



Environmental Protection Plan

Line 5 Wisconsin Segment Relocation Project

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INTRODUCTION

This Environmental Protection Plan (EPP) outlines construction-related environmental policies, procedures, and protection measures Enbridge developed as a baseline for construction. Enbridge developed this EPP based on its experience implementing Best Management Practices (BMPs) during construction; the Wisconsin Department of Natural Resources (WDNR) Storm Water Construction Standards; and the Federal Energy Regulatory Commission's (FERC's) Upland Erosion Control, Revegetation, and Maintenance Plan (May 2013 Version) and Wetland and Waterbody Construction and Mitigation Procedures (May 2013 Version). It is intended to meet or exceed federal, state, and local environmental protection and erosion control requirements, specifications, and practices. The EPP addresses typical circumstances that may occur along the Project. Project-specific permit conditions and/or landowner agreements may supersede the general practices described in this document. Landowner agreements must also comply with applicable federal and state permit conditions.

Alternative construction procedures implemented in lieu of this EPP will provide an equal or greater level of protection to the environment and require advance approval from Enbridge. Unless otherwise specified, the construction Contractor (Contractor) is responsible for implementing the requirements of this EPP.

Enbridge will provide construction oversight to monitor compliance with the measures of this EPP and requirements of applicable permits. Enbridge's Environmental Inspectors (EIs) will assist the Contractor in interpreting and implementing the requirements of the EPP and verify compliance with these procedures for Enbridge. The EIs will interpret environmental conditions and requirements and will coordinate and consult with Project management staff to address unforeseen situations should they occur in the field. The EI, in consultation with Enbridge Environment staff, will have the authority to stop activities and order corrective mitigation for actions that are not in compliance with the measures in this EPP, landowner agreements, or environmental permit requirements.

1.0 CONSTRUCTION LINE LIST AND PERMITS

Enbridge will provide the Contractor with a Construction Line List (CLL) that describes special requirements (e.g., timber salvage, topsoil segregation, restoration measures, fencing requirements, etc.) as agreed upon with landowners provided the special requirements conform to Project permits. The Contractor will comply with these special requirements and/or permit conditions.

The CLL identifies requirements and comments provided by landowners; however, it is not a comprehensive list of construction requirements. The CLL will be considered in conjunction with other Project documents and permits. Permit requirements supersede landowner preferences unless the permit defers to the landowner.

2.0 RIGHT-OF-WAY REQUIREMENTS

All construction equipment and vehicles will be confined to the approved construction right-of-way (ROW) and additional temporary workspace (ATWS). Construction activities are restricted to the approved designated areas.

The construction ROW (i.e., construction workspace) for the Project will vary and includes the permanent ROW, temporary workspace, and ATWS as defined below and shown in Figures 1 through 3, 14 through 16, and 18.

- ROW (Permanent): The permanent ROW is the portion of the construction ROW that Enbridge maintains to facilitate access and aerial inspection of the pipeline system.
- Temporary Workspace: In addition to the permanent ROW, construction requires Temporary Workspaces (TWS). The TWS is adjacent to and contiguous with the proposed permanent ROW.
- ATWS: Site-specific ATWS is necessary at select locations such as steep slopes, roads, waterbodies, railroads, some wetland crossings, and to cross under existing pipelines or foreign utilities. ATWS is typically in uplands adjacent to the construction ROW and at least 50 feet away from wetland boundaries and the ordinary high-water mark/ordinary high water level (OHWM/OHWL) of waterbodies except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land. If safe work practices or site conditions do not allow for a 50-foot setback at a waterbody, Enbridge designs ATWS areas no closer than 20 feet from the OHWM/OHWL of a waterbody. In some areas, Enbridge designs ATWS closer and within wetland resource boundaries.

Prior to commencement of clearing operations, Enbridge will mark the outer limits of the construction ROW and ATWS.

3.0 IDENTIFICATION OF RESOURCES AND ENVIRONMENTALLY SENSITIVE AREAS

Enbridge will post signs identifying the boundaries of sensitive resource areas, waterbodies, wetlands, or areas with special requirements along the construction work area.

4.0 CONTROLLING SPREAD OF UNDESIRABLE SPECIES

It is Enbridge's intent to minimize the potential introduction and/or spread of undesirable species (i.e., invasive species, noxious weeds, or crop diseases) along the construction ROW due to pipeline

construction activities. However, it is not practicable for Enbridge to eradicate undesirable species that are on or adjacent to the construction ROW. Enbridge will identify plant species that are considered noxious weeds and/or invasive plants that may occur within the counties being crossed by the pipeline corridor.

4.1 PREVENTION AND CONTROL MEASURES

To prevent the introduction of identified noxious weeds and invasive species to the Project, construction equipment will be cleaned prior to arriving on site. Equipment designated for use within waterbodies will be washed and dried prior to use. Purge and clean all pumps before proceeding from one location to the next if designated noxious weeds or invasive species (e.g. zebra mussels, Eurasian milfoil, etc.) are known to be present in the area. The Contractor(s) will keep logs documenting the cleaning history of each piece of equipment and make the logs available to the EI or other Enbridge Representative upon request. Contractors may use the equipment cleaning log provided in Appendix A or an equivalent form approved by Enbridge. In the event that equipment and/or material arrives onsite that Enbridge deems not to be clean, the Contractor will be responsible for cleaning the equipment and/or materials (at an Enbridge approved site). Any equipment found to be in noncompliance with the cleaning requirement will be removed from the Project sites until it has been adequately cleaned. The Contractor will be responsible for the proper disposal of all visible dirt and loose materials at an Enbridge approved facility.

Prior to clearing and grading of the construction right-of-way and pending landowner permission, major infestation areas identified during surveys or by Enbridge's EIs may be treated with the recommended herbicides or their equivalents as identified through consultation with local authorities. All proposed herbicides will be reviewed and approved by Enbridge's Environment Department prior to use. Alternatively, full construction ROW topsoil segregation may be implemented for weed control in upland areas to allow equipment to work through the area after topsoil has been stripped, as long as equipment stays on the subsoil (clearing, grading, and restoration equipment will still be cleaned). The Contractor(s) will obtain necessary permits and/or certifications for the use of the applicable herbicides, is responsible to limit off-ROW overspray, and will comply with state laws regarding the use of those herbicides. Contractor(s) will keep proper documentation of the locations where the herbicides have been used and provide such documentation to Enbridge within 3 days of completing the work. Weed control spraying will be restricted near certified organic farms and prohibited on certified organic farms. Treatment of known infestation areas will be completed in accordance with applicable chemical contact times (as specified by the manufacturer) in advance of clearing and grading within the construction ROW. Treatment may be restricted in areas that are not readily accessible, such as areas where access is limited by topography or other site conditions such as saturated/inundated soils. In the event that an area is determined to be inaccessible, the EI will be notified and a site-specific alternative treatment method will be developed.

If herbicide application is not used, mechanical means (scrape down/blow down) will be used to remove weeds from tracked equipment prior to leaving the infested area. High pressure water wash stations may be established in select areas if the above measures do not adequately remove soil and vegetation debris from construction equipment. Enbridge will determine where this practice will be implemented.

To prevent the spread of noxious weeds and invasive species during construction Enbridge will minimize the time duration between final grading and permanent seeding. In addition, mulch used on the Project will consist of weed-free material. The Contractor(s) will be responsible for identifying and acquiring sources of weed-free mulch. Sources will be approved by Enbridge prior to purchase.

Additional Project-specific information on invasive and noxious weed control can be found in Enbridge's Invasive and Noxious Weed Control Plan ("INS Plan").

5.0 POTHOLING/HYDROVAC SLURRY

Hydrovac excavation may be used to positively identify pipelines and other buried utilities. Hydrovac slurry typically consists of water and native soil. Hydrovac slurry will be stored in an Enbridge-approved subsoil area using an unlined bermed containment or a topography-contained area within the construction workspace. Final disposal of hydrovac slurry will occur at an Enbridge-approved upland subsoil area within the construction workspace on the same parcel that the hydrovac material was generated, or at an off-site approved disposal facility. If disposal occurs on site, the hydrovac material must be incorporated into subsoil material prior to topsoil replacement. Enbridge does not allow discharge of hydrovac slurry on to topsoil or mixing with topsoil.

6.0 WET WEATHER CONSIDERATIONS

This EPP contains best management practices for construction to continue during most wet weather conditions. BMP examples include but are not limited to full topsoil segregation in agricultural areas, dewatering requirements, and agriculture area compaction relief. However, Enbridge will suspend certain activities during construction in wet soil conditions, based on consideration of the following factors:

- extent of surface ponding;
- extent and depth of rutting and mixing of soil horizons;
- areal extent and location of potential rutting and compaction (i.e., can traffic be rerouted around wet area); and,
- type of equipment and nature of the construction activity proposed.

The Contractor will cease work of the applicable activity until Enbridge determines that site conditions are such that work may continue. The EIs, in collaboration with Enbridge construction management, will ultimately decide if wet weather shutdown of a construction activity is necessary in a given location.

Should wet weather create field conditions that result in sediment transport, including on Project-approved access roads, Enbridge's EIs will work with the Project's contractor to adaptively manage changing field conditions through installation of additional site-specific erosion controls based on changing conditions at the time of construction. These site-specific erosion controls will include silt fence, bio-logs, straw bales, or equivalent erosion and sediment control devices based on the changing site conditions. Where additional BMPs are necessary, Enbridge's EI and the Project's contractor will determine the appropriate BMPs based on field conditions (such as slope, length of slope, presence of sensitive features, or presence of concentrated flow) per this EPP and the applicable Technical Standards.

7.0 CLEARING AND GRADING

The initial stage of construction involves the clearing of brush, trees, and tall herbaceous vegetation from the ROW. Clearing may be accomplished with chain saws, mowers, and hydraulic tree-cutting equipment, which generally results in little soil disturbance.

7.1 DISPOSAL OF NON-MERCHANTABLE TIMBER

Disposal of non-merchantable timber and slash will occur by mowing, chipping, grinding, and/or hauling off site to a disposal facility or chipped and used as mulch at sites that are not seeded (refer to WIDNR Technical Standard 1058 included in Appendix F).

In non-agricultural, non-wetland areas, chips, mulch, or mechanically cut woody debris may be uniformly broadcast across the ROW where the material would ultimately be incorporated into the topsoil layer during grading activities, with landowner approval (coordinated through Enbridge ROW agents) and in accordance with WIDNR Technical Standard 1058 (Appendix F).

Vegetation and trees within wetlands will be cut off at ground level, leaving existing root systems intact; clearing debris will be removed from the wetland for disposal. Hydro-axe debris, or similar can be left in the wetland if spread evenly in the construction ROW to a depth which will allow for normal revegetation, as specified in applicable permit conditions and not to exceed two inches in depth/thickness.

Burning of non-merchantable wood will be allowed only where the Contractor has acquired all applicable permits and approvals (e.g. agency, landowner) and in accordance with all applicable regulations. The Contractor will provide Enbridge with copies of these permits and/or approvals prior to initiating burning.

7.2 DISPOSAL OF MERCHANTABLE TIMBER

All merchantable timber will be managed in accordance with landowner and/or Contractor agreements.

7.3 STUMP REMOVAL

To facilitate proper cleanup and restoration in upland areas, tree stumps outside the ditch line will be ground below normal ground surface or completely removed and hauled off to an Enbridge-approved disposal facility. Stumps in the ditch line will be completely removed, ground, and hauled to an approved disposal facility.

In wetlands that are not actively cultivated or in rotated cropland, the extent of tree stump removal will be limited to directly over the ditch line. Stumps and root systems from the rest of the construction ROW in wetlands will not be removed, unless Enbridge determines that safety-related considerations require them to do so.

7.4 CLEARING AND GRADING ADJACENT TO WATERBODIES

During initial clearing, a 20-foot section (from the OHWM/OHWL) of undisturbed herbaceous vegetation on all stream banks will be left to limit the potential for sediment transport by runoff, except where grading is necessary for bridge installation, or where restricted by applicable regulations and/or permit conditions (such as impaired waterways).

Woody vegetation within the 20-foot undisturbed section can be cut and removed during clearing, leaving the stumps and root structure intact. Non-woody vegetation and the soil profile will be left intact until ready to begin trenching the stream crossing. This buffer should not be confused with the 50-foot setback required for extra workspace or erosion and sediment control measures. Sediment control measures at the 20-foot line adjacent to streams must be installed and maintained immediately after clearing and prior to initial ground disturbance.

7.5 GRADING IN A WETLAND

Grading activities will be confined to the area of the trench. Enbridge will only allow grading outside the trench where required to ensure safety and to restore the construction ROW after backfilling the trench.

8.0 EROSION AND SEDIMENT CONTROLS

8.1 RIGHT-OF-WAY ACCESS

Access to the ROW will be from public roadways and Enbridge-approved private access roads only. Enbridge is responsible for posting signs or other methods to identify approved access roads in the field and to confine access only to the approved roads. Access roads must be maintained throughout construction to minimize resource disturbance associated with Project activities, such as rutting and/or sediment runoff. The level of effort needed to maintain the temporary access roads during active construction will be based on field conditions encountered throughout construction. Where access roads cross a wetland, matting will be installed through the wetland to minimize the potential for rutting, compaction, and soil mixing due to construction traffic. If rutting develops along temporary access roads in upland areas, Enbridge will either add matting, install gravel/soil, grade the area, or restrict use of the access road until field conditions improve. Site-specific erosion controls will be installed as needed to prevent or minimize the transport of sediment off dirt access roads, including silt fence, bio-logs, straw bales, or equivalent erosion control devices. Additional BMPs will be determined based on field conditions, including slope, slope length, presence of sensitive features, and presence of concentrated flow.

Vehicle tracking of soil from the construction site will be minimized by installation and implementation of BMPs such as stone pads, timber mats, reducing equipment/vehicle access to the construction ROW where practicable (off-ROW parking), or equivalent. Installation of stone access pads will be in accordance with applicable permits and state/federal specifications, including WIDNR Technical Standard 1057 (Appendix F). If such BMPs are not adequately preventing sediment tracking onto public roads, street sweeping (or other equivalent means of collecting sediment) will be used. If soil tracking onto a roadway occurs, the accumulated material will be removed from the road and returned to the construction ROW within an upland area as soon as possible, but in no circumstances more than 24 hours after discovery. In addition, soil on roadways cannot be swept, washed, or graded into the road ditch or onto the shoulder. If the roadside ditch is part of a jurisdictional waterway, tracking pads will be placed in adjacent upland areas unless the adjacent upland area is actively cultivated agricultural land. If tracking pads cannot be relocated to an adjacent upland area, Enbridge will obtain a permit from the applicable authority prior to installing the tracking pad or culvert. If permitted in wetlands, Enbridge will limit tracking pads in size to reduce impacts. Tracking pads installed in wetlands will use clean rock placed on geotextile fabric, as approved by an EI and with approval from applicable regulatory agencies. All rock and fabric will be removed from the wetland during cleanup.

8.2 TEMPORARY EROSION AND SEDIMENT CONTROLS

Temporary erosion and sediment control devices (ECDs) will be installed after clearing and prior to grubbing and grading activities at the base of sloped approaches to streams, wetlands, and roads. Temporary ECDs will also be installed at the edge of the construction ROW as necessary to contain spoil and prevent sediment transport off right-of-way. Temporary ECDs may be installed in other areas determined by the EI to slow water leaving the site and prevent siltation of waterbodies and wetlands down slope or outside of the construction ROW (e.g., swales and side slopes). ECDs may also be necessary

along the edge of the construction ROW to contain spoil and sediment within the construction ROW through wetlands.

Temporary ECDs will be placed across the entire construction ROW at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from tile line inlets, drainage ways, wetlands, and/or waterbodies until final stabilization occurs and there is no potential scouring or sediment transport to surface waters. Adequate room will be available between the base of the slope and the sediment barrier to accommodate ponding of water and sediment deposition.

All non-functional ECDs will be repaired, replaced, or supplemented within 24 hours after discovery, or as soon as practicable following discovery. In limited situations of non-functional ECDs discovered near existing utilities, such as roadways or within utility crossings, where digging would be required to repair ECDs, Enbridge may extend the timing in areas where an active one call is not in place to accommodate the one call regulations. Enbridge will take measures to temporarily contain stormwater until the one call is updated and ECDs can be repaired, replaced, or supplemented. Refer to the Project alignment sheets and field markings for locations of underground utilities.

Temporary ECDs installed across the travel lane may be removed during active daytime construction; however, they must be properly reinstalled after equipment passage, or activities in the area are completed for the day. These ECDs must also be repaired and/or replaced prior to inclement weather, when forecasted.

8.3 SILT FENCE, STRAW BALES, BIOLOGS, DITCH CHECKS, SEDIMENT TRAPS, & SEDIMENT BASINS

Figures 4 through 6 include the installation specifications for silt fence, straw bales, and biologs. If the Contractor uses silt fence or straw bales, they must remove sediment when the depth reaches one-third of the height. If the Contractor uses biologs, they must remove sediment when the depth reaches one-half of the height. Silt fence and biologs must be installed and maintained in accordance with WIDNR Technical Standard 1056. Straw bales must be installed and maintained in accordance with WIDNR Technical Standard 1055.

In areas where concentrated flow paths with contributing drainage area less than one acre cross a line of silt fence or in low points in a silt fence, ditch checks will be used in accordance with WIDNR Technical Standard 1062 to reduce the velocity of water.

Where natural upland water conveyances/concentrated flow paths with contributing drainage areas greater than one acre are bisected by the construction workspace, site-specific erosion and sediment controls will be implemented to either divert flow away from the right-of-way following a runoff event, or the conveyance will be temporarily dammed to prevent erosion and sediment transport. Where concentrated flow is dammed, each location must be checked following a 0.5 or greater rain event/following a snow melting event. Water that has accumulated upslope of the will be pumped across the construction worksite and discharged downslope into the conveyance/concentrated flow path using dewatering practices as outline in this EPP and in accordance with WIDNR Technical Standard 1061.

8.4 TEMPORARY STABILIZATION

Installation of temporary seeding, mulch (straw or hydromulch), and erosion control blanket may be required by Enbridge in certain locations (including topsoil piles) if there are construction delays within a

spread of at least 14 days. Enbridge may require the Contractor to install temporary stabilization materials sooner based on site conditions, or as required in Project permits.

8.5 EROSION CONTROL BLANKET

The appropriate class of erosion control blanket will be installed in accordance with manufacture recommendations, state Department of Transportation (DOT) specifications, and/or WIDNR Technical Standards 1052 and 1053 (Appendix F) when restoring waterbodies, on exposed slopes greater than 30 percent, and other areas as specified by Enbridge (refer to Figure 7). Erosion control blanket installation on exposed slopes will be completed prior to snowfall where practicable; however, construction progress and/or seasonal weather variations may prevent installation prior to the first snowfall. Erosion control blankets with plastic should not be used near waterbodies or sensitive resource areas.

8.6 MULCH

Enbridge will require mulch (weed free straw, wood fiber hydromulch, or a functional equivalent) to provide temporary stabilization for topsoil/subsoil or during restoration to support revegetation in accordance with WIDNR Technical Standard 1058 (Appendix F), landowner agreements, and/or other applicable permit conditions. Enbridge specifically requires mulch on:

- Slopes greater than 5 percent; and
- Dry, sandy areas that can blow or wash away (field decision).

Mulch will be free of noxious weeds, as listed in applicable state laws. The Contractor will be responsible for identifying and acquiring sources of weed-free mulch and receive Enbridge approval prior to purchase.

Mulch will be applied at a rate of 2 tons per acre to cover at least 75 percent of the ground surface, unless otherwise stipulated by permit conditions; and distribution will occur by a mechanical mulch blower or by hand in areas not accessible to the mulch blower. Mulch shall be long enough to be effectively anchored/crimped using a mulch-anchoring tool or disc set in the straight position to minimize loss by wind and water, as site conditions allow. In areas not accessible to a mulch-anchoring tool or too steep for safe operation, liquid tackifiers may be used with advance written approval from Enbridge and following the manufacturer's recommended method and rate of application. Mulch should not be applied in concentrated flow paths. Erosion control blankets should be installed in these locations in accordance with requirements outline in this EPP and WIDNR Technical Standard 1053.

The Contractor can use hydro-mulch and liquid tackifier in place of straw or weed-free hay mulch with prior approval from Enbridge. All hydromulch and liquid tackifier products will be on the applicable state DOT product list. Application rates of land applied additives will be at the manufacturer's recommended rate and in accordance with WIDNR Technical Standard 1050 (Appendix F).

8.7 CAT TRACKING

Cat tracking may be implemented, based on site conditions (sandy or silt soils) and in accordance with WIDNR Technical Standard 1067 (Appendix F), to reduce erosion potential by driving a bulldozer vertically up and down the slope, which results in the tracks being oriented horizontally; creating small speed bumps for water (refer to Figure 8).

8.8 DRAIN TILE INLET PROTECTION

Enbridge will attempt to locate existing drain tile inlets that are located near the construction work area prior to construction and mark using flags. The Contractor will protect located drain tile inlets with the potential to receive stormwater from construction of the Project using the appropriate ECDs until sources with the potential to discharge achieve stabilization. The determination of the specific ECD will be made in accordance with WIDNR Technical Standard 1060 (Appendix F) based on the location of an inlet with respect to the Project area, drainage area from the construction work area to the inlet, topography, vegetation, soils, and accessibility to the inlet. Where drain tile inlets are located off of the construction ROW, Enbridge may not have authorization to install ECDs at the inlet site. In these cases, sediment control measures (typically silt fence) will be installed along the edge of the construction work area that drains to the inlet structure to minimize sedimentation.

8.9 TEMPORARY AND PERMANENT SLOPE BREAKERS

Temporary and permanent slope breakers will be installed to minimize concentrated or sheet flow runoff in disturbed areas in accordance with the maximum allowable spacing included on Figure 9 and/or the WIDNR Technical Standard 1066 (Appendix F), unless otherwise specified in permit conditions. Spacing between slope breakers may be reduced to minimize slope length and to divert surface runoff based on site-specific conditions.

If the length of the slope is less than the distance of the required spacing, slope breakers are not necessary unless a sensitive resource area (e.g., wetland or public roadway) is immediately down slope, or as requested by the EI. Temporary slope breakers will be constructed according to the specifications provided in Figures 9 and 10 and WIDNR Technical Standard 1066 (Appendix F). Permanent slope breakers will not be installed in wetlands or across waterbodies.

With exception for actively cultivated areas, permanent berms (diversion dikes or slope breakers) will be installed on all slopes, according to the requirements provided in Figures 10 and 11, unless otherwise specified in permit conditions

8.10 NOISE AND DUST CONTROL

The Contractor must take reasonable steps to control construction-related noise near residential areas and other areas as directed by Enbridge. The Contractor must take reasonable steps to control construction-related dust near residential areas, near road ways, in areas prone to wind erosion, and any other areas as directed by Enbridge. Control practices must be in accordance with WIDNR Technical Standards 1068 (Appendix F) and may include wetting the ROW and access roads, limiting working hours in residential areas, reestablishment of vegetation and/or additional measures as appropriate based on site-specific conditions

9.0 TOPSOIL SEGREGATION

Upland areas where topsoil will be stripped include croplands, hay fields, pasture, residential areas, and other areas as requested by the landowner or as specified in the Project plans, commitments, and/or permits. Topsoil will not be used to construct berms, trench breakers, temporary slope breakers, improving or maintaining roads, or to pad the pipe. Berms for stacking pipe in pipe yards may be constructed using topsoil with landowner permission. Gaps will be left where stockpiled topsoil and spoil piles intersect with water conveyances (i.e., ditches, swales, and waterways) to maintain natural drainage and install ECDs.

9.1 TOPSOIL SEGREGATION METHODS

The following topsoil segregation methods will be employed during construction:

- Full Construction ROW (refer to Figure 1)
- Trench-Line-Only (refer to Figure 2)
- Modified Ditch-Plus-Spoil Side (refer to Figure 3)

The Full Construction ROW topsoil segregation technique is typical in active cropland, hayfields, pasture, and residential areas which will consist of stripping topsoil from the spoil storage area, ditch line, and the travel lane to the topsoil storage area. Enbridge utilizes the Trench-Line-Only topsoil segregation method where the width of the construction ROW is insufficient for other methods. Enbridge will utilize the Trench-Line-Only topsoil segregation method in wetlands without standing water. Enbridge does not typically segregate in standing water wetlands unless specifically requested by the landowner and/or managing land agency in accordance with applicable permit conditions.

Enbridge may use alternative topsoil segregation methods, such as Ditch-Plus-Spoil or Modified Ditch-Plus-Spoil Side, in grass and forest areas or as requested by the landowner.

9.2 DEPTH OF TOPSOIL STRIPPING

In deep soils (more than 12 inches of topsoil), topsoil will be stripped to a minimum depth of 12 inches, unless otherwise specified/requested by other plans, permit conditions, or the landowner. Additional space may be necessary for spoil storage for stripping of more than 12 inches of topsoil. If less than 12 inches of topsoil are present, the Contractor will attempt to segregate to the depth that is present.

When constructing in wetland areas without standing water, up to 12 inches of topsoil (organic layer) will be stripped from the trench line and stockpiled separate from trench spoil to preserve the native seed stock. In standing water wetlands, organic soil segregation is not typically practical; however, the Contractor will attempt to segregate as much of the organic layer as possible based on site/saturation conditions.

10.0 TRENCHING

Trenching in uplands typically occurs using a backhoe excavator or a rotary wheel ditching machine. A backhoe is typically used to excavate the trench in wetlands. Excavated material will be side cast (stockpiled) within the approved construction ROW separate from topsoil. Where Enbridge deems appropriate, plugs of subsoil in the ditch will be left or temporary access bridges across the trench will be constructed for the landowner to move livestock or equipment. Trenches will also be sloped where they start and end to allow ramps for wildlife to escape.

Unless Enbridge or Project permits specify otherwise, the Contractor will limit the amount of excavated open trench to a maximum of 3 days of anticipated welding production per spread, per pipe. Enbridge may decrease this timeframe based on site conditions. Site-specific activities such as horizontal directional drilling, guided bores, road bores, tie-in points, and valve work may occur independent of a spread and are not subject to the timeframe restriction.

11.0 TRENCH BREAKERS

Trench breakers slow the flow of subsurface water along the trench. Trench breakers will be constructed of non-native materials such as sand bags, bentonite bags, or polyurethane foam and will not use topsoil.

Trench breakers must not be constructed using topsoil. The materials selected at each location will be dependent on site-specific conditions such as ground water level, soil type/composition, slope, and proximity to sensitive resource areas such as wetlands and waterbodies.

Trench breakers will be installed at the base of slopes greater than 5 percent where the base of the slope is less than 50 feet from a waterbody or wetland, and where necessary to avoid draining a waterbody or wetland. Trench breakers will extend (key into) the undisturbed trench walls a minimum of 6 inches, and will be placed from the bottom of the trench to near the top, completely surrounding the pipe. Trench breakers will not be installed within a wetland. Enbridge Engineering will determine the need for, and spacing of, any additional trench breakers.

12.0 CONCRETE COATING

Concrete will typically be mixed off-site and coated pipe will be transported to the construction ROW on trucks. If required, pre-fabricated concrete weights and/or saddlebag weights may be used to provide negative buoyancy. Limited mixing and coating activities may occur on the construction ROW for coating pipe joints and concrete weight repairs.

Equipment used for mixing, pouring, casting, or coating will not be washed within 100 feet of any wetland or waterbody. Concrete wash water will be contained in a leak-proof containment facility or impermeable liner. The Contractor will provide equipment capable of reclaiming wash water during wash out. The EI will determine where ECDs are necessary down slope of equipment wash areas to capture sediments and minimize erosion from runoff.

13.0 DRAIN TILE REPAIRS

The following requirements apply to the repair of damaged drain tile lines:

- Damaged/cut drain tile lines will be staked or flagged in such a manner that they will remain visible until permanent repairs are made prior to final backfilling of the trench. Enbridge will record the location of damaged, cut, and repaired tile lines using GPS technology or equivalent.
- Screens (or equivalent) will be installed on all damaged drain tile lines to prevent the entry of foreign materials, small mammals, etc.
- If water is flowing through any damaged drain tile line, immediate temporary repair will be completed until such time that permanent repairs can be completed. If the drain tile lines are dry and water is not flowing, temporary repairs are not necessary if the permanent repairs can occur within 14 days of the time the damage occurred.
- Rain events during dry periods can produce flow and require temporary repairs to facilitate draining of the fields to prevent crop damage. Damaged drain tiles will be temporarily or permanently repaired within 48 hours after a one inch rain event, or flow occurs in a previously non-flowing drain tile.
- Permanent repairs shall be made in accordance with the contract specifications. The Contractor will utilize double-walled drain tile and maintain the original alignment and gradient.
- Before completing permanent repairs, the drain tile lines on both sides of the trench will be probed (or examined by other suitable means) for their entire length within the work areas to check for damage by vehicular traffic or construction equipment and repair accordingly.

- Permanent drain tile line repairs shall be made within 14 days of pipeline installation within the trench, weather and soil conditions permitting

14.0 BACKFILLING

Backfilling follows pipe installation and consists of replacing the material excavated from the trench. In areas where topsoil segregation occurred, the subsoil will be replaced and the topsoil spread uniformly over the area from which it was removed. Prior to backfilling, the trench may be dewatered, in accordance with the methods discussed in Section 25.1, if water obscures the trench bottom.

Subsequent to pipe installation, backfilling of wetland trenches will take place immediately, or as approved by EI. Wetlands will be restored as near as practicable to pre-construction conditions and reasonable attempts will be made to return the subsoil to its pre-construction density. During backfilling of wetland areas, subsoil will not be mounded above the height of the adjacent undisturbed trench wall. Subsoil that exceeds the elevation of the ground adjacent to the trench will be removed from the wetland and disposed of in an upland area or an Enbridge-approved disposal site. After the trench is backfilled with subsoil, the previously segregated topsoil will be spread over the trench area and mounded no more than 12 inches above the adjacent, undisturbed soil. In unsaturated wetlands, Enbridge may specify a lower maximum height based on site conditions.

15.0 CLEANUP

All waste materials, including litter generated by construction crews, will be disposed of on a daily basis. Initial cleanup and rough grading activities may take place simultaneously. Cleanup involves removing construction debris (including litter generated by construction crews and excess rock) and large woody debris. Final grading includes restoring disturbed areas as near as practicable to preconstruction conditions, returning the topsoil where stripped, preparing a seedbed and de-compacting subsoil (where applicable) for permanent seeding, installing or repairing temporary ECDs, repairing/replacing fences, and installing permanent erosion controls.

Cleanup (including installation of temporary ECDs) will begin within 72 hours after backfilling the trench. Final grading, topsoil replacement, seeding, and installation of permanent erosion control structures will be completed within 20 days after backfilling the trench (10 days in residential areas). If an area is not actively being restored for a period of 14 days or greater, the area must be temporary stabilized (e.g., seeded and mulched, hydromulched, or similar). If construction or restoration unexpectedly continues into the winter season and conditions prevent compliance with these timeframes, the area must be temporarily stabilized and ECDs will be installed and maintained until conditions allow completion of cleanup.

16.0 SOIL COMPACTION TREATMENT

Subsoil compaction on the equipment travel areas of the ROW will be alleviated utilizing a deep tillage device or a chisel plow. Cultivated fields will be decompacted to a subsoil depth of 18 inches; however, closely spaced drain tiles areas may necessitate a shallower depth. All other areas will be decompacted to a subsoil depth of 12 inches. Decompaction in most cases will occur prior to topsoil placement. Seasonal conditions may necessitate replacing the topsoil prior to alleviating subsoil compaction. In these areas, decompaction depths will be increased by the topsoil depth. The presence of stumps and roots may preclude the activity in forested areas where ditch plus spoil segregation occurred.

If subsequent construction and cleanup activities result in further compaction, additional measures to alleviate the soil compaction will be performed.

17.0 ROCK REMOVAL

Rock removal will occur in cultivated areas, hayfields, pastures, and residential areas, as well as other areas at the landowner's request. A diligent effort will be made to remove excess stones equal to or larger than 4 inches in any dimension from the upper 4 inches of the subsoil, or as specified in permit conditions or landowner requirements. Rock removal will occur after soil decompaction. In the same areas after topsoil replacement, rock removal will continue until the size and density of stones greater than 4 inches in any dimension are similar to undisturbed areas adjacent to the ROW.

Rocks removed from the ROW may be piled in upland areas with landowner permission, or hauled off-site to an Enbridge-approved disposal site.

18.0 REPAIR OF DAMAGED CONSERVATION PRACTICES

All soil conservation practices (such as terraces, grassed waterways, etc.) that are damaged by the pipeline construction will be restored to preconstruction conditions to the extent practicable.

19.0 LAND LEVELING FOLLOWING CONSTRUCTION

Following the completion of the pipeline, the construction ROW will be restored to its pre-construction conditions, as practicable. Should uneven settling or documented surface drainage problems occur following the completion of pipeline construction and restoration, Enbridge will take appropriate steps to remedy the issue.

20.0 OFF-ROAD VEHICLE CONTROL

Enbridge will install and maintain measures to control unauthorized vehicle access to the ROW upon completion of restoration activities at the request of the landowner. Such measures may include installing fences and gates, or placement of other barriers such as boulders or timbers.

21.0 REVEGETATION & MONITORING

Enbridge developed this section in conjunction with Natural Resources Conservation Service (NRCS) guidelines. Project-specific permit conditions and landowner requests (with exception to wetlands) for specific seed mixes (as indicated in the Project CLL) take precedence over this section.

21.1 PROJECT SEED SPECIFICATIONS

Seed will be purchased on a Pure Live Seed (PLS) basis. Seed tags will identify:

- purity;
- germination;
- date tested;
- total weight and PLS weight;
- weed seed content; and
- seed supplier's name and business information.

Seed will be used within 12 months of testing as required by applicable state rules and regulations. The seed tags on the seed sacks will also certify that the seed is "Noxious Weed Free". Seed rates for the

Project assume a PLS rate, not actual weight basis. Therefore, to determine the correct application rate if not indicated on the seed tag, a correction calculation will be performed based the purity and germination. For example, a seed mix that has a specified 10 pounds PLS per acre, 95 percent germination rate, and is 80 percent pure needs to be applied at the following rate:

$$(95\% \text{ germination} \times 80\% \text{ purity})/100 = 76\% \text{ PLS}$$
$$10 \text{ pounds PLS per acre}/.76\% \text{ PLS} = 13.2 \text{ pounds per acre actual seeding rate}$$

The species components of individual mixes are subject to availability at the time of purchase. Grass species may be substituted with alternative native or non-invasive species that are included in the NRCS guidelines and with Enbridge approval.

During seeding activities, seed tags shall be collected and provided to Enbridge. The EI will review tags prior to installation to ensure that the seed mix complies with Enbridge's specifications and that the seed is being applied to the correct location. If bulk delivery of seed occurs, the above information will still be made available to Enbridge. Off-loading/on-loading of seed will not occur in a designated wetland area.

Legume seed (if used) will be treated with an inoculant specific to the species and in accordance with the manufacturer's recommended rate for the seeding method (broadcast, drill, or hydroseeding). When hydroseeding, four times the manufacturer's recommended rate of inoculant will be used.

21.2 TEMPORARY REVEGETATION

Unless specifically requested by landowners or land managing agencies, Enbridge does not intend to establish temporary vegetation in standing water wetlands and/or other standing water areas. In actively cultivated areas, Enbridge will restore the land in accordance with landowner agreements. If requested or approved by the landowner, Enbridge will apply a temporary seed mixture to stabilize the area.

21.3 TIMING FOR TEMPORARY VEGETATION

Temporary revegetation or site stabilization will be established in construction work areas where 14 days or more will elapse between:

- actively working a disturbed site;
- the completion of final grading at a site and application of the permanent seed and ECDs ; and/or,
- where there is a high risk of erosion due to site-specific soil conditions and topography.

Enbridge may require the Contractor(s) to conduct temporary seeding sooner than 14 days at site-specific locations near sensitive resource areas and/or areas prone to wind/water erosion.

Temporary vegetation will be established at any time between **April 1 and September 1**. Attempts at temporary revegetation after this date should be assessed on a site-specific basis and with Enbridge approval.

21.4 PERMANENT REVEGETATION

Permanent vegetation will be established in areas disturbed within the construction work area (permanent easement, TWS, and ATWS), except in actively cultivated areas and standing water wetlands. The seed mixes for permanent seeding include native seed varieties commonly found and/or available from local seed distributors. Enbridge selected seed mixes (refer to Appendix B) to augment revegetation

via natural recruitment from native seed stock in the topsoil and are not intended to change the natural species composition. Rates provided assume a drill application and will be adjusted as discussed in Section 21.1.

21.5 UPLAND CONSTRUCTION AREAS

Appendix B includes Enbridge's standard upland seed that include species that will provide for effective erosion control and revegetation of the Project area. This seed mix will be used in upland areas unless a landowner or land managing agency specifies otherwise.

21.6 WETLAND AREAS

Non-standing water wetlands will be seeded using the mix provided in Appendix B to provide temporary cover and allow natural revegetation via the seeds and rhizomes in the topsoil spread back over the ROW after pipe installation. No fertilizer, lime, or mulch will be applied in wetlands.

Enbridge does not plan to seed standing water wetland areas because the reestablishment of vegetation occurs best through natural process without supplemental seeding.

Enbridge plans to allow natural reforestation of the temporary workspace area within forested wetlands via stump sprouting, root sprouting, and natural recruitment.

21.7 WATERBODY BANKS

Enbridge will reestablish stream bank vegetation using the seed mix provided in Appendix B, unless applicable agencies specify otherwise. Where a waterbody is within a wetland, the banks will be reseeded with the applicable wetland seed mix.

21.8 SPECIALIZED SEED MIXES

Enbridge will provide specialized seed mixes upon landowner request on a site-specific basis for:

- Residential Areas: This seed mix will be used to reestablish residential lawns or other types of "turf-type" land cover.
- Wildlife Areas: This seed mix will be used to provide a desirable food source for wildlife, specifically deer.
- Conservation Reserve Properties: Enbridge will work with the landowners to apply parcel-specific CRP seed mixes when applicable.

21.9 SEED BED PREPARATION AND SEEDING PROCEDURES

Deep tillage will be performed in actively cultivated areas and in non-agricultural areas (as directed by Enbridge) to relieve soil compaction and promote root penetration. Deep tillage will not occur in non-farmed wetlands. The soil will then be tilled with a disc, field cultivator, or chisel plow (or equivalent) to prepare a seedbed, breaking up large clods and firm the soil surface to a minimum depth of 2 inches for temporary seeding or a minimum depth of 4 inches for permanent seeding in accordance with Technical Standard 1059 (Appendix F).

Tillage and equipment operations related to seeding and mulching will be performed parallel to ground contours as much as practicable. Fertilizer and other soil amendments will be incorporated into the soil during seedbed preparation per the Project-specific CLL requirements, Technical Standard 1059, and other permits.

21.10 SEEDING METHODS

Seed will be applied uniformly at specified rates across the prepared construction ROW by drilling, broadcasting, hydroseeding, or air seeding. The EI will suspend seeding activities if conditions are such that equipment will cause rutting of the surface in the designated seeding areas. Enbridge will continue to monitor ROW conditions to resume seeding activities as site conditions improve and according to the general seeding timing restrictions listed in Section 21.3.

21.10.1 Drill Seeding

Seeding equipment will be capable of uniformly distributing the seed and sowing it at the required depth. Drills will have a feeding mechanism that provides a uniform flow of seed at the desired application rate. Double-disc furrow openers, equipped with depth bands and packer wheels to firm the soil over the seed, will be used where practicable.

21.10.2 Broadcast Seeding

Broadcast seeding rate will be double the drill-seeding rate. Seed will be uniformly applied using a mechanical or hand operated seeder. Following seeding, a cultipacker, harrow, or hand rake will be used to cover the seeds and firm the seedbed as is appropriate for the area.

21.10.3 Hydroseeding

Hydroseeding rate will be double the drill seeding rate, or the same as broadcast seeding rate. Seed will be applied alone or in combination with fertilizer and/or hydromulch slurry. If seed is applied alone, the amount of hydromulch material will be adjusted to the seed slurry to show where seeding has taken place, providing a means to identify uniform cover of the construction ROW. Hydroseeders will provide continuous agitation and be capable of supplying a continuous, non-fluctuating flow of slurry. Enbridge will pre-approve all hydromulch products, which must be on the applicable state DOT product list.

21.11 COMPANION CROPS

Enbridge will utilize a companion crop (refer to Appendix B) with the perennial species where soil erosion is a severe hazard. A companion crop will be used with all seed mixes.

Seeding rates for companion crops are lower than normal seeding rates for those crops to reduce competition with the seeded perennial species.

21.12 SOIL AMENDMENTS

Enbridge will consult with NRCS representatives and review county soil survey information to assess where soil amendments, specifically the application of fertilizer or lime may be necessary to promote successful revegetation. Fertilizer or lime will not be used with native seed mixes. When using non-native species on dry, dry-mesic and mesic sites for permanent seeding, lime and fertilizer will be applied at rates appropriate based on the soil pH conditions. Soil amendments may be applied to agricultural, pasture, and/or residential lands at the request of landowners and/or land managing agencies. Enbridge will apply phosphate free fertilizers to areas within 100 feet of a waterway if soil amendments are necessary.

21.13 SEEDING PERIODS

Recommended seeding dates in the table below are based on climatic records, research, and experience; and they also represent optimum periods for the germination of grass and legumes. The dates below provide adequate development of adventitious roots prior to stressful periods.

Recommended Seeding Dates	
Species Type and Season of Planting	Recommended Dates
<u>Cool Season Species</u>	
Spring	Prior to May 20
Late Summer	August 10 to September 1
Late fall dormant seeding	Typically November 1 and later
<u>Warm Season Species</u>	
Spring	May 10 to June 25
<u>Warm/Cool Season Mix</u>	
Spring	May 1 to June 14

Enbridge may delay seeding during frozen ground conditions until the applicable spring seeding period or will complete dormant seeding where conditions allow (i.e., no snow cover). Enbridge will install temporary ECDs during frozen conditions.

21.14 TIMING OF FINAL SEEDING

Upon final grading of the construction ROW, and upon the restoration of wetland and waterways, seeding and restoration/stabilization will occur within 48 hours if weather and soils conditions allow. Other methods of stabilization will be used if temporary seeding is not appropriate due to seasonal conditions (e.g., mulch, erosion control blanket).

21.15 DORMANT SEEDING

Dormant seeding is a method used after soil temperatures cool to 55 degrees Fahrenheit or cooler to prevent germination. Dormant seeding is only practicable if the soil is not frozen and snow is not present. Procedures for applying soil amendments, seedbed preparation, seeding, and mulching are the same as outlined for permanent revegetation in this section.

Where dormant seeding is conducted, one or more of the following temporary ECDs will be installed within 48 hours of seeding, unless the local soil conservation authority, landowner, or land managing agency specifies otherwise:

- noxious weed-free straw mulch, at not more than 2 tons/acre, anchored;
- hydromulch, at 2 tons/acre, anchored; and/or
- erosion control blanket.

Additional ECDs will be applied at the request of the EI.

21.16 MANAGEMENT AND MONITORING

Enbridge will monitor restored areas in accordance with the Project-specific post-construction monitoring plans and conditions identified in the applicable Project permits and/or licenses. Monitoring will continue until restoration goals and permit conditions have been met.

22.0 CONSTRUCTION THROUGH ORGANIC FARMS

Pipeline construction through Organic farms certified or presently considered for certification under the National Organic Program (NOP) requires special consideration during construction. Therefore, Enbridge will prepare site-specific Organic Crossing Plans that will include by reference construction protocols provided in this EPP for pre-construction clearing, ROW preparation, construction, and post construction reclamation. Enbridge will document modifications to these practices to accommodate specific organic farm certification and farming practices in the Organic Crossing Plan. As such, Organic Farm crossing plans are site specific and Enbridge will provide, as necessary, as a supplement to this EPP.

23.0 STREAM AND RIVER CROSSING GENERAL REQUIREMENTS

The procedures in this section apply to streams, rivers, and other waterbodies such as jurisdictional ditches, ponds, and lakes.

Stream crossing requirements, including construction methods, timing, erosion control, and restoration are described in this section and in the stream crossing permits issued by state and federal agencies and by tribal authorities (as applicable). During wet and high runoff conditions, the EI will determine whether conditions warrant additional considerations for construction activities.

23.1 TIME WINDOW FOR CONSTRUCTION

All in-stream work activities (installation of dams, sheet piling, etc.) will be within the construction workspace reviewed and approved by the permitting agencies. In-stream trenching will be conducted during periods permitted by the appropriate regulatory agencies and applicable permits. Unless otherwise specified in applicable permits and with exception to blasting and other rock breaking measures and directional drill, in-stream construction activities (specifically trenching, pipeline installation, backfill, and restoration of the streambed contours) for wet crossing methods will occur within the following timeframes:

- Minor Waterbodies (all waterbodies less than or equal to 10 feet wide at the water's edge at the time of crossing): 24 hours
- Intermediate Waterbodies (all waterbodies greater than 10 feet wide but less than 100 feet wide at the water's edge at the time of crossing): 48 hours
- Major Waterbodies (all waterbodies greater than 100 feet wide at the time of crossing): As specified by Enbridge or in the applicable permits.

These timeframes apply when flow is present. These timeframes also apply to dry crossing methods as a guideline that Enbridge Environment staff, Construction Management, and the EI can extend based on site-specific conditions.

Enbridge designed stream crossings as close to perpendicular to the axis of the stream channel as engineering and routing constraints allow, creating the shortest crossing length. Clearing and grading near waterbodies will occur in accordance with Section 7.4.

23.2 BRIDGES

Temporary equipment bridges will be used to cross waterways (upon approval by the appropriate agency), including small waterways such as ditches and intermittent streams. Bridges will be constructed as described below and will be removed as soon as possible during final restoration. Bridges will not typically be installed at directionally drilled waterbodies, unless there is no reasonable alternative that provides an efficient, economical way to transport heavy construction equipment around the waterbody by truck.

23.2.1 Types of Bridges

Typical equipment bridges installation is shown on Figures 12 and 13. Enbridge has designated a specific bridge type for each waterbody crossing. Information on the approved bridge type is provided in Enbridge's Wetland and Waterbody Crossing Table. Approved Bridge designs are included in Appendix G of this EPP.

23.2.2 Bridge Design and Maintenance

Bridges will be designed as close to perpendicular to the axis of the stream channel, creating the shortest crossing length, using clean materials, and will be built and maintained in accordance with applicable permits. Equipment bridges will be designed to withstand the maximum foreseeable flow of the stream without restriction or cause pooling. Bridge headers may be keyed into the stream bank, but above the ordinary high water mark, where needed to safely install the bridge and accommodate construction use. The area disturbed for bridge headers must be minimized to the extent practicable. Areas disturbed for bridge placement must be stabilized with seeding, geotextile fabric, or temporary erosion control installation. Bridge approaches must be constructed using open materials (no earthen ramps). Bridges will be designed and maintained to prevent soil from entering the waterbody and soil that accumulates on the bridge decking will be removed.

23.2.3 Bridge Removal

Equipment bridges will be removed during final cleanup or, if access is necessary, after final cleanup and permanent seeding. Restoration of the bridge area will occur upon bridge removal. Restoration will include restoring original contours, seeding, installation of erosion control blankets, and installation of temporary erosion controls based on site-specific conditions per Section 8.0 of this EPP and in accordance with application Technical Standards.

23.3 STREAM AND RIVER CROSSING CONSTRUCTION METHODS

The following stream and river crossing methods will be used, subject to further restrictions by Enbridge and applicable permits.

23.3.1 Wet Trench Method

A dry crossing method must be used to cross waterbodies with standing or flowing water. These methods include the dam and pump method and the flume method. The wet trench method may be used to cross streams and rivers not permitted using other techniques (flume, dam and pump, or directional drilling) in accordance with the following procedures and Figure 14:

- Install sediment control measures from the 20-foot vegetative buffer left on each stream bank. Install spoil containment structures back from the stream bank so that spoil does not migrate into the stream.

- Grade stream banks and areas necessary for safe bridge and pipeline installation will be within the construction workspace reviewed and approved by the permitting agencies.
- After grading, use backhoes or draglines to excavate the trench. Where possible, excavating equipment will operate from one or both banks, without entering the stream. If equipment must encroach into the stream, it will operate on clean construction mats. Streambed material will be segregated (e.g., upper one foot and the remaining trench spoil will be stored separately) and placed within a spoil containment structure in approved construction work area limits. Storage of streambed spoil within the stream will only occur if expressly approved in the applicable permits.
- Leave earthen trench plugs (hard plugs) between the stream and the upland trench undisturbed during excavation of the in-stream trench to prevent diversion of the stream flow into the open trench and to prevent water from the adjacent upland trench from entering the waterbody. Remove trench plugs immediately prior to pipe placement, and then replace when the pipe is in place. Dewater trench water accumulated upslope of trench plugs in accordance with Section 25.1 prior to trench plug removal. Manage water within the trench in accordance with Section 25.1.
- Backfill the in-stream trench that the stream bottom is as near as practicable to its pre-construction condition, with no impediments to normal water flow. Backfill material will consist of the spoil material excavated from the trench and parent streambed unless otherwise specified in state or federal permits.
- Permanent stabilization will be initiated within 24 hours of backfilling the crossing, which includes restoring the stream banks as near as practicable to pre-construction conditions unless that slope is determined to be unstable. If Enbridge determines that the slope is unstable, the banks will be reshaped to prevent slumping. Once the banks are reshaped, ECDs will be installed within 24 hours of backfilling the crossing. Seed (refer to Section 21.7) and mulch and/or erosion control blankets will be installed within a 50-foot buffer on either side of the stream. Temporary slope breakers will also be installed on all sloped approaches to streams in accordance with Section 8.9.

23.3.2 Dam and Pump Method

The dam and pump method involves damming of the stream upstream and downstream of the trench before excavation (refer to Figure 15) and pumping water around the construction area using the following procedures:

- Construct the dams using sandbags, inflatable dams, aqua-dams, sheet piling, and/or steel plates. The dams will prevent the stream from flowing into the construction area. Continuously monitor the dams for a proper seal. Additional sandbags, plastic sheeting, steel plating, or similar materials may be necessary to minimize the amount of water seeping around the dams and into the construction work area.
- Pumping of the stream across the ROW will commence simultaneously with dam construction to prevent interruption of downstream flow. Pump stream flow across the construction area through a hose and discharge to an energy-dissipation device, such as plywood boards, to prevent scouring of the streambed.
- Place the pumps and fuel containers on the upstream side of the crossing in impermeable, sided structures which will act as containment units (refer to Section 29.0). Pumps used for this crossing

method will not be placed directly in the stream or on the streambed. Pumps will have a capacity greater than the anticipated stream flow. The pumping operation will be staffed 24 hours a day. Pumping will be adjusted as necessary to maintain an even flow of water across the work area and near-normal water levels upstream and downstream from the crossing.

- Suspend the pump intake to prevent sediment uptake from the bottom of stream and equip with a screen, or equivalent device, to prevent fish uptake.
- Where possible, excavating equipment will operate from one or both banks, without entering the stream. If equipment must encroach into the stream, it will operate on clean construction mats (free of soil and plant material prior to being transported onto the construction ROW). Segregate streambed material place within a spoil containment structure in approved construction work area limits. Storage of streambed spoil within the stream will only occur if expressly approved in the applicable permits.
- Leave earthen trench plugs (hard plugs) between the stream and the upland trench undisturbed during excavation of the in-stream trench to prevent diversion of the stream flow into the open trench and to prevent water from the adjacent upland trench from entering the waterbody. Remove trench plugs immediately prior to pipe placement, and then replace when the pipe is in place. Dewater trench water accumulated upslope of trench plugs prior to trench plug removal in accordance with Section 25.1.
- Manage standing water isolated in the construction area by the dams in accordance with Section 25.1.
- Backfill the in-stream trench so that the stream bottom is as near as practicable to its pre-construction condition, with no impediments to normal water flow. Backfill material will consist of the spoil material excavated from the trench and parent streambed unless otherwise specified in state or federal permits.
- Permanent stabilization will be initiated prior to restoring flow, which includes restoring the stream banks as near as practicable to pre-construction conditions unless that slope is determined to be unstable. If Enbridge determines that the slope is unstable, the banks will be reshaped to prevent slumping. Once the banks are reshaped, ECDs will be installed immediately after backfilling the crossing. Seed (refer to Section 21.7) and mulch and/or erosion control blankets will be installed within a 50-foot buffer on either side of the stream. Temporary slope breakers will also be installed on all sloped approaches to streams in accordance with Section 8.9.
- Upon completing bank stabilization, the dam will be removed to resume natural stream flow.

23.3.3 Flume Method

The flume method (refer to Figure 16) involves placement of flume pipe(s) in the stream bed to convey stream flow across the construction area without introducing sediment to the water using the following procedures:

- The flume(s) will be of sufficient diameter to transport the maximum flows anticipated to be generated from the watershed. The flume(s), typically 40 to 60 feet in length, will be installed before trenching and align so as not to impound water upstream of the flume(s) or cause downstream bank erosion.

- Incorporate the upstream and downstream ends of the flume(s) into dams made of sand bags and plastic sheeting (or equivalent). Construct the upstream dam first and will funnel stream flow into the flume(s). The downstream dam will prevent backwash of water into the trench and construction work area. Dams will be continuously monitored for a proper seal and adjustments made to prevent large volumes of water from seeping around the dams and into the trench and construction work area.
- Where possible, excavating equipment will operate from one or both banks, without entering the stream. If equipment must encroach into the stream, it will operate on clean construction mats. Segregate streambed material and place within a spoil containment structure in approved construction work area limits. Storage of streambed spoil within the stream will only occur if expressly approved in the applicable permits.
- Leave earthen trench plugs (hard plugs) between the stream and the upland trench undisturbed during excavation of the in-stream trench to prevent diversion of the stream flow into the open trench and to prevent water from the adjacent upland trench from entering the waterbody. Remove trench plugs immediately prior to pipe placement, and then replace when the pipe is in place. Dewater trench water accumulated upslope of trench plugs prior to trench plug removal in accordance with Section 25.1.
- If additional trench dewatering is necessary to complete the installation of the pipe, manage in accordance with Section 25.1.
- Backfill the in-stream trench so that the stream bottom is as near as practicable to its pre-construction condition, with no impediments to normal water flow. Backfill material will consist of the spoil material excavated from the trench and parent streambed unless otherwise specified in state or federal permits.
- Permanent stabilization will be initiated prior to restoring flow, which includes restoring the stream banks as near as practicable to pre-construction conditions unless that slope is determined to be unstable. If Enbridge determines that the slope is unstable, the banks will be reshaped to prevent slumping. Once the banks are reshaped, ECDs will be installed immediately after backfilling the crossing. Seed (refer to Section 21.7) and mulch and/or erosion control blankets will be installed within a 50-foot buffer on either side of the stream. Temporary slope breakers will also be installed on all sloped approaches to streams in accordance with Section 8.9.
- Upon completing bank stabilization, the dam will be removed to resume natural stream flow.

23.3.4 Directional Drill and/or Guided Bore Method

Installing the pipe underneath a stream will involve placing a drill unit on one side of the stream. A small-diameter pilot hole will be drilled under the stream along a prescribed profile. After the pilot hole has been completed, barrel reams will be used to enlarge the pilot hole to accommodate the desired pipeline diameter. Drilling mud will be necessary to remove cuttings and maintain the integrity of the hole. Water from an Enbridge-approved source will be used, in accordance with Section 26.0, to prepare the slurry of drilling mud. The pipe section is then pulled through the pilot hole using the drilling rig.

Drilling Mud

Drilling mud and slurry will be stored back from the waterbody in an earthen berm sediment control structure, in tanks, or by other methods so that it does not flow into the waterbody, adjacent wetlands or off the workspace.

After the pipe is in place, excess drilling mud will be hauled off to an Enbridge-approved disposal location or licensed disposal facility.

Temporary Stabilization

The directional drilling/guided bore method normally does not result in the disturbance of the stream banks or riparian vegetation (with exception of limited hand clearing required to facilitate guide wire placement, place pumps to appropriate water, etc.), which reduces the potential for erosion and sedimentation at the stream crossing. Consequently, temporary ECDs installed at open-cut crossings typically are not necessary for drilled/bored crossings. If clearing activities along the HDD path or inadvertent response activities result in ground disturbance, the disturbed areas will be stabilized using appropriate temporary ECDs based on the level of disturbance and seeded. Mulch will also be applied in upland areas.

23.3.5 Swales & Intermittent Streams/Agricultural Ditches

Concentrated flow paths and swales will be restored as near as practicable to original conditions. Swales and concentrated flow paths will be seeded and erosion control blankets will be installed to the perceivable top of bank for the width of the construction ROW unless the area is actively cultivated by the landowner.

The pipeline will typically be installed across intermittent streams and agricultural ditches using the wet trench method (refer to Section 23.3.1) or as otherwise specified in the applicable permits. If rain is forecasted within 24 hours prior to the crossing, a dry crossing technique will be implemented (as previously detailed and at the discretion of Enbridge). For small, dry intermittent streams and agricultural drainage ditches, standard upland construction procedures may be used, which involve grading, stringing, welding, excavating the trench with backhoes, installing the pipe in the trench, and backfilling the trench with native material. When the dry intermittent stream is small enough to string the pipe without grading the banks, the 20 foot grading buffers will still apply.

23.3.6 Supplemental Bank Stabilization

Unstable soils and/or site-specific factors such as stream velocity and flow direction may require additional restoration efforts, such as installation of rock rip-rap, to stabilize disturbed stream banks. Rock rip-rap will only be used where site-specific conditions require and where Enbridge acquired applicable permits or approvals. Geotextile fabric and rock riprap will be placed according to site and permit conditions (refer to Figure 17) and disturbed soils will be prepared upslope and on either side for seeding.

24.0 WETLAND CROSSING GENERAL REQUIREMENTS

The intent of these procedures is to minimize construction-related disturbance and sedimentation of wetlands and to restore as nearly as possible to pre-existing conditions. Additionally, in wetlands actively farmed at the time of construction, Enbridge will construct the pipeline using standard upland methods.

Pipe stringing and fabrication may occur within the farmed wetland adjacent to the trench, or adjacent to the farmed wetland in a designated ATWS.

Refer to the following Sections for additional details regarding construction requirements in wetland areas:

- Clearing and Grading, Section 7.0
- Erosion and Sediment Control, Section 8.0
- Topsoil Segregation, Section 9.0
- Backfilling, Section 14.0
- Restoration and Revegetation, Section 21.0

24.1 RIGHT-OF-WAY STABILIZATION

Typically, low ground pressure equipment will be used, limiting disturbance to the wetland. Tree stumps, brush riprap, imported soil, and rock fill will not be brought in to stabilize the ROW in wetlands. Where low ground pressure equipment is not used, construction equipment will operate from timber construction mats or equivalent means with prior approval from Enbridge (refer to Figure 18a, 18b, and 18c). To prevent the spread of noxious and invasive plant species, timber mats will be free of loose soil and plant material prior to being transported onto the construction ROW and/or moved from one area of the construction ROW to another area. Timber riprap (also known as corduroy road) will not be used without prior written approval from Enbridge and the appropriate regulatory agencies. Pre-existing corduroy roads in wetlands may be used, but may not be improved, maintained, restored, or replaced without site-specific authorization from applicable agencies.

Subsoil from the pipeline trench will be sidecast within the wetland construction workspace. Subsoil may be placed on top of equipment mats for additional stabilization over the ditch line or on the working side to facilitate trench excavation. All timber mats, construction debris, and larger woody vegetative debris will be removed during cleanup of wetlands.

24.2 PIPELINE INSTALLATION

The following procedures minimize siltation and disturbance to wetlands during installation.

24.2.1 Push/Pull Method

Large wetlands with standing water may not be feasible to cross with typical crossing methods. In these areas, the pipeline will be assembled in an upland area and positioned in the trench using the push-pull and/or float techniques.

Usually this fabrication requires use of ATWS adjacent to the construction ROW. A backhoe (or equivalent) supported on timber mats, swamp hoe, or equivalent low ground pressure equipment will be used to dig the trench. The prefabricated section of pipeline is then push-pulled into position or floated across the wetland. When the pipeline is in position, the floats (if used) are removed and the pipeline will sink into position. The trench will then be backfilled and a backhoe, similar equipment working from construction mats, or low ground pressure equipment will be used to restore the wetland.

24.3 CONSTRUCTION MATTING

It is anticipated that construction matting will be placed in wetlands for greater than 60 consecutive days during the growing season. Post construction, all disturbed areas, including construction matting locations, will be revegetated and monitored in accordance with Project-specific post-construction monitoring plans and applicable permit conditions. As stated in Section 21.6 of this EPP, non-standing water wetlands will be seeded post construction using the mix provided in Appendix B to provide temporary cover and allow natural revegetation via the seeds and rhizomes in the topsoil. No fertilizer, lime, or mulch will be applied in wetlands. Enbridge does not plan to seed standing water wetland areas because the reestablishment of vegetation occurs best through natural process without supplemental seeding.

25.0 CONSTRUCTION DEWATERING

25.1 TRENCH DEWATERING

Prior to initiating dewatering activities, the EI will approve the water discharge plan to ensure that the best management practices are applied in such a way as to minimize the potential for scour and water containing sediment from reaching a wetland or waterbody and conform with WIDNR Technical Standard 1061 (Appendix F). Furthermore, Enbridge requires landowner approval in advance of placement of dewatering structures outside of the approved construction ROW. Each water discharge situation will be assessed to include:

- **Water Discharge Setting** - This includes:
 - Soil Type - The soil type the discharged water would flow over. The management of discharged water traveling over sandy soil is more likely to soak into the ground as compared to clay soils.
 - Ground Surface - The topography in the area that would influence the surface flow of the discharged water.
 - Adjustable Discharge rate – Managing the flow rate of the discharged water (which may need to vary) based on the site conditions to minimize instances of water from reaching a sensitive resource area such as a wetland or waterbody. (Example - Water discharged at 500 gallons per minute may soak into the ground while if discharged at a higher flow rate would cause water to flow via overland runoff into a sensitive resource area)
 - Discharge Outfall - The amount of hose and number/size of pumps necessary to attempt to discharge water at a location which drains away from waterbodies or wetlands.
- **Pump Intake** - Use floating suction hose or other similar measures to prevent sediment uptake from bottom of trench.
- **Overwhelming Existing Drainage** - If the discharge (assumed to be clean) enters a stream, the additional flow will not exceed 50 percent of the peak storm event (to prevent adding high water volumes to a small stream channel that causes erosion due to imposing high flow conditions).

- **Filtering Mechanism** – Direct all dewatering discharges through a filtering device as indicated below.
 - Well-Vegetated Upland Area – Direct water to a well-vegetated upland area through a geotextile filter bag sized appropriately for the discharge flow and suspended sediment particle size (refer to Figure 19).
 - Straw Bale Dewatering Structure – Where the dewatering discharge point is not in an upland area due to site conditions and/or distance, direct the discharge into a straw bale dewatering structure in conjunction with a geotextile filter bag, if necessary based on site conditions. The size of the straw bale dewatering structure is dependent on the maximum water discharge rate (refer to Figure 20).
 - Alternative dewatering methods – Enbridge may approve alternative methods on a site-specific basis and in accordance with applicable permit conditions.

25.1.1 Flow Measurement and Water Sampling

The volume of water discharged from the trench will be recorded, if specified in the applicable permits. The volume may be determined using a flow meter, or equivalent method, as approved by Enbridge or specified by applicable permit conditions.

Enbridge will collect and analyze samples of the discharge water if specified by applicable permit conