILL SOIL, WATER AND COMPACT ACCORDING TO SPECIFICATIONS



TYPICAL BRUSHLAYERING WITH SLOPE CONSTRUCTION

NOTE:

1. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

BRUSHLAYERING

FILE: BRSHLAYR

Government of Alberta ■ Transportation

B.M.P. #27b3
Typical Section

Riparian Zone Preservation Sediment Control and Erosion Control	B.M.P. #30

Description and Purpose

- Protection of existing plants and trees adjacent to all natural water bodies (riparian zones) adjacent to construction areas
- Existing vegetation acts as an effective vegetative buffer strip as a form of erosion and sediment control measure

Applications

- Permanent measure
- Existing established vegetation acts as an effective sediment control and erosion control buffer strip barrier to slow down flows and allow sedimentation filtration to occur
- May be used along property boundaries to minimize sediment transport off construction site despite non-presence of watercourse adjacent

Construction

- It is highly important to preserve an established vegetative buffer as freshly planted vegetation generally require substantial growth periods before they are as effective as established riparian zones
- Wherever possible, retain as much existing vegetation as possible between construction areas and sensitive zones (wetlands, marshes, streams, floodplains, etc.) to entrap sediment and to minimize sediment transport off of the construction site into the sensitive zones
- Define and delineate riparian zones to be preserved in Environmental Construction Operations Plan (ECO Plan) prior to commencement of construction
- Clearly mark riparian zones to be preserved in the field (with construction fencing, survey flagging, or other highly visible measure) so all personnel involved with construction operations can identify areas to be preserved

Construction Considerations

- Riparian zones must be fenced off immediately to minimize trespassing and to ensure effectiveness of riparian zone is maintained
- Do not allow equipment to enter areas not necessary to construction
- Based on site-specific situations established buffer zones of adequate width

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans

Riparian Zone Preservation Sediment Control and Erosion Control	B.M.P. #30

- Maintain fences protecting riparian zones from trespassing

Scheduling

Sediment Control and Erosion Control

B.M.P. #32

Description and Purpose

- Scheduling the sequence and timing arrangement of construction activities (1) to efficiently maximize the amount of erosion protection installed (such as topsoiling and seeding) as soon as a portion of grade construction is completed, and (2) to limit the portion of land disturbance (construction) compatible with the efficient rate of construction of erosion control measures achievable
- Incorporating erosion and sedimentation control concerns during the scheduling phase will minimize the amount and duration of bare soil exposure to erosion elements and ensure erosion and sedimentation control measures are implemented at an appropriate time
- Scheduling may be designed during planning stages by the contractor and altered during construction to suit actual conditions encountered

Applications

- Temporary measure

Implementation

- Incorporate a schedule with erosion protection perspective to form part of the overall construction plan
- Determine sequencing and timetable for the start and end of each item, such as clearing, grubbing, stripping, etc.
- Incorporate installation of appropriate erosion and/or sediment control measures in construction schedule
- Allow sufficient time before rainfall begins to install erosion and/or sediment control measures
- Whenever possible, schedule work to minimize extent of site disturbance at any one time
- Incorporate staged topsoiling and revegetation of graded slopes as work progresses
  - Don’t leave all topsoiling and revegetation until the very end of the project

Inspection and Maintenance

- Routinely verify that construction activities and the installation of erosion and sediment control measures is progressing in accordance with schedule
  - If progress deviates from schedule, take corrective action

- When changes to the project schedule are unavoidable, alter the schedule as soon as practicable to maintain control of erosion

Stabilized Worksite Entrances Sediment Control and Erosion Control	B.M.P. #33

Description and Purpose

- Comprised of a gravel pad located at site access points (entrances) that are used to reduce the amount of sediment carried off construction sites by vehicles
- Collect sediment from vehicle washing and retains sediment on construction site
- Should include water supply to wash off excess soil from vehicles prior to exiting the constructions site

Applications

- Temporary measure
- For use anywhere vehicles enter or exit a construction site

Implementation

- Install gravel pad at planned entrances to worksite
  - Gravel pad (minimum of 15 m in length) should be of sufficient length to accommodate longest anticipated vehicle entering or exiting the site
  - Width of pad should be sufficient to accommodate the widest anticipated vehicle entering or exiting the site (minimum of 3.6 m in width)
  - Thickness of gravel pad should be a minimum of 0.30 m thick (0.3 m thickness is preferred for highway projects) and should comprise 50 to 150 mm diameter coarse aggregate placed on top of woven geotextile filter fabric
- Install temporary sediment control measures (such as straw bale barriers or silt fences) to collect washed off sediment from gravel pad

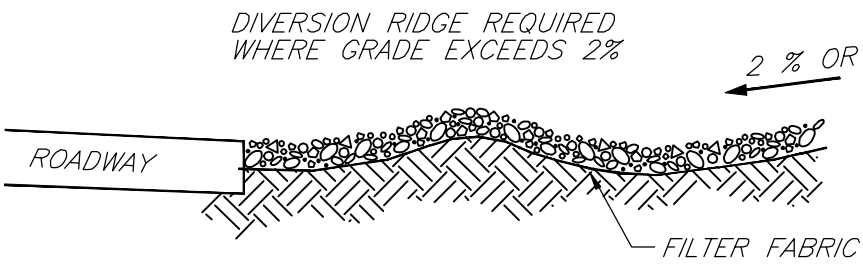
Construction Considerations

- Should be constructed at all access points to construction sites
  - If impractical to construct at all access points, limit vehicle access traffic to stabilized worksite entrances only
- Entrances located with steep grades or at curves on public roads should be avoided
- Woven geotextile filter fabric should be used as underlay below gravel pad as strength requirement
- Install an elevated ridge adjacent to roadway if gradient of the gravel pad is steeper than 2%, sloped towards the roadway

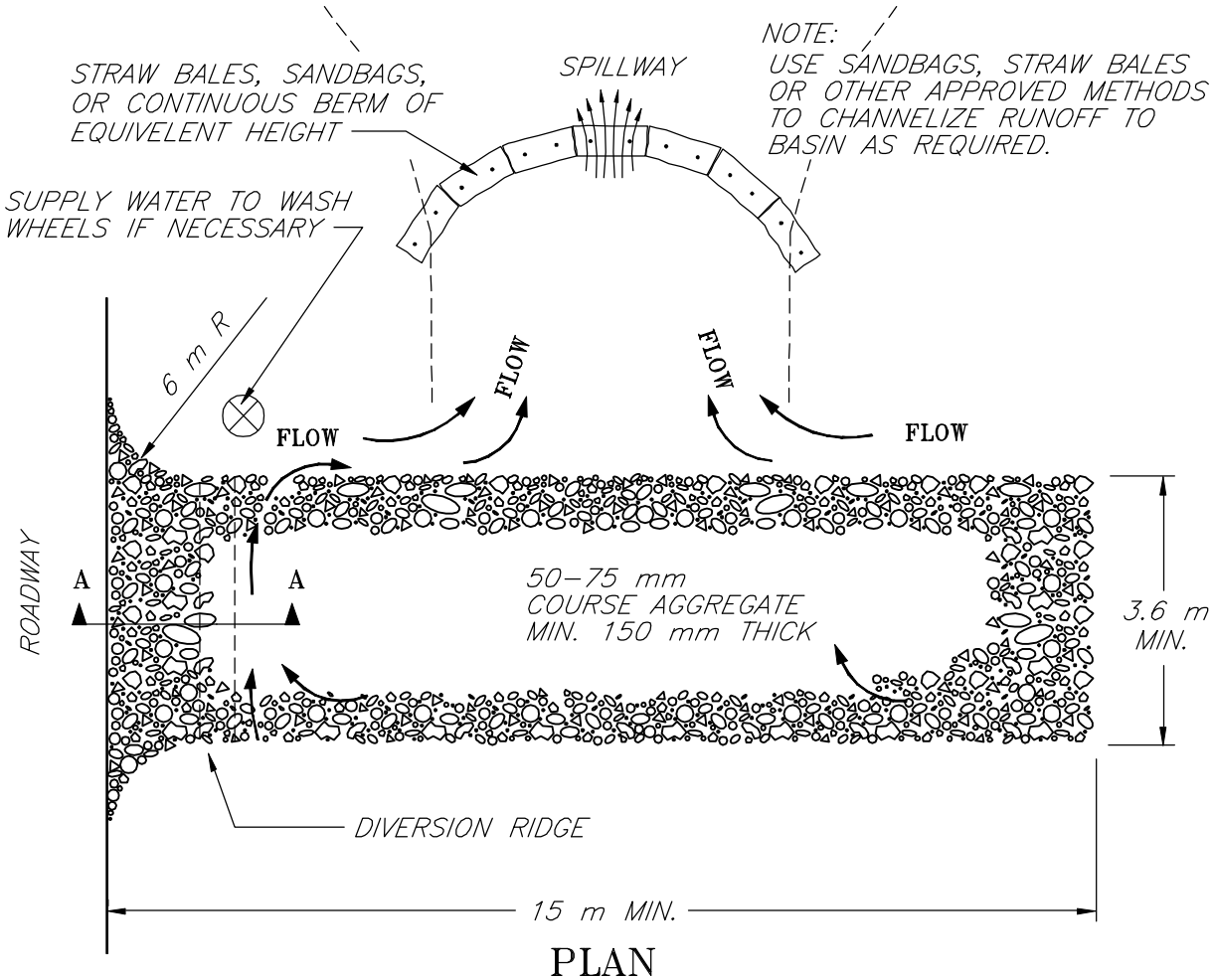
Inspection and Maintenance

Stabilized Worksite Entrances Sediment Control and Erosion Control	B.M.P. #33

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Granular material should be regraded when required
  - Material may need to be added to fill large voids to maintain a minimum pad thickness of 0.30 m
- Inspect and clean out downstream sediment control measures at least once per week and after periods of significant rainfall
- Material accidentally deposited onto public roads should be cleaned as soon as possible



SECTION A – A



PLAN

NOTES:

1. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHT–OF–WAYS. THIS MAY REQUIRE TOP DRESSING, REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.
2. WHEN NECESSARY, WHEELS SHALL BE CLEANED PRIOR TO ENTRANCE ONTO PUBLIC RIGHT–OF–WAY.
3. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABLIZED WITH CRUSHED STONE THAT DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN.
4. FOR HIGHWAY CONSTRUCTION, 300mm THICKNESS OF GRAVEL IS PREFERRED.
5. THIS FIGURE IS PROVIDED FOR GUIDANCE ONLY AND DOES NOT CONSTITUTE A DESIGN. A SITE SPECIFIC DESIGN IS REQUIRED FROM DESIGNER/ENGINEER.

TEMPORARY GRAVEL CONSTRUCTION ENTRANCE/EXIT

FILE: ENTRANCE

Slope Texturing (a-c) Sediment Control	B.M.P. #34 (a - c)

Description and Purpose

- Texturing of slopes, either by roughening the surface, tracking the surface, or installing grooves or benches
- Texturing reduces the runoff velocity, traps sediment, and increases the infiltration of water into the soil

a) Surfacing Roughening

b) Grooved or Serrated Slope

c) Benched Slope

Applications

- Temporary measure
- May be used to roughen the exposed soils on the slope surface in the direction of water flow to minimize erosion and to entrap some sediments
- May be used on fresh cut or fill slopes (8 m length or longer; practical travel reach of a dozer) with gradients of generally 3H:1V or steeper (2H:1V as general steepness limit) constructed in cohesive soils
- May be used on slope subgrade that will not be immediately topsoiled, vegetated or otherwise stabilized
- May be applied to topsoiled slope to provide track serration to further reduce erosion potential
- May be used in graded areas with smooth and hard surfaces
- As part of slope design, benching may be used to effect a reduction of erosion hazard where a long slope length needs to be shortened into smaller sectional lengths with mid-benches; normally a 3 m wide bench can be appropriate
  - Benching is usually a permanent slope design feature and should only be designed by a qualified geotechnical engineer
  - Benching of a long slope section to divide into short sections can reduce erosion hazard in the range of 30 to 50% (e.g., sediment yield for 15 m high 3H:1V slope with mid-bench)

Construction

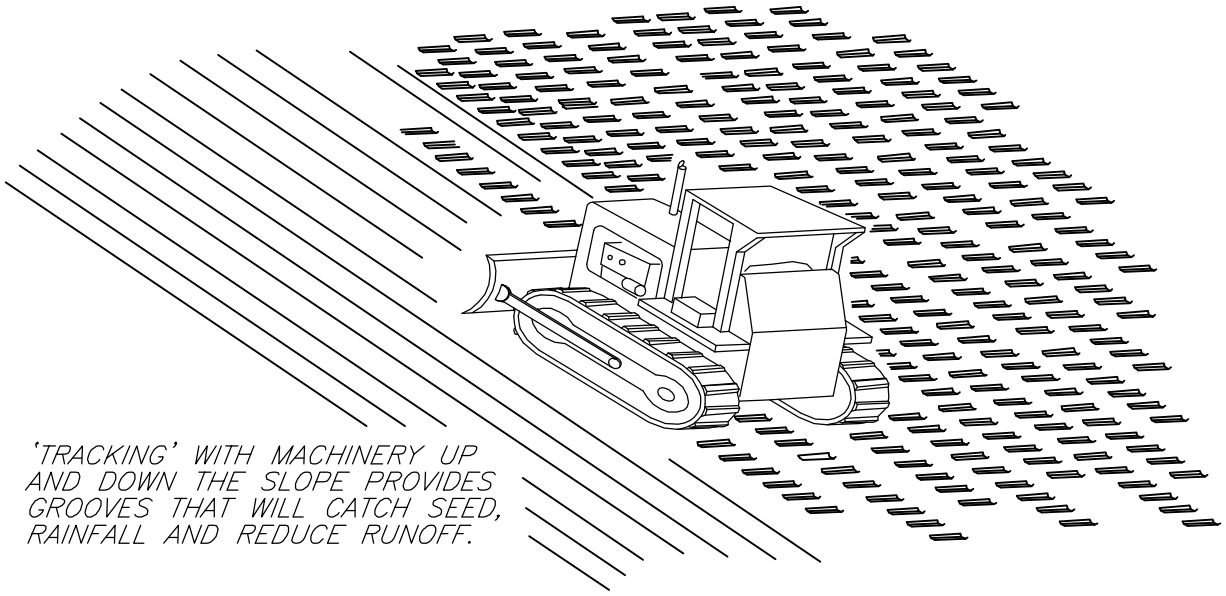
- Surface Roughening
  - Leave soil in rough grade condition, do not smooth grade soil

  - Large lumps of soil will aid in decreasing runoff velocities, trap sediment, and increase infiltration of water

- Surface Tracking
  - Using tracked construction equipment to move up and down the slope, leaving depressions perpendicular to the slope direction; limit passes to prevent overcompaction of the surface
  - Depressions in the soil will aid in decreasing runoff velocities, trap sediment, and increase infiltration of water
- Grooving
  - Excavating shallow furrows across the width of the slope, perpendicular to the direction of the slope
  - If used, contour grooves should be approximately 0.1 to 0.2 m in depth
- Grooves can be made by using equipment or hand
- Benching
  - Construction of narrow, flatter sections of soil on the slope, perpendicular to the direction of the slope
  - Benches should be designed by qualified geotechnical engineer

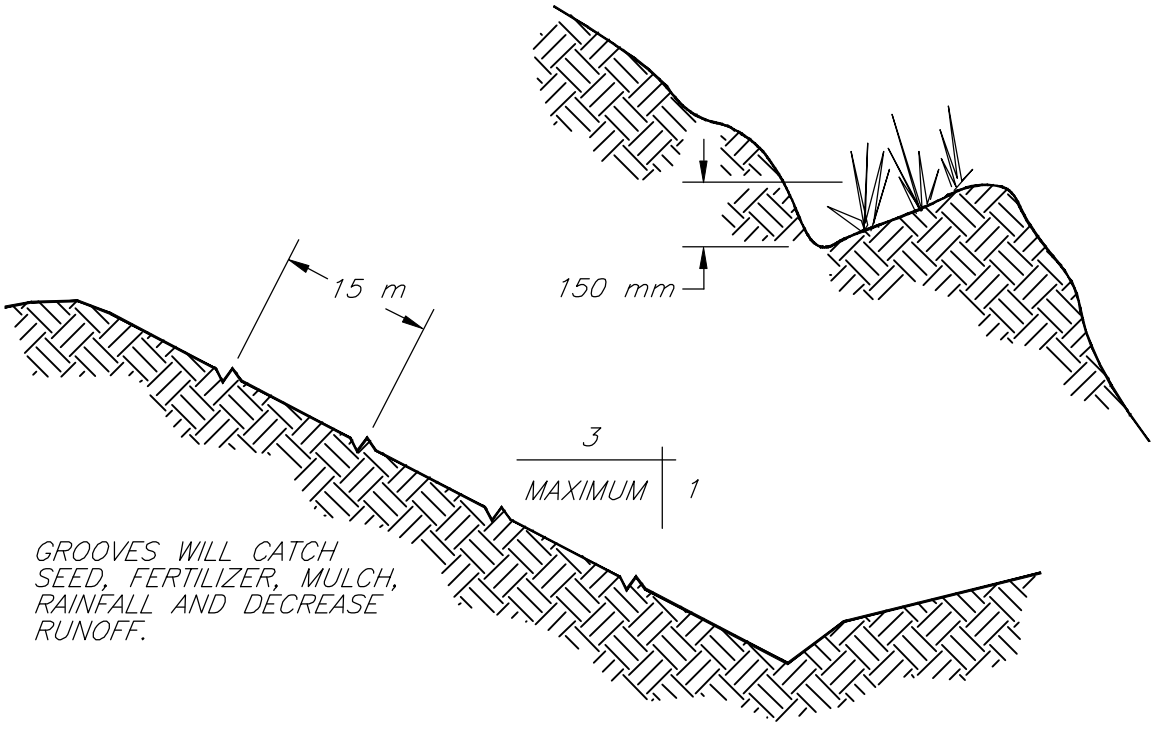
Construction Considerations

- During tracking operations, care must be taken to minimize disturbance to the soil where the equipment turns or changes direction
- Minimize the number of tracking passes to 1 or 2 times to avoid overcompaction, which can negatively impact the vegetation growth
- It is practical to track roughen a slope length of greater than 8 m for practical up/down slope operation of a small bulldozer. It is important to minimize the loosening of soil caused by turning movement of the bulldozer at the end of each pass. As the erosion potential is lower for slope of low vertical height (<3 m height and 3H:1V slope), the tracking of low height slope is not required and not practical for bulldozer tracking operation.



'TRACKING' WITH MACHINERY UP AND DOWN THE SLOPE PROVIDES GROOVES THAT WILL CATCH SEED, RAINFALL AND REDUCE RUNOFF.

TRACKING



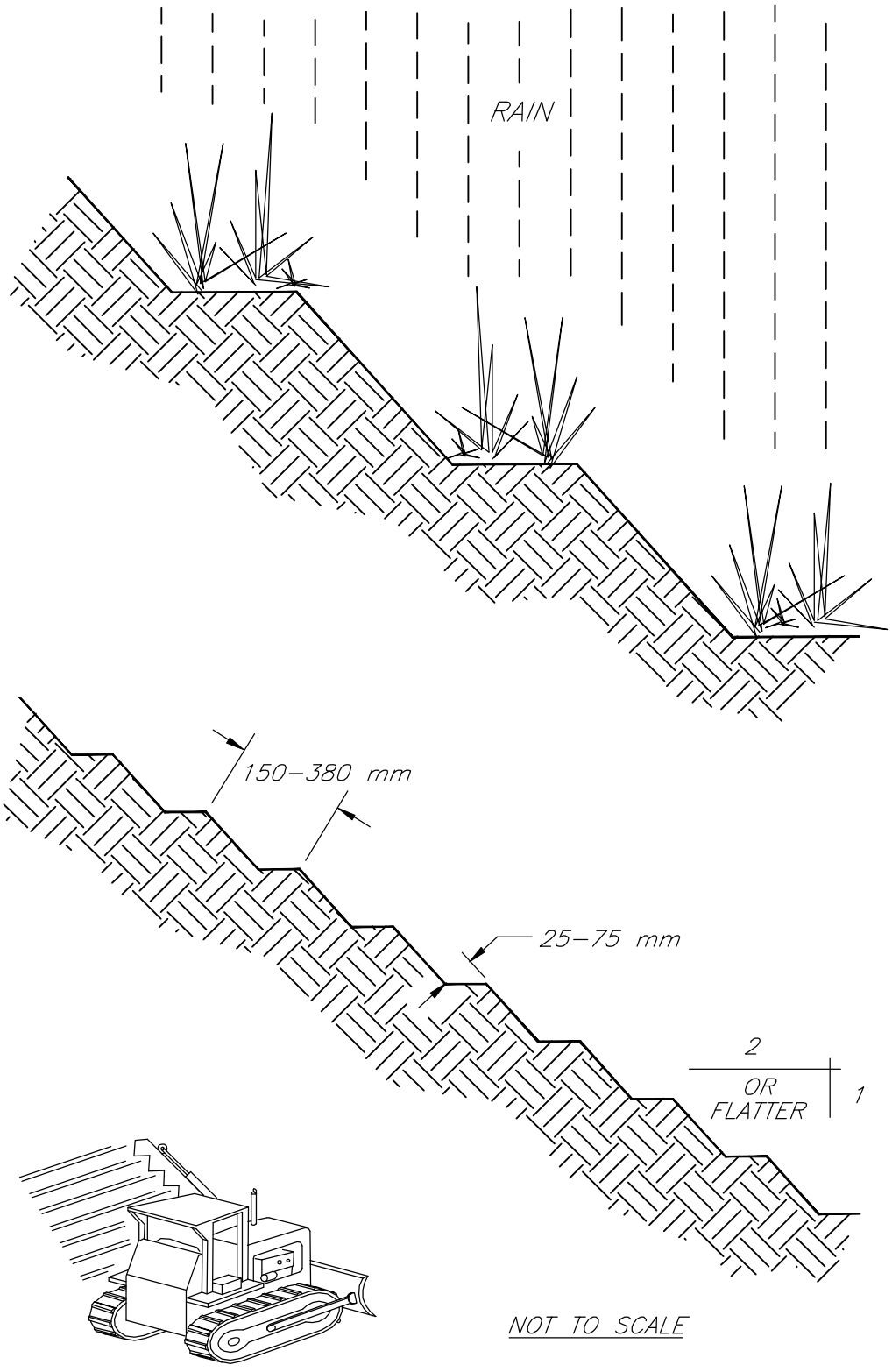
CONTOUR FURROWS

SURFACE ROUGHENING

FILE: SRFROUGH

Government of Alberta ■ Transportation

B.M.P. #34a
Typical Section



NOT TO SCALE

NOTE:

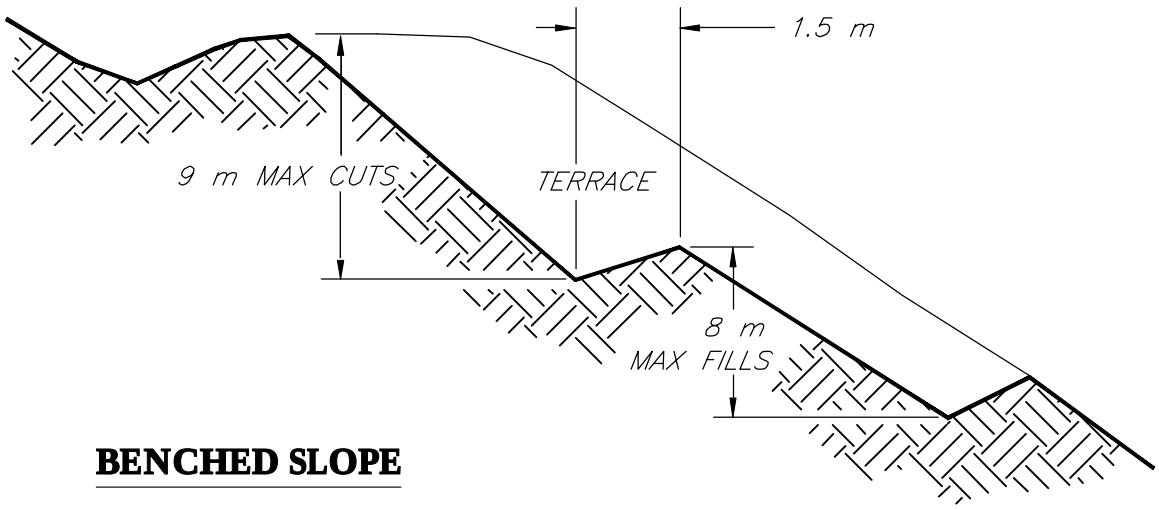
GROOVE BY CUTTING SERRATIONS ALONG THE CONTOUR. IRREGULARITIES IN THE SOIL SURFACE CATCH RAINWATER, SEED, MULCH AND FERTILIZER.

GROOVED OR SERRATED SLOPE

FILE: SERSLOPE

Government of Alberta ■ Transportation

B.M.P. #34b
Typical Section



BENCHED SLOPE

NOT TO SCALE

BENCHED SLOPE

FILE: STPSLOPE

Government of Alberta ■ Transportation

B.M.P. #34c
Typical Section

Compost Blanket Erosion Control	B.M.P. #37

Description and Purpose

- Compost is the product resulting from the controlled biological decomposition of organic material, occurring under aerobic conditions
- Compost has been sanitized through the generation of heat and stabilized to the point that it is appropriate for its particular application
- Active composting is typically characterized by a high temperature phase that sanitizes the product and allows a high rate of decomposition
- It is followed by a lower temperature phase that allows the product to stabilize while still decomposing at a slower rate
- Compost should possess no objectionable odours or substances toxic to plants
- Compost contains plant nutrients but is typically not characterized as a fertilizer
- May derive from agricultural, forestry, food or industrial residues, bio-solids, leaf and yard trimmings, manure, tree wood, or source-separated or mixed solid waste

Applications

- Compost blanket are commonly used for temporary erosion and sediment control
- The technique is appropriate for slopes up to 2H:1V grade and on level surface
- Only used in areas that have sheet flow drainage patterns (not for areas that receive concentrated flows)
- Compost used on AT projects must meet Canadian Council of Ministers of the Environment (CCME) Guidelines for Compost Quality (trace elements, maturity/stability, pathogens), which are adopted by Alberta Transportation and found on AT Products List (www.transportation.alberta.ca)

Installation

- Slightly roughen (scarify) slopes and remove large clods, rocks, stumps, roots larger than 50 mm in diameter and debris on slopes where vegetation is to be established
- Apply compost at the rates as follows:

Annual Rainfall/Flow Rate	Total Precipitation	Application Rate for Vegetated Compost Surface	Application Rate for Unvegetated Compost Surface
Low	25 mm – 635 mm	12.5 mm – 19 mm	25 mm – 37 mm
Medium	635 mm – 1270 mm	19 mm – 25 mm	37 mm – 50 mm
High	>1270 mm	25 mm – 50 mm	50 mm – 100 mm

- Compost shall be uniformly applied using an approved spreader, e.g., bulldozer, site discharge manure spreaders
- A pneumatic blower unit propels the compost directly at the soil surface, thereby preventing water from moving between the soil-compost interface
- Seeding can be incorporated during the compost application

Construction Considerations

- Use higher blanket application rate in high rates of precipitation and rainfall intensity, and snow melt
- Compost may be used in conjunction with a compost blanket, especially in regions with spring melt, and sites with severe grades and long slopes
- In regions subjecting to wind erosion, a coarser compost product or higher blanket application rate is preferred
- Use lower blanket application rate in lower precipitation rates and rainfall intensity regions

Inspection and Maintenance

- Inspection frequency should be in accordance with the PESC and TESC Plans
- Areas damaged by washout or rilling should be regraded if necessary and re-covered with compost immediately