

BCTS
BC Timber Sales
Prince George Business Area

SEDIMENT AND

EROSION CONTROL

FIELD GUIDE

PREFACE

While it is impossible to prevent sediment from leaving disturbed forest lands due to rainfall and snow melt, significant reductions can be realized. This field manual had been developed to assist those in the forestry field who install, maintain, monitor and inspect sediment and erosion measures associated with roads and stream crossings. This document does not address all mitigation measures that are available to implement; however, information has been incorporated to increase the effectiveness of the most common Best Management Practices (BMPs) found in BC Timber Sales forestry applications.

Techniques presented in this manual have been developed from personal experience, research, Erosion Draw 4.0, and teaching about sediment and erosion control. While none of the BMPs will achieve 'Zero Sediment Discharge', correct application, implementation and maintenance can result in significant reductions of sediment in runoff waters. It is expected that the use of this manual will result in practical and effective control of sediment that may be generated during forestry operations.

Methods outlined in this manual have been designed for uses prescribed in various environmental plans based on variables triggered through the BCTS Risk Matrix. Depending on key variables present at each site location, the risk of activities can be assessed and the corresponding Environmental Management Plan (EMP) or Sediment and Erosion Control Plan (SECP) will be prepared.

This manual is to be used as a guide, and is in no way designed to replace contract/license design specifications if applicable. If specified design parameters have been prescribed, these specifications/prescriptions take precedence over the methods and techniques presented in this manual. For additional information refer to the BC Timber Sales Environmental Management System, Emergency Response Manual and site specific Emergence Response Plans.

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CROSS DRAINS & DITCH BLOCKS

Instructions For Installation:

Cross drains should be installed to facilitate natural drainage patterns, such as at the top of steep gradients, at seepage zones, at zones with localized overland flow, at low points, immediately prior to cut slopes and through cuts and at any location where accelerated ditch erosion could potentially begin. Refer to the BCTS SECP plans and contract specifications to determine installation location.

To encourage smooth entry of ditch flows, skew cross drain culverts perpendicular to the road centerline, by 3" for each 1% that the road grade exceeds 3% to a maximum of 45°.

Should be installed in conjunction with Ditch Blocks to direct flows into CMP inlet.

Should be installed at appropriate depth within road fills/ditch line to facilitate complete drainage.

Install cross drain culverts at a gradient of 1–2.5%

Ditch blocks should consist of non-erodable materials such as boulders, cobbles, and riprap.

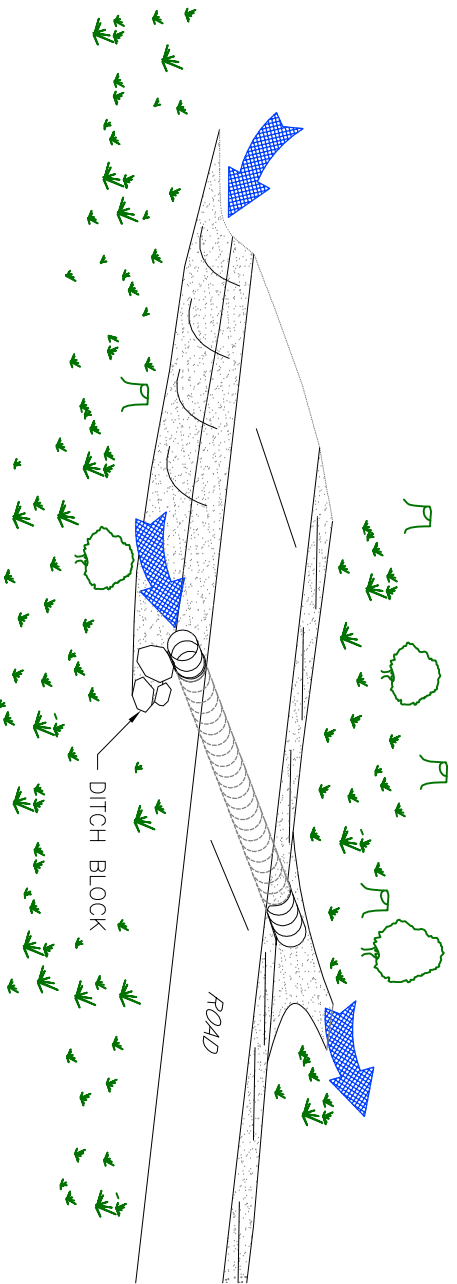
Do not install cross drains below natural ground elevation in overland section of road as this promotes pooling. Do not install ditch blocks above the running surface of the road.

In erodable soils or steep slopes the cross drain spacing should be reduced.

Installation of cross drains will have an effect on the drainage patterns and must be considered along with the ground stability when armouring drain outlets. Refer to page 8 on Cross Drain Outlet Armouring.

Inspection/Maintenance

Inspect structures after heavy precipitation events to ensure they are functioning properly.



LINED DITCHES

Instructions for Installation

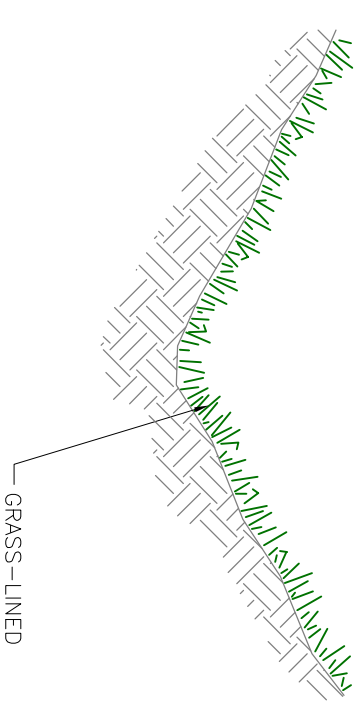
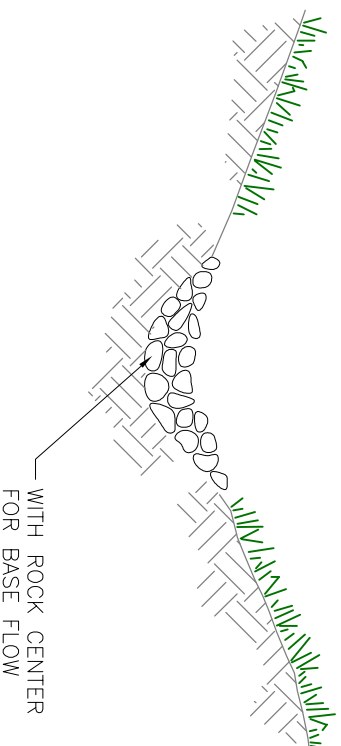
Ditches which drain towards larger stream crossings, which exhibit high flows, should be lined with non-erosive substrates to minimize sediment delivery to the stream. Upon ditch excavation completion, hard substrates (rip rap, cobbles, gravel) can be placed within ditch line and compacted into the ditch bed (excavator). For lower gradient ditches the entire ditch can be seeded, inside of using hard armoring techniques.

Ensure entire bed is covered.

Inspection/Maintenance

Inspect locations where CMP outlets drain into the ditch line, as increases in water velocities/erosive potential are associated with these areas.

Inspect after substantial rain events/storms. Remove debris and repair any areas where stones have been removed.



TYPICAL CROSS-SECTION

CHECK DAMS

Instructions for installation

Check dams can be made of rock, a log overlain with geotextile anchored to the stream bed, or Geo-ridge structures.

The steeper the slope the more check dams should be installed in the ditch lines.

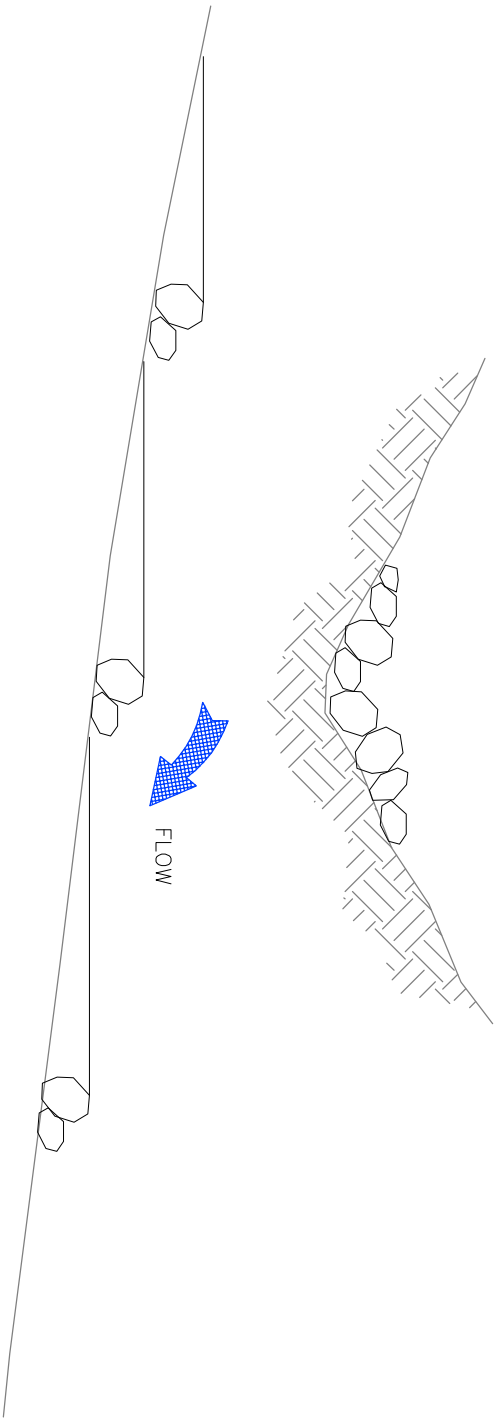
With all check dams the check dam size will depend largely on the expected water volumes. The ends must be higher than the center (15–45cm higher on the ends than in the center of the dam). This will allow water to flow over the structure instead of around it. Ensure edges are keyed into the ditch bed and that the ditch is deep enough to prevent water from escaping. The spacing should be that the bottom elevation of the check dam should be approximately the same elevation as the top of the next check dam.

Ensure the bottom of the geotextile is secured to ditch bed with suitable substrates.

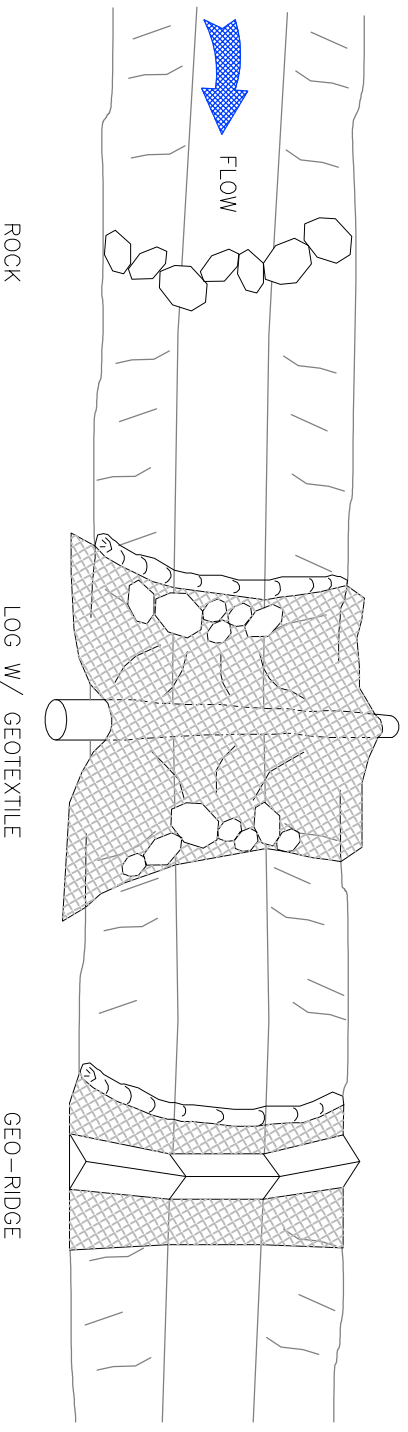
The Geo-ridge can be installed in conjunction with geotextile fabric to further control flows and increase the filtering effectiveness/efficiency. Grade the surface, install the geotextile fabric and then install the Geo-ridge units perpendicular to the flow, centered over the geotextile fabric, secure with anchors/pins.

Inspection/Maintenance

Inspect dams after significant rain events/freshet to ensure they are intact/functioning. Repair displaced rocks with available substrates. If sediment builds up behind the rock check dam, they may need to be dredged occasionally to maintain functionality.



3 TYPICAL TYPES OF CHECK DAMS



CROWN ROAD SURFACE

Instructions For Installation

Road crowning should follow geometric road design if available. If design plans are unavailable, use the standard slope of 2% from the road center line to the edge.

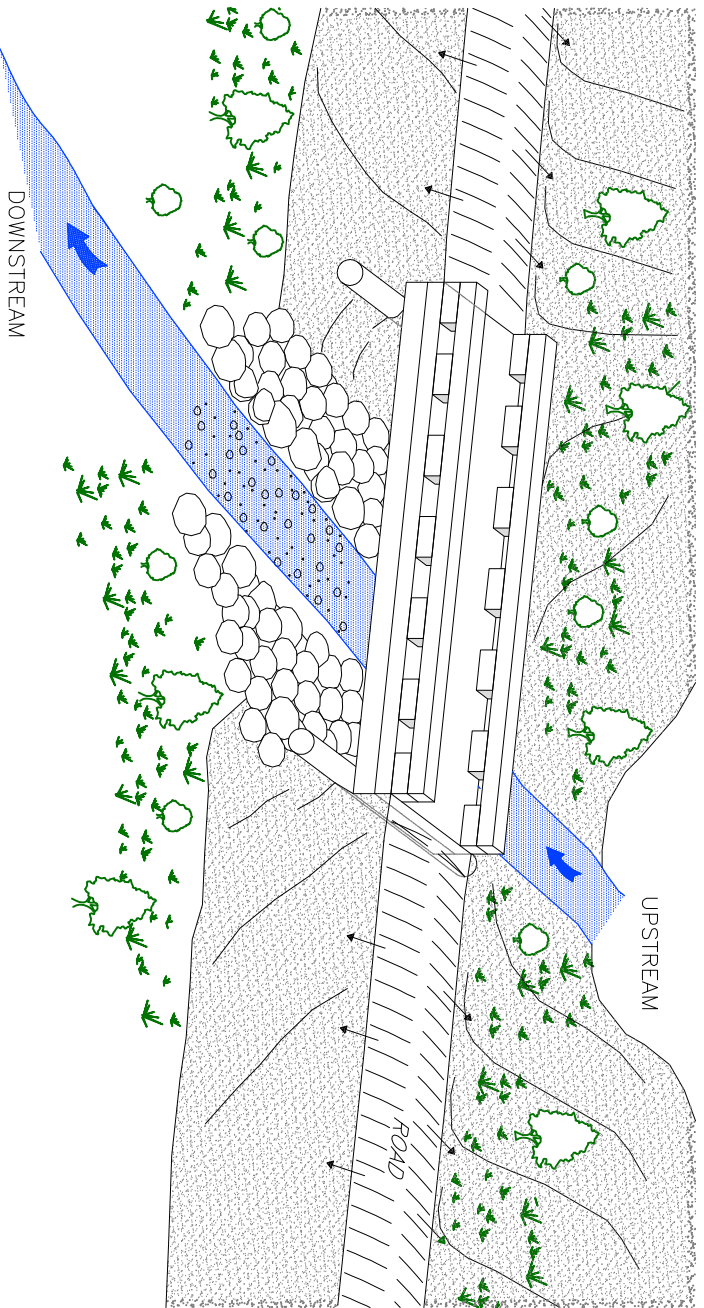
Ensure running surface of road is crowned on approach to drainage crossing structure (minimum 15–20m from stream crossing). Center of road should be slightly elevated to direct surface flow off the road surface into ditch lines.

During road construction, extra fills should be deposited/compacted along road centerline adjacent to crossing.

Inspection/Maintenance

Road surface should be inspected for crowning upon approach to drainage crossing locations prior to machinery leaving the site. Ensure road surface is crowned prior to advancement of road building activities.

If road surface adjacent to crossing is not sufficiently crowned, accumulation of water may occur on road surface causing erosion. Additional fills should be placed in this location to crown the surface.



WING DITCHES

Instructions for installation

Excavate wing ditches to direct flow out of ditch lines to avoid accumulation of water/velocity causing sediment mobilization.

Construct below ditch grade as wing ditches are gravity fed.

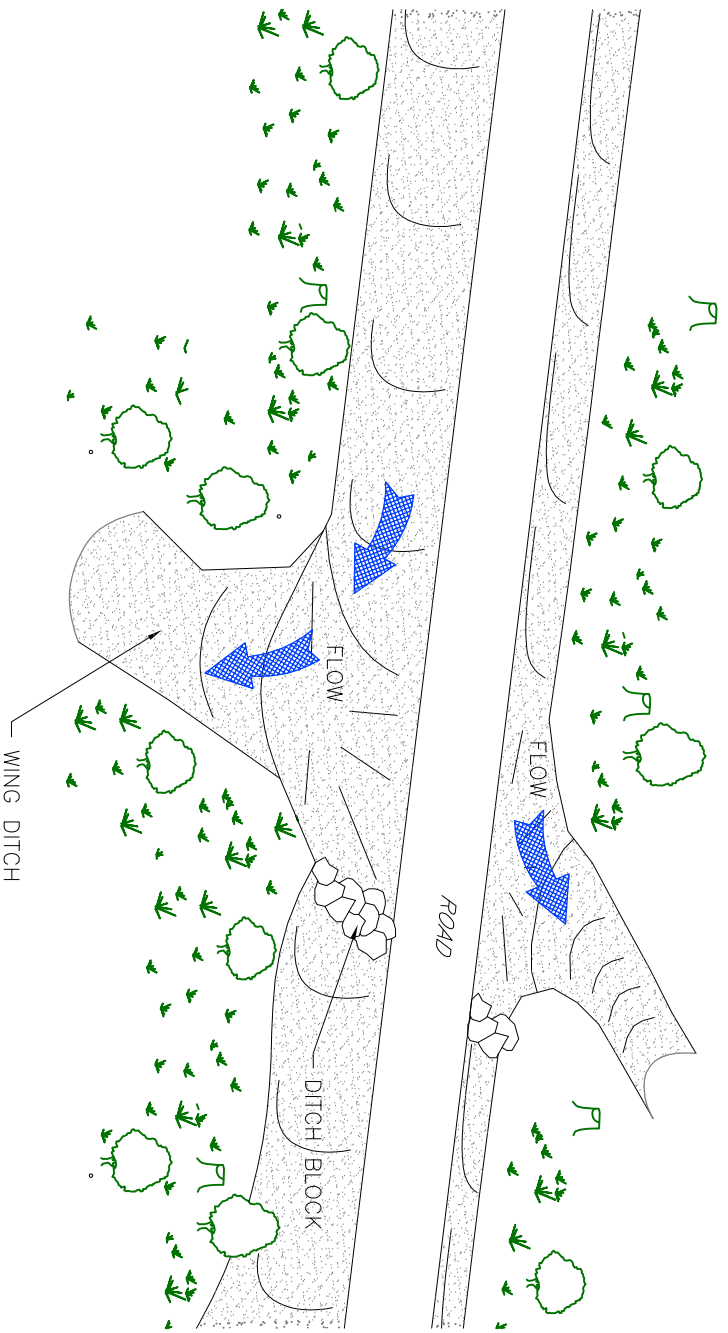
Install as many as terrain allows.

Measures must be taken to ensure that the slopes are capable of withstanding the drainage directed at them. This can be done by lining the ditch (page 2), installing check dams to slow flows (page 3), or armouring outlets where heavy flows are anticipated (page 8).

May be associated with cross drains in some cases to get rid of water from both ditch lines.

Inspection/Maintenance

Ensure wing ditch is functioning properly during periods of heavy flow within ditch lines. Excavate/remove debris as necessary.



SEEDING/MULCHING

Instructions For Installation

Select approved seed mixture (BCTS standard forestry reclamation mixture) for the geographic location as specific grass species have higher success of germination rates than others. Apply grass seed after surface roughening using a broadcast seeder, which will distribute seeds evenly over the entire area. Apply seed to manufacturers specifications to a minimum of 80% pure live seed [PLS] (usually displayed on seed bag). Seed all disturbed soils.

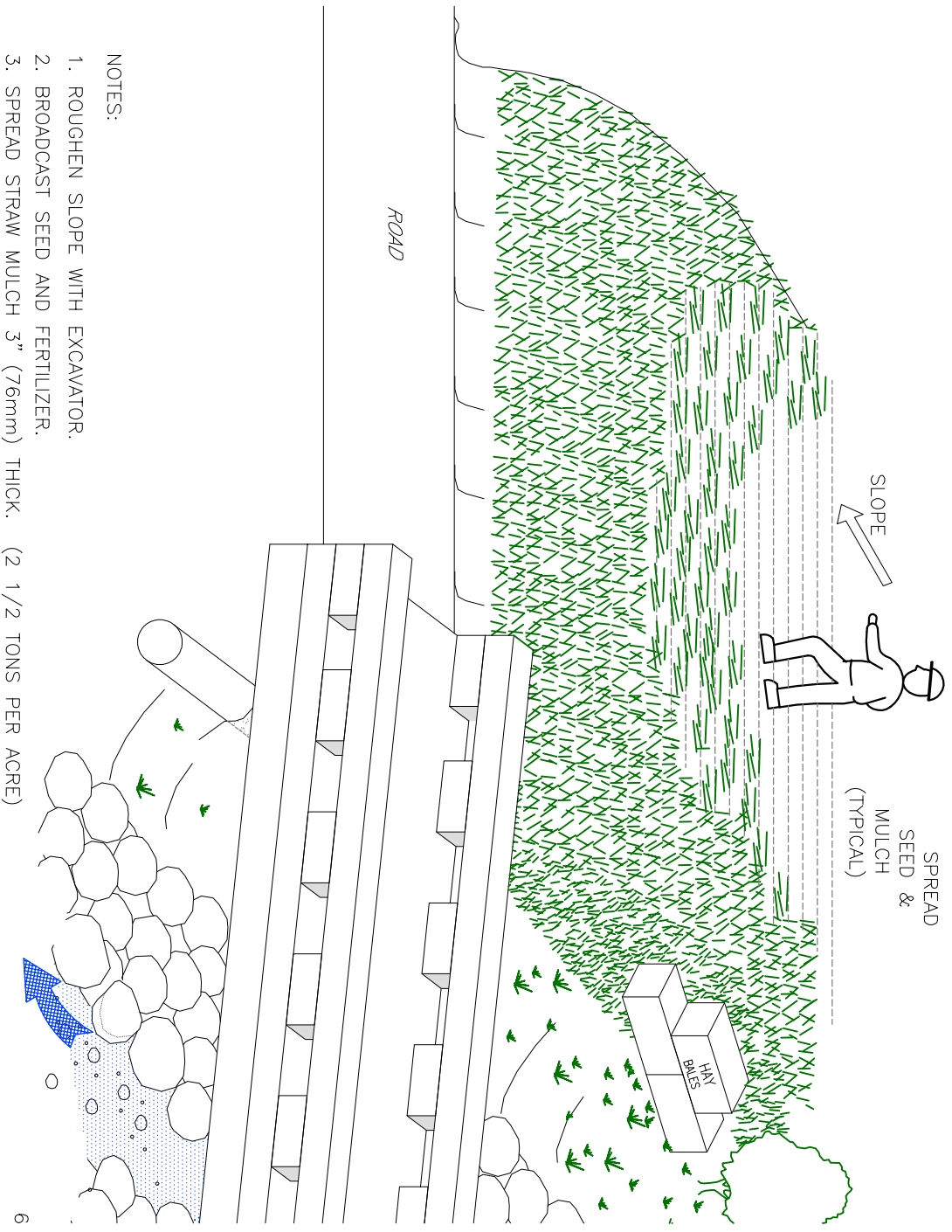
Do not over—seed, as competition for nutrients will occur decreasing the overall health of all established grasses.

Fertilize exposed soils with 18–18–18 at 300kg/hr. Do not fertilize in the riparian management area of any stream or any direct conveyance to a stream.

After seeding and fertilization, hand mulch all exposed soils. Break bales and scatter over soils to prevent seed from washing away prior to germination. Hay mulch should not be applied more than 5cm deep on seeded sites and should cover at least 80% of the soil surface.

Inspection/Maintenance

Inspect seeded sites during the growing season to ensure germination success of applied seed. Any areas where grass failed to establish should be re—seeded.



ARMOR INLET & OUTLET OF CMP (NON-FISH BEARING STREAM)

Instructions For Installation

Inlets and Outlets of CMPs should be armored accordingly based on the size and flow regime of the drainage. Drainages that exhibit heavy flows should be heavily armored with assorted rip rap, boulders and cobbles.

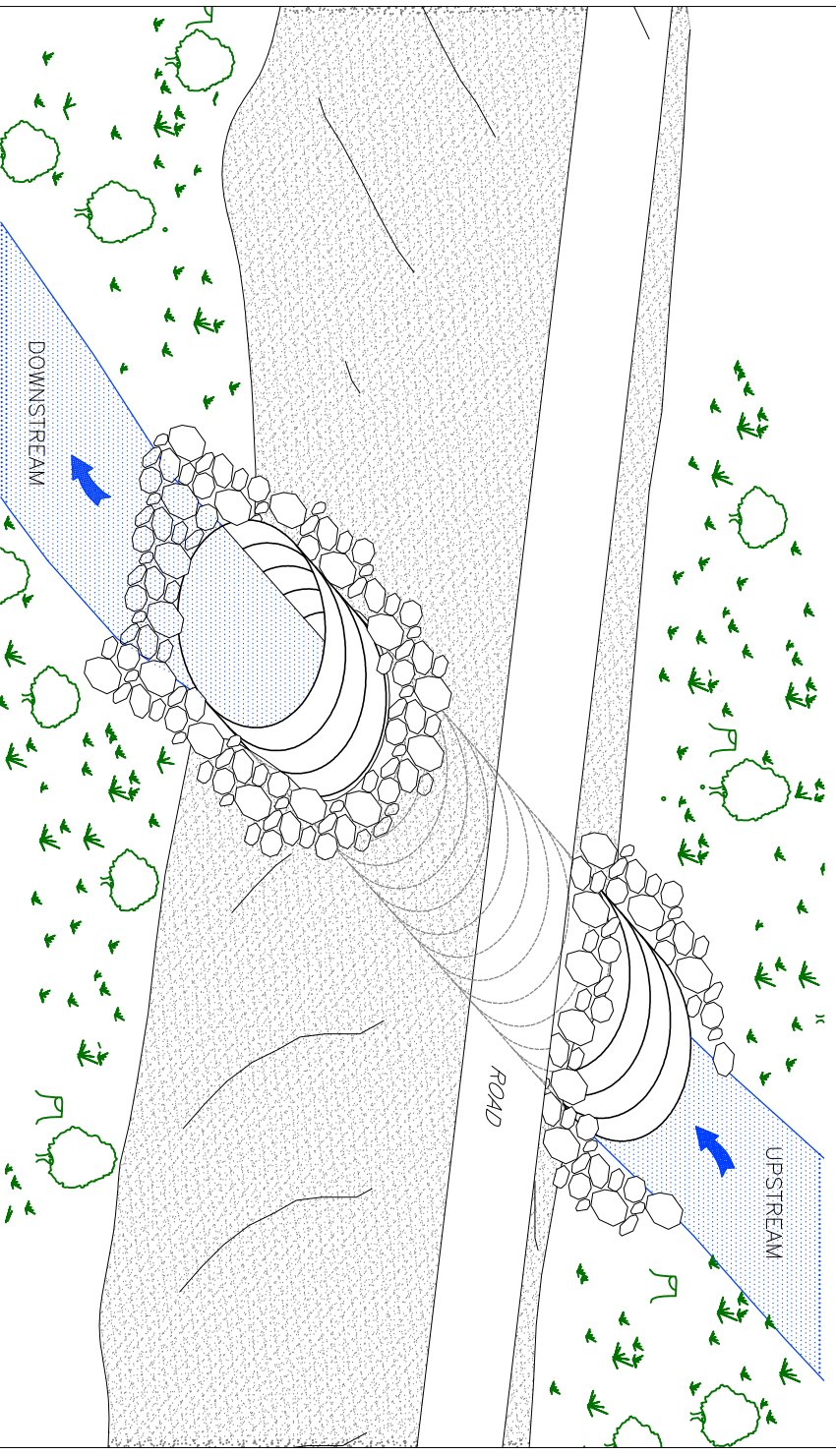
Place large angular substrates (if available) around inlet and outlet of CMP tight to stream bed. Fill holes with smaller materials once leading edge has been installed. Ensure armor is tight to CMP around inlet and outlet to prevent erosion (inlet) and undermining during high flows.

Place smaller substrates within stream channel at outlet of CMP to provide additional armoring.

Ensure geotextile collar is installed at inlet of CMP to prevent piping and undermining.

Inspection/Maintenance

Inspect armor after significant rain events and make necessary repairs. Ensure woody debris does not block inlet flow, clean as necessary.



CROSS DRAIN OUTLET ARMORING

Instructions/For Installation

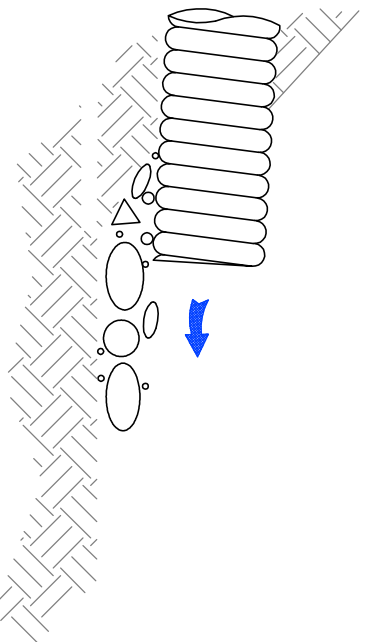
Armor outlet of cross drain when the following variables are present; erodable soils, high gradients, high velocities or when high flows are expected.

Use non-erodable materials such as cobbles, boulders, and rip rap as available on site. Size and amount of armor material will depend on site specific characteristics; however enough armor must be present to prevent scouring/undermining at the outlet of the structure.

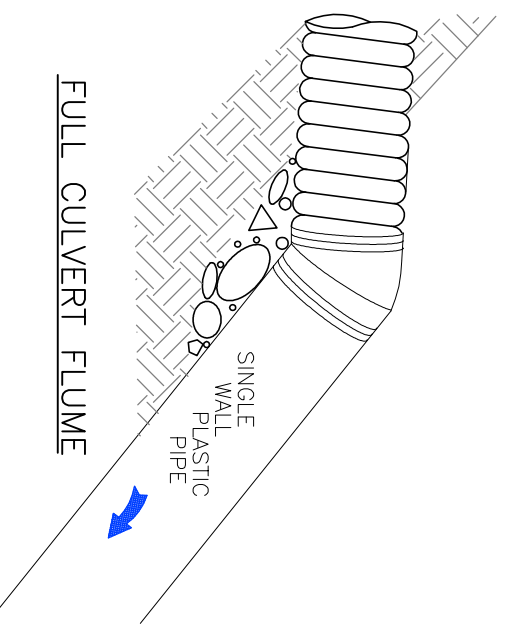
Ensure plastic pipe is of sufficient length to discharge at bottom of slope as water velocities/erosive potentials are likely to increase.

Inspection/Maintenance

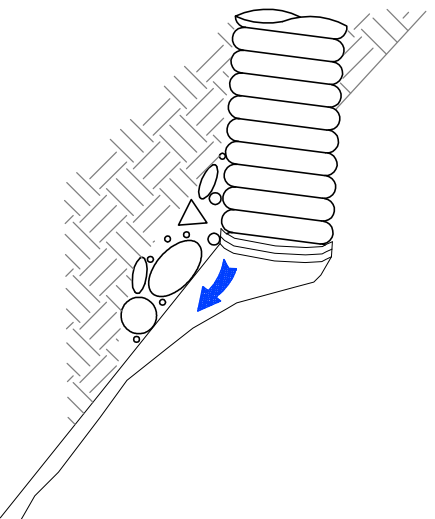
Inspect periodically after periods of increased flow to ensure armoring remains present/functioning.



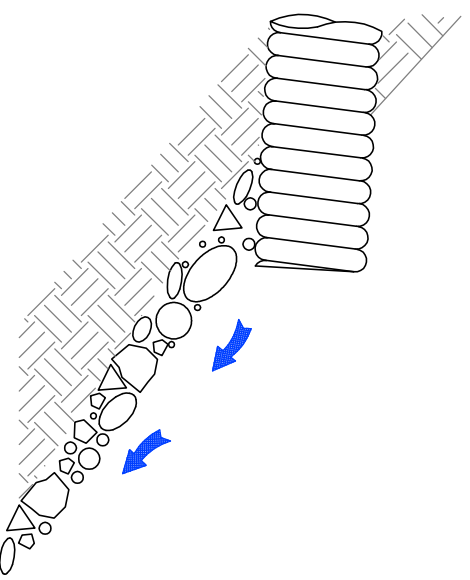
SECTION



FULL CULVERT FLUME



SOFT POLY SOCK



FULL ARMoured ROCK CONVEYANCE

SURFACE ROUGHENING

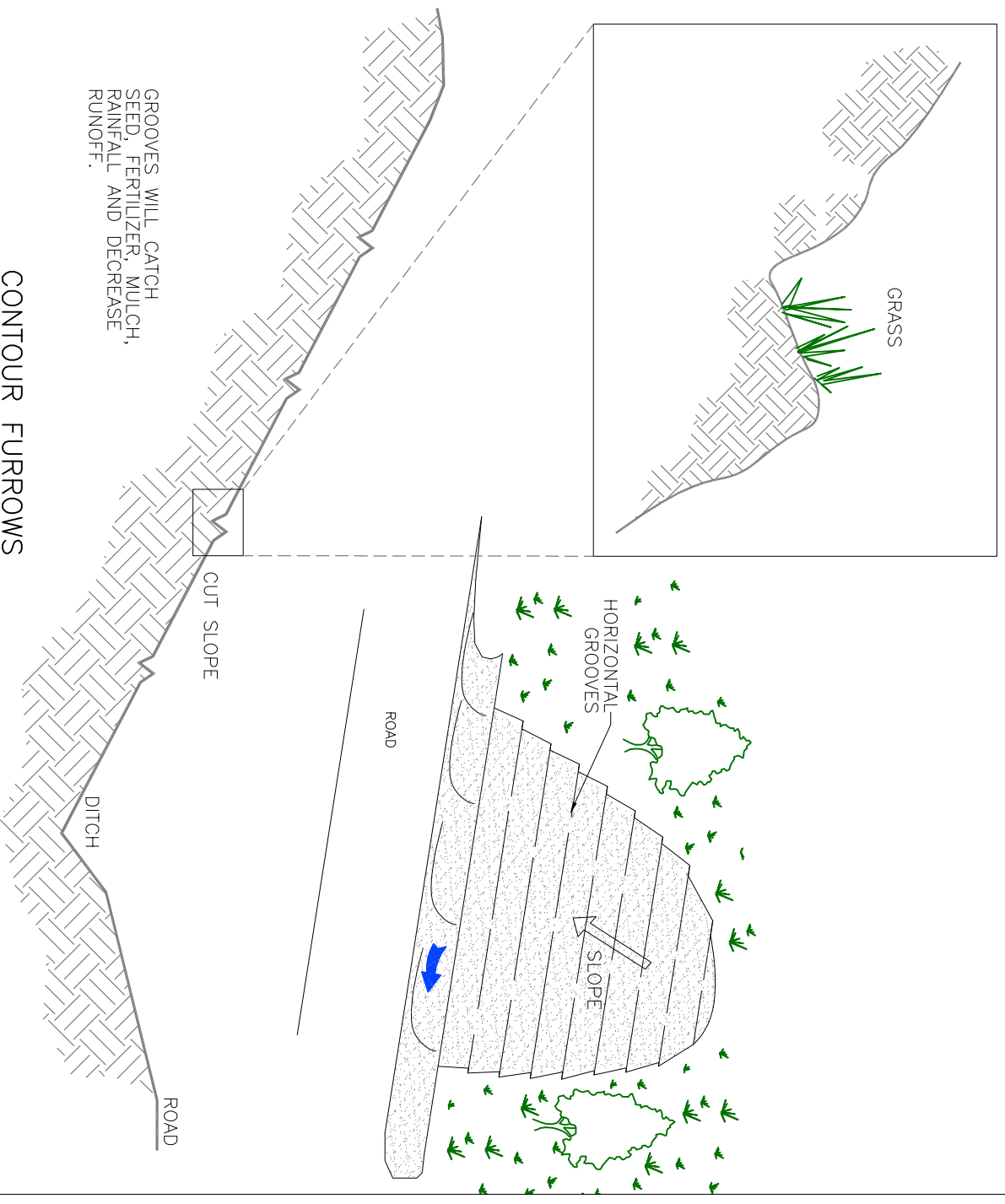
Instructions for installation

Roughen disturbed slopes creating deep grooves to catch the seed/fertilizer. Allows vegetation to establish on steep slopes. Prevents rainfall/runoff from washing seeds (prior to germination) off slopes.

Roughening can be achieved using the bucket of an excavator by swinging the bucket horizontal along the slope gently creating grooves with the leading edge of the bucket (surface roughen serrate slope between furrows).

Inspection/Maintenance

Inspect roughened slopes to ensure large scale slumping is not evident (after large rain events). If slumping is evident remove slumped materials from the toe of the slope and re-seed as necessary.



CONTOUR FURROWS

GROOVES WILL CATCH
SEED, FERTILIZER, MULCH,
RAINFALL AND DECREASE
RUNOFF.

CROSS DITCH

Instructions For Installation

Cross ditches should be installed back from the stream channel across the road prior to the riparian zone of the stream. Ensure sufficient length to prevent passage of surface flow down road grade to deactivated crossing.

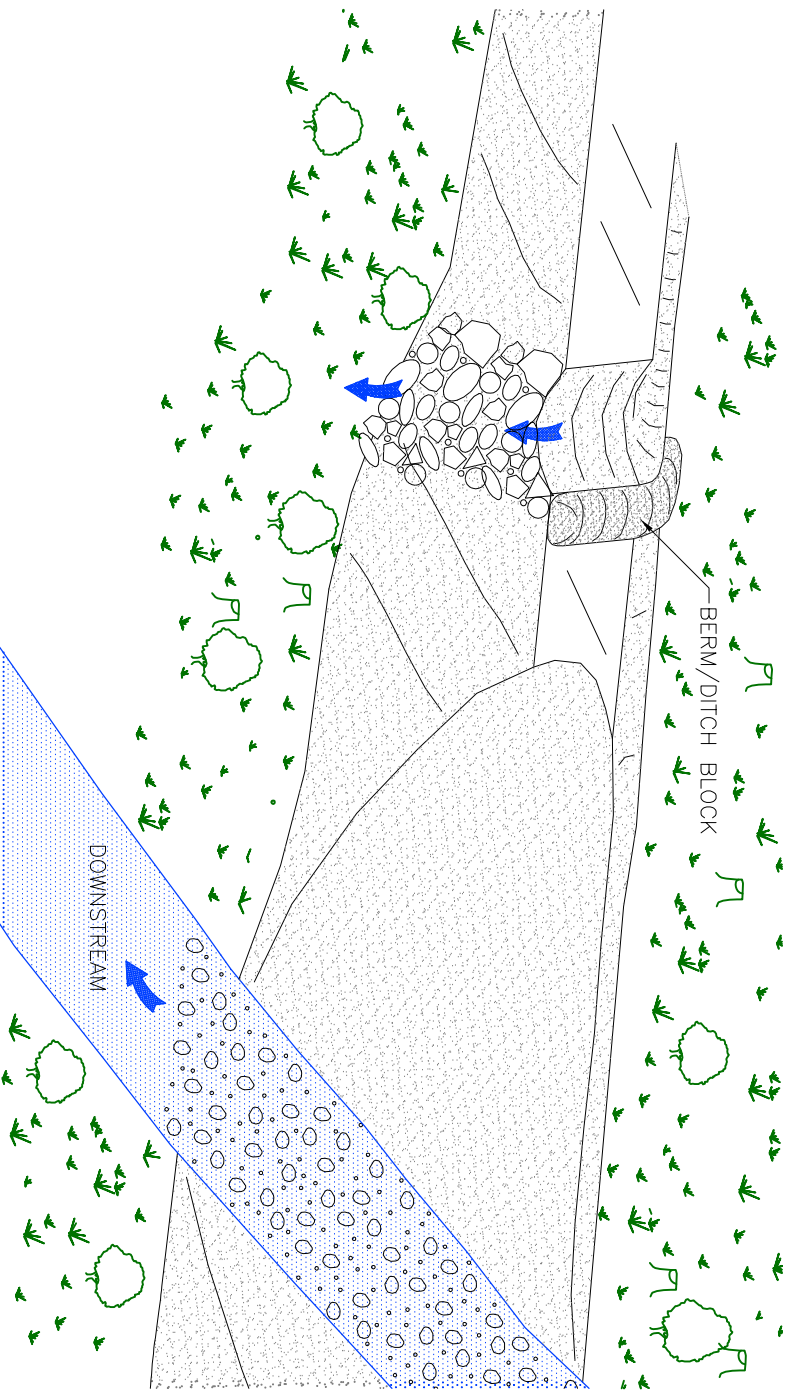
Should be installed in areas where road grade slopes towards crossing. Ensure that the slope below the outlet of the drainage structure is stable, and armour where necessary.

Cross ditch should be excavated to well below the original grade. It should be skewed so that water flowing through it is not slowed down or made to abruptly change direction, therefore steeper roads require more skew. Ditch gradient should be installed at a minimum of 2%. For ditch lining specifications refer to page 2 and for outlet armouring refer to page 8.

Maintenance/Inspection

Should be inspected periodically to ensure measure is functioning properly and not contributing sediment to the stream crossing.

Fix or replace any damaged sections with suitable materials.



WATERBAR

Instructions for installation

Excavate road fill materials across entire road surface to facilitate drainage of flows on the surface of the road. Ensure vehicular access is maintained as well as slope stability below the waterbar.

Fills from waterbar are deposited immediately down grade forming a berm.

Armour as necessary after considering the materials present and the slope stability below the waterbar.

Ensure the waterbar does not transfer water out of the ditch line, just off of the roadway.

Inspection/Maintenance

Inspect during heavy precipitation events to ensure dimensions of structure are sufficient to remove all flows off road grade.



SECTION

DE-COMPACT ROAD SURFACE

Instructions For Installation

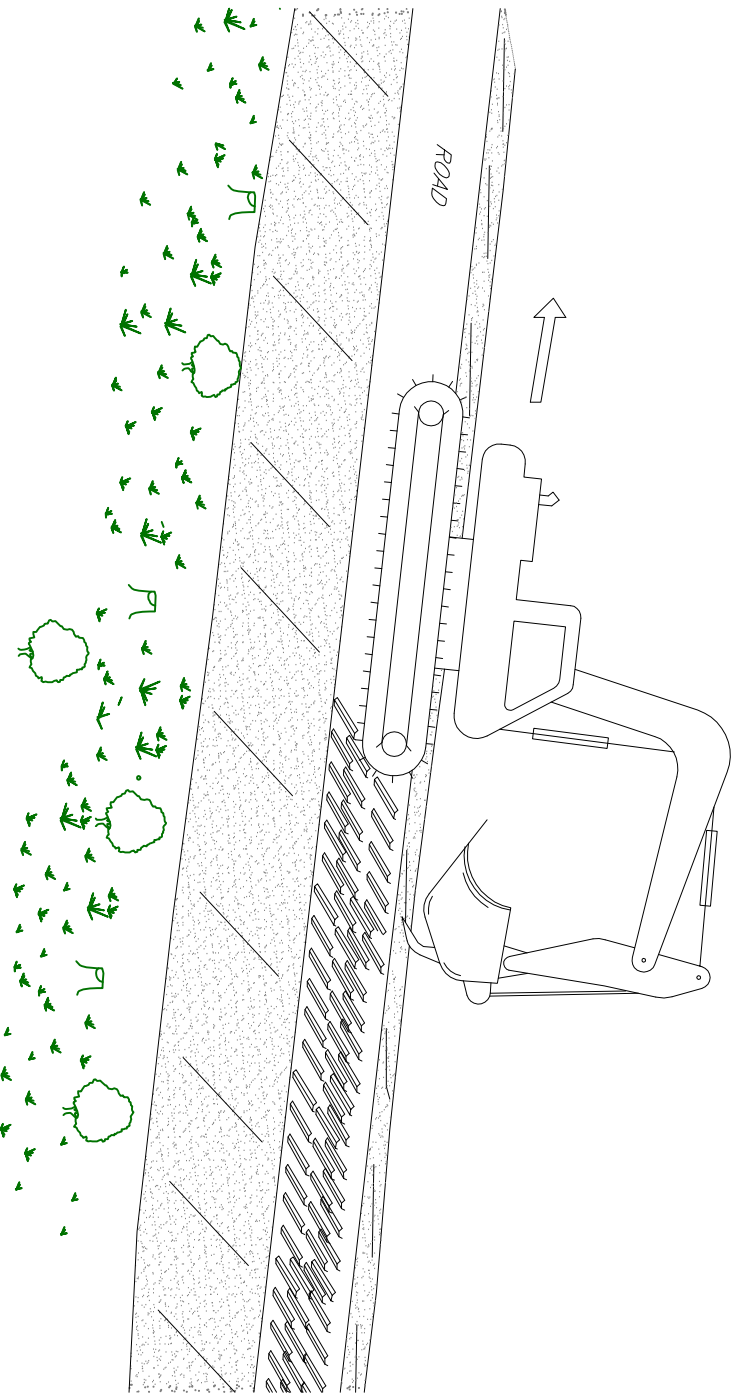
Loosen compacted fills within the existing road grade to provide a suitable growing medium (rooting success) for trees and plants prescribed for planting. This encourages water to penetrate the old road surface allowing establishment of vegetation. The depth of excavation/decompaction should reflect planting objectives (increase depth if trees are scheduled for planting).

Excavator bucket/thumb/riper, or bulldozer with ripper can be used to loosen road surface as deactivation is carried out.

Planting, seeding and mulching should be carried out immediately after de-compaction is complete.

Inspection/Maintenance

Deactivated road surface should be inspected to ensure establishment of vegetation is successful and no significant sedimentation or erosion is occurring. Replant areas where vegetation failed to establish and mitigate for erosion if evident.



SILT FENCE

Instructions for Installation

Silt fence shall be placed on the slope contours to maximize ponding efficiency.

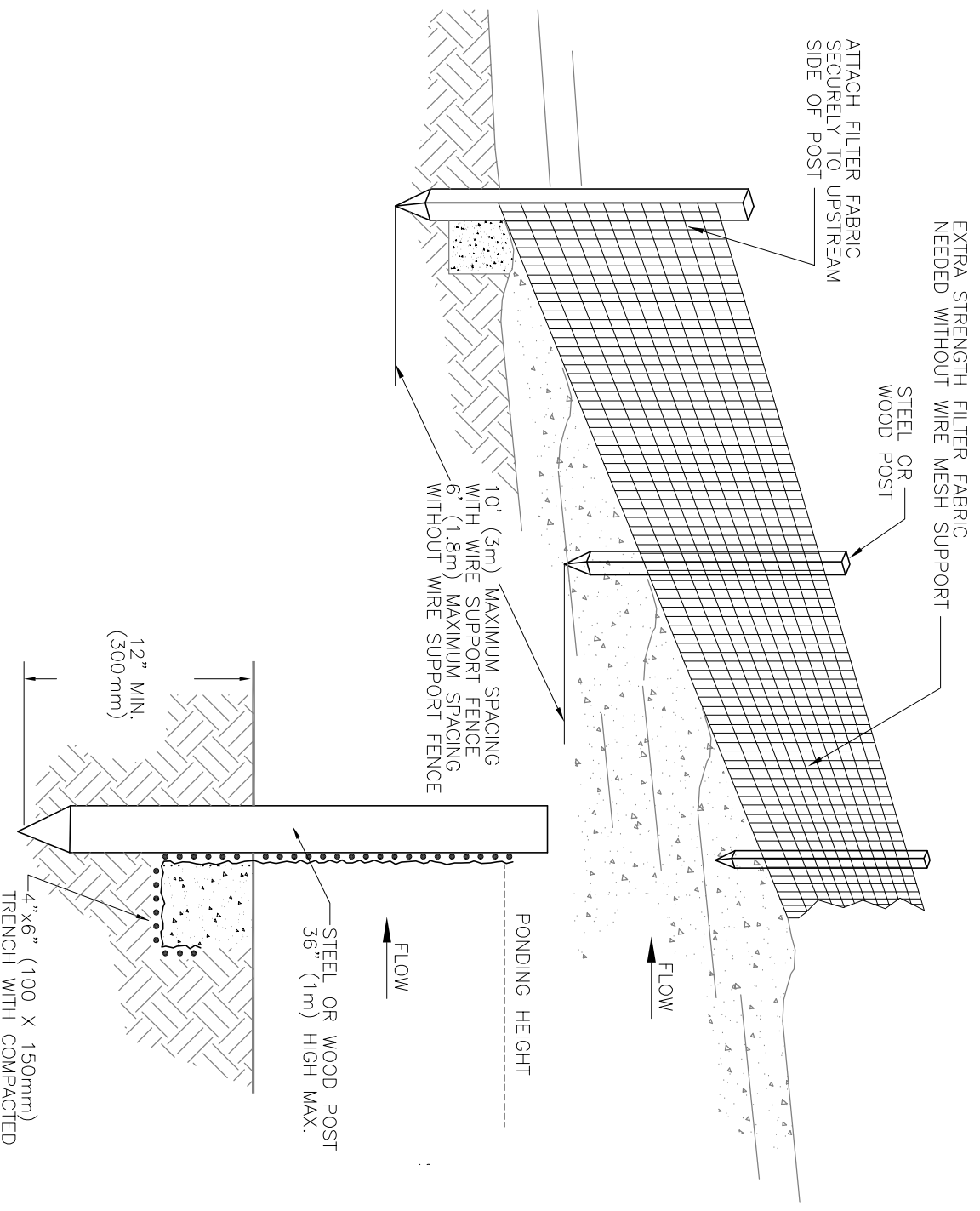
Inspect and repair fence after each storm event and remove sediment when necessary.
Maximum storage height is 225.

Removed sediment shall be deposited to an area that will not contribute to sediment off-site and can be permanently stabilized.

The silt fence is a temporary feature that must be removed from the site once sufficient vegetation has been established.

Inspection/Maintenance

Ensure silt fence is not clogged (clean as necessary) and remains upright (as installed) after heavy rain events.



TRENCH DETAIL

IN-STREAM SEDIMENT CURTAINS (NON-FISH BEARING STREAMS)

Instructions For Installation

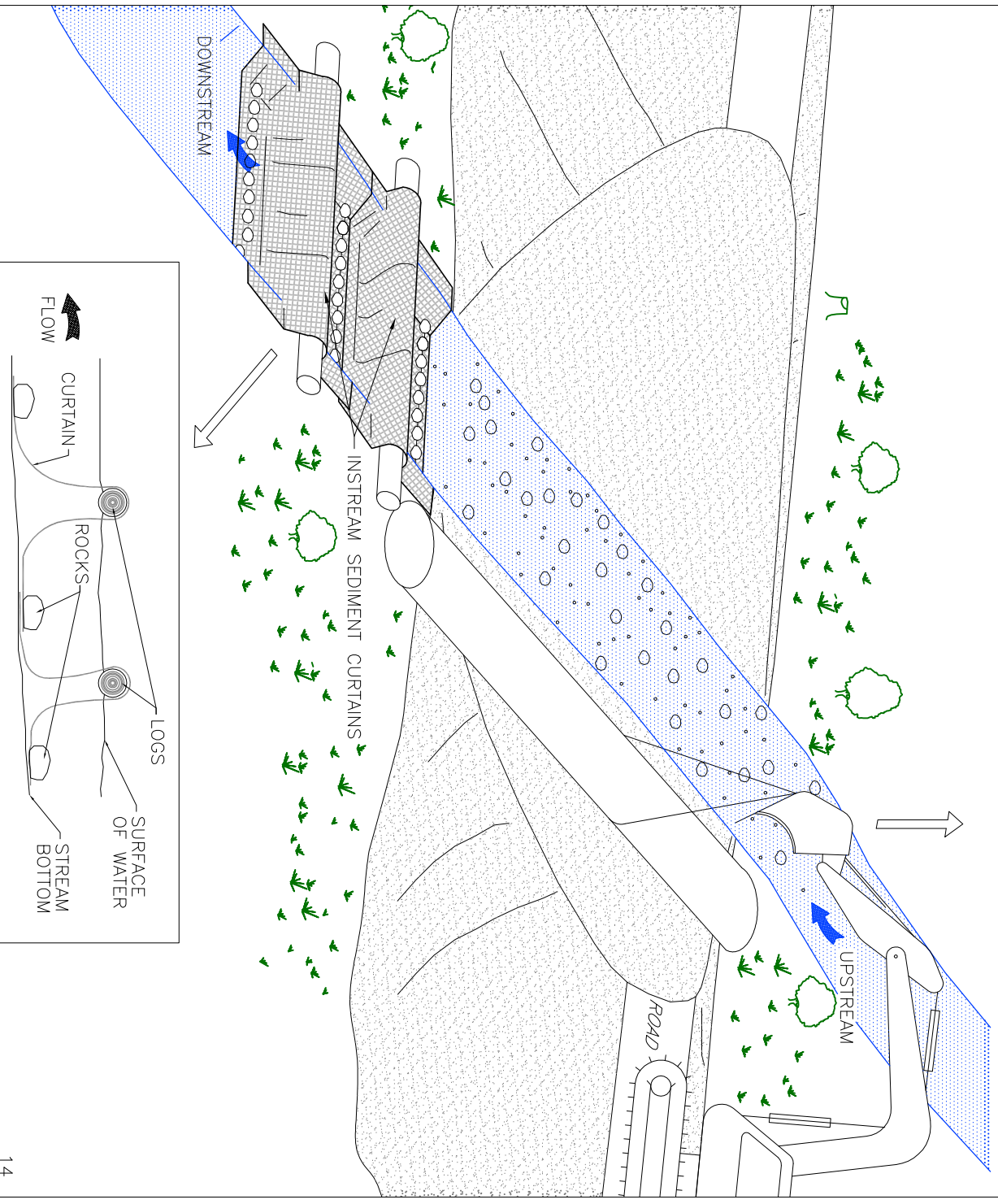
Install immediately below CMP installation location (if flows present). Ensure the bottom edge of the filter cloth is sealed to stream bed with hard substrates and across the entire wetted width of the stream channel.

Drape fabric across material (log/lumber) long enough to span the width of the stream channel. Ensure material is of sufficient strength to support wet filter fabric.

This is a very temporary measure. Do not leave in place too long as fabric will become clogged causing failure/sediment delivery to stream.

Inspection/Maintenance

Filter fabric should be maintained/cleaned if substantial sediment accumulation is noted. Fabric should be removed and disposed of after CMP installation is complete/sediment source has been eliminated.



SEDIMENT DIAPER INSTALLATION

Instructions For Installation

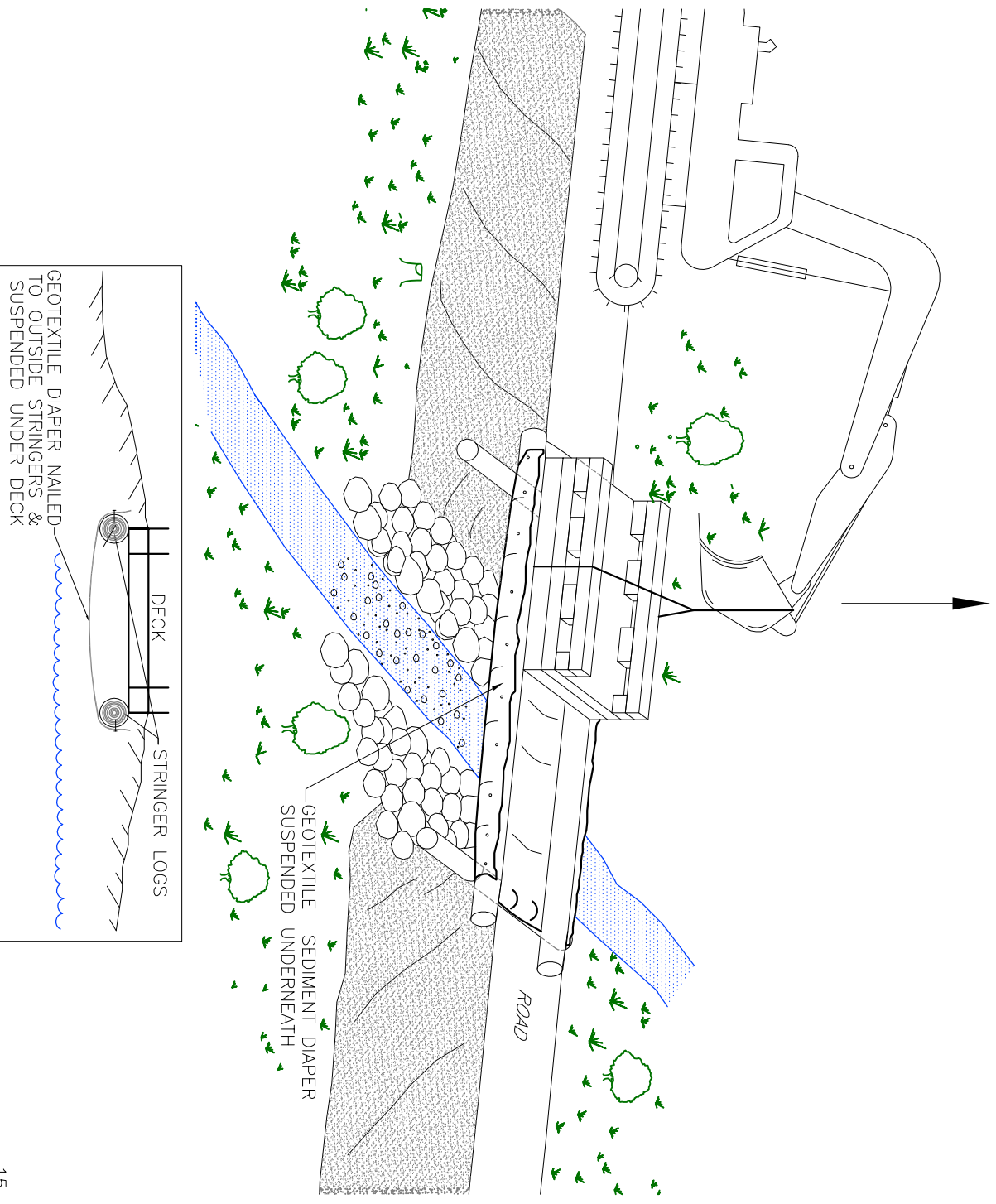
Cut large piece of geotextile fabric/poly large enough to cover the underside of the existing crossing structure. Fasten to outer stringer logs with nails and wrap under structure to opposite stringer log.

Prior to removing structure, sweep sediments off bridge deck. Carefully lift decking off support structures. Next, remove inner stringers first with sediment diaper still fastened to outer stringers. Finally roll out stringers together with sediment diaper included. Lift entire unit clear from the stream and away from the channel. Remove diaper once decking is out of the riparian zone of the stream.

Inspection/Maintenance

Replace fabric if damage is apparent.

Ensure sediment diaper is securely attached to log stringers or secured to terrain below (steel bridge). Inspect diaper for damage prior to removal of additional modules if present.



CROSS SECTION VIEW

TYPICAL TEMPORARY STREAM CROSSING TECHNIQUES WITH BANK PROTECTION

Instructions For Installation

Temporary crossing structure should be installed outside of the wetted perimeter of the stream, back from the edges of the stream banks to prevent compaction.

Installation location is site specific. Structure can be installed on road centerline, above or below road crossing based on existing features.

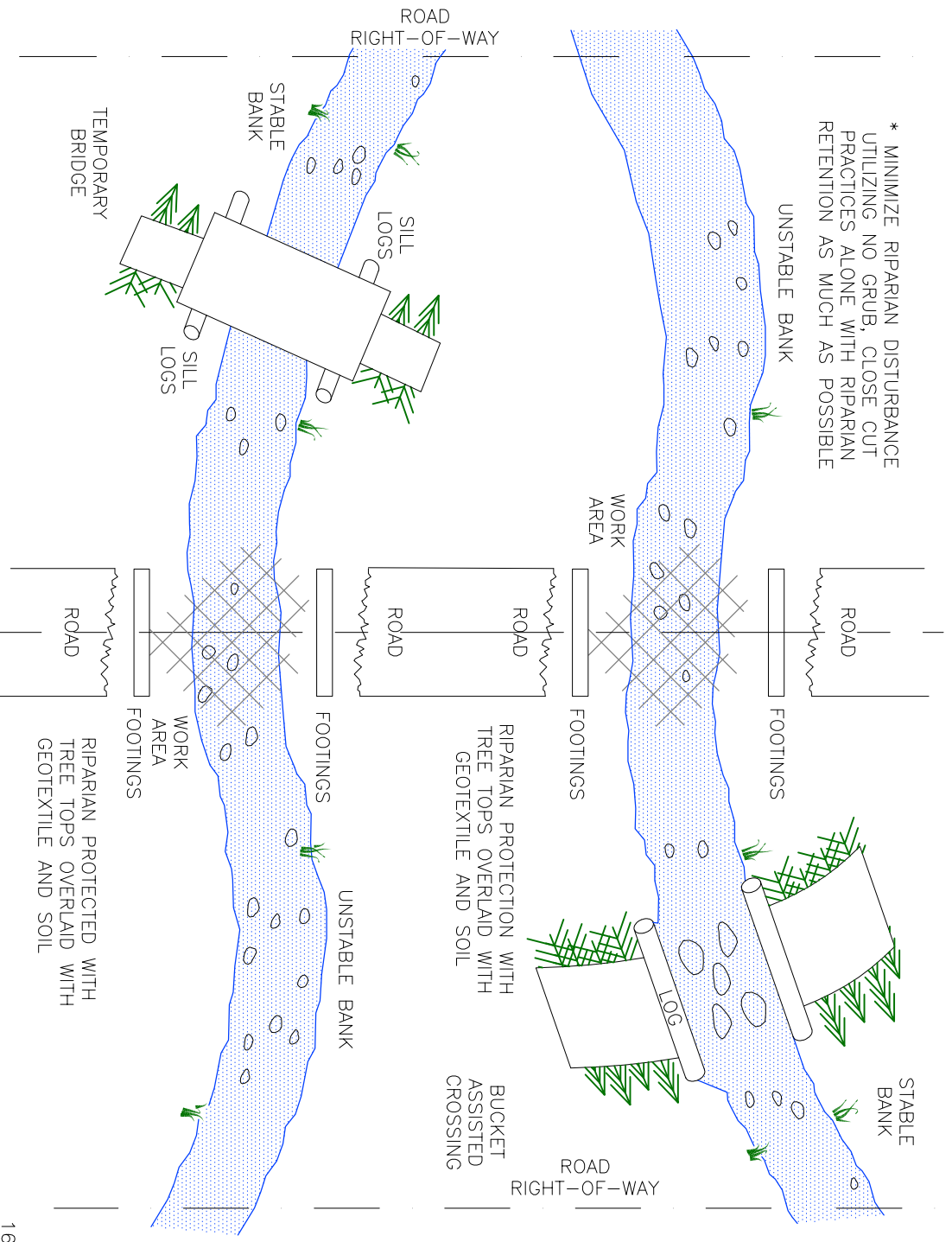
Once installed, crossings should be minimized to prevent further disturbance to underlying terrain/vegetation.

A bucket assisted crossing can occur using large rocks/hard substrates if compaction of stream bed/banks will not occur and the stream is narrow enough to do so.

Inspection/Maintenance

Upon installation, structure should be inspected to ensure that compaction of the stream banks will not occur causing sedimentation to the stream.

Upon removal of temporary crossing, site should be restored to exhibit pre-crossing characteristics (vegetation etc.)



SETTLING BASIN

Instructions/For Installation

Construct basin within ditch line where increased gradients are present in areas where ditch lines are anticipated to exhibit fluctuating flows. Basin should be excavated deeper than the existing ditch line.

Typical install at base of through-cut where no potential exists to divert water to forest before it enters the watercourse.

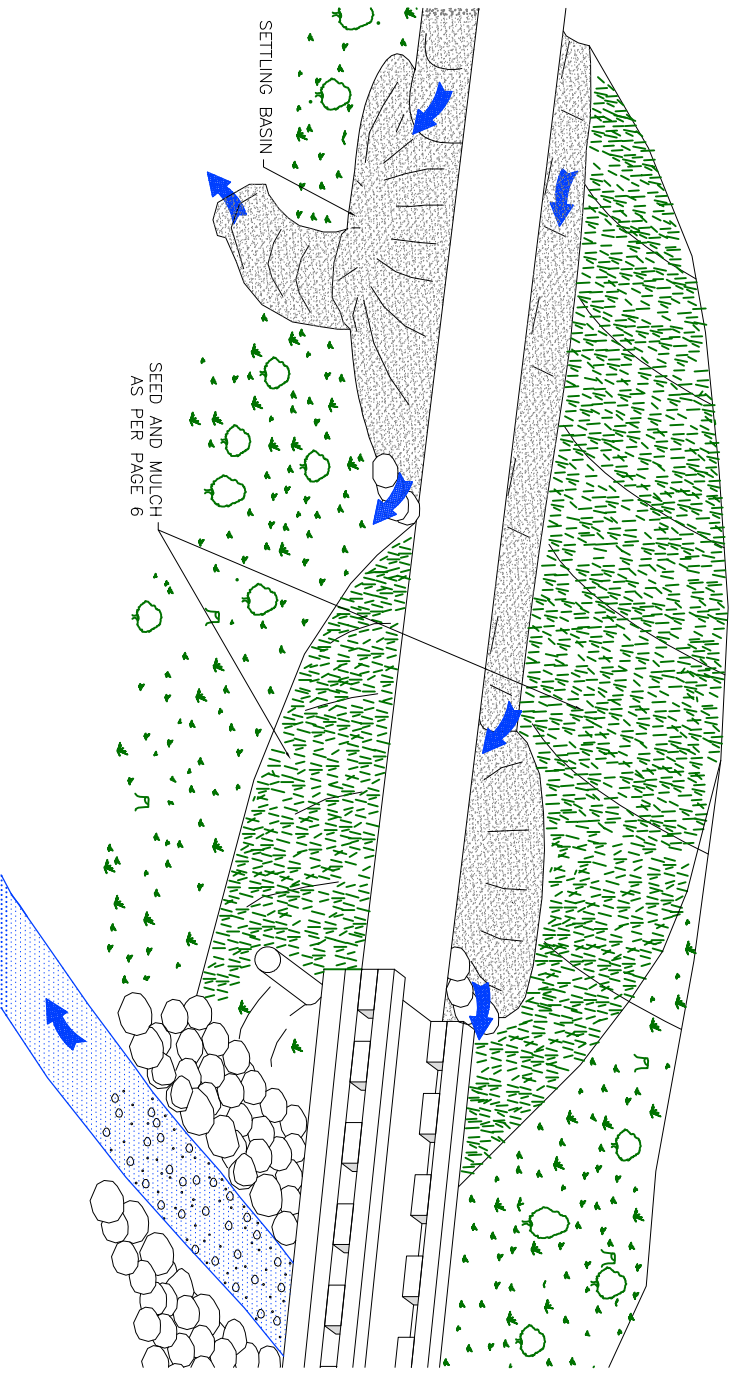
Should be installed in conjunction with wing ditch. The wing ditch should be connected with the settling basin approximately half way up. This will prevent the basin from overflowing while allowing particles to fall out of suspension.

The settling basin should have a length to width ratio of 2:1. Ensure one end of the basin has a lower lip to allow partial flows to leave basin once settling has occurred. Armor outlet of basin as required. The size of the basin should be consistent with the anticipated flows (i.e. long steep uninterrupted ditch lines with no wing ditches require much larger basins [5–6m] than ditches with low gradients and little expected flows [2–3m]).

In higher rise sites, settling basins may be constructed in series for maximum settling time.

Inspection/Maintenance

In areas where heavy silt loads are present within the ditches, the settling basin should be re-excavated to remove accumulated sediments. This should occur once the basin is half full.



LIVE STAKING

Instruction for Installation
Harvest and plant stakes during the dormant season only. Use healthy, straight and live wood only.

Ensure stakes are at least 18" and planted butt-end down. Trim branches off prior to installation.

Plant 80% of the stakes in the ground and do not damage/split stakes during insertion into ground.

Tamp the soil around stake.

Inspection/Maintenance

Check for success/establishment during growing season.

Replace unsuccessful stakes with new stakes as outlined above.

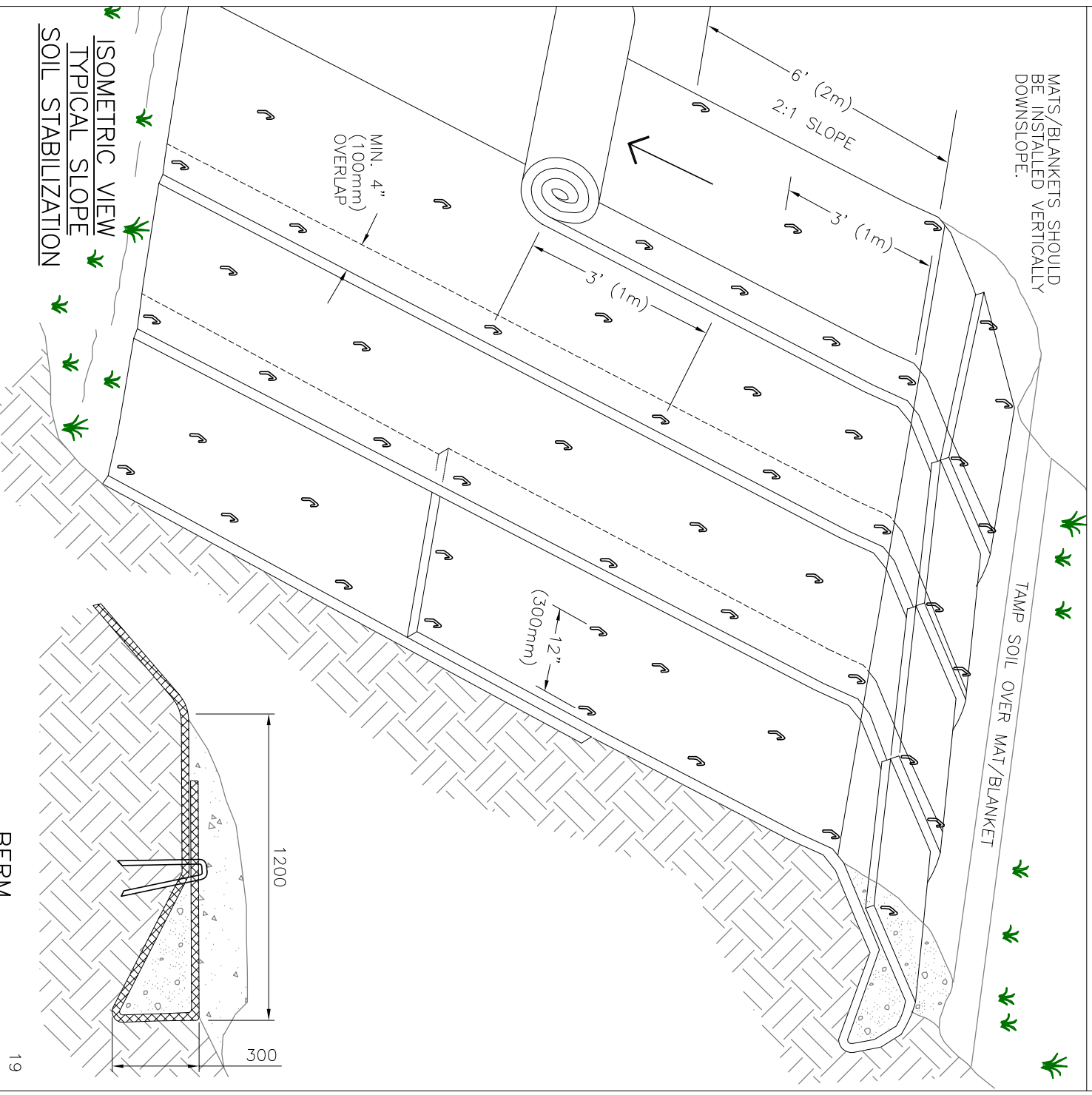


EROSION MATS

Instructions for Installation
Apply permanent seeding before placing blankets.

Slope surface shall be free of rocks, clods, sticks and grass. Mats/Blankets shall have good soil contact. Lay blankets loosely and stake or staple to maintain direct contact with the soil. do not stretch the mats/blankets.

Inspection/Maintenance
Ensure mats are intact (in place) and vegetation has established during growing season.



BERM

STREAM DIVERSION TECHNIQUES

Instructions for installation

Install diversion dam immediately upstream of active work area. Based on site specific variables (flow volume of stream) determine if active or passive methods of diversion are necessary.

Install watergate or hay bale coffer dam as outlined below.

If pumps are utilized, ensure that they are able to handle the expected water volume present at the time of construction. At least one spare pump must be available in case of higher than expected volumes. All pump intakes must be screened to prevent fish entrainment.

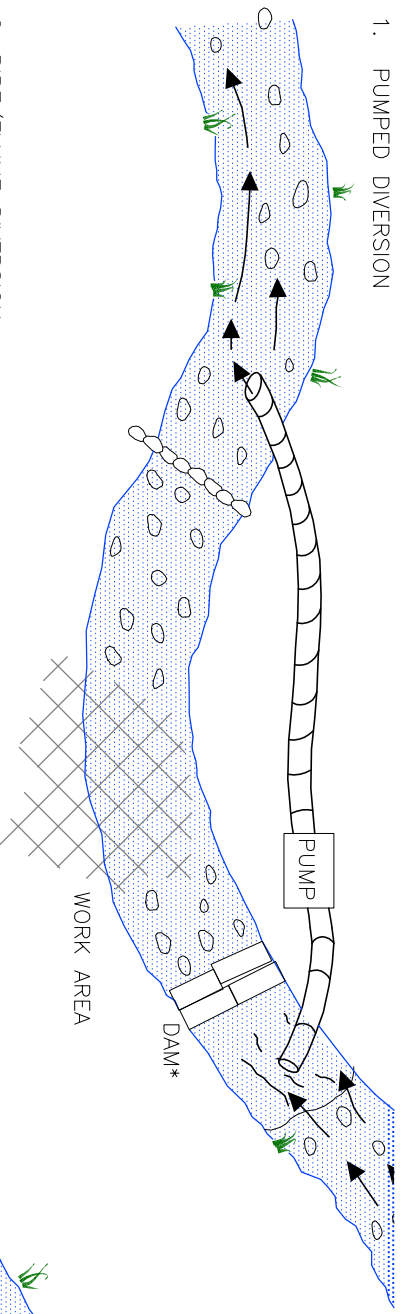
For fish bearing streams, all fish in isolated areas must first be removed and placed downstream by qualified fisheries personnel, prior to complete de-watering.

Inspection/Maintenance

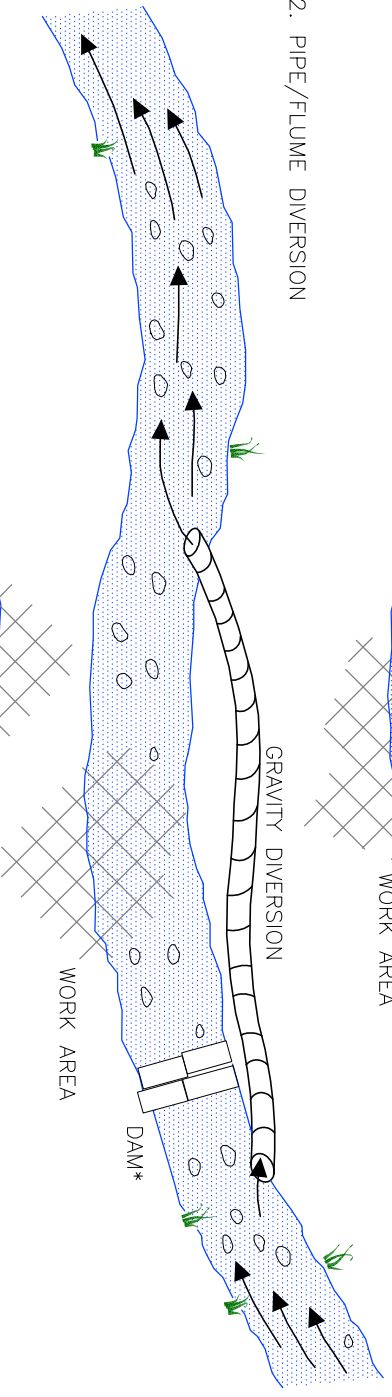
Ensure pump/diversion channel is able to transfer all flows around active work area based on volume of flows within drainage.

Ensure dam is functioning properly exhibiting no evidence of breaching/failure.

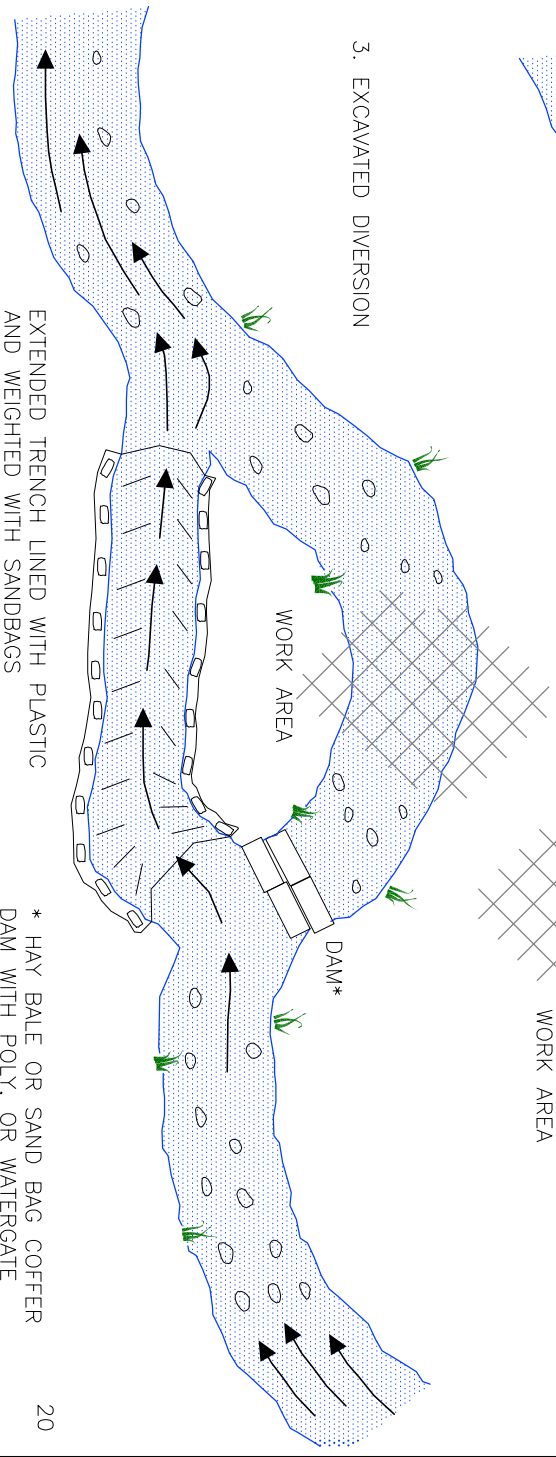
1. PUMPED DIVERSION



2. PIPE/FLUME DIVERSION



3. EXCAVATED DIVERSION



EXTENDED TRENCH LINED WITH PLASTIC
AND WEIGHTED WITH SANDBAGS

* HAY BALE OR SAND BAG COFFER
DAM WITH POLY, OR WATERGATE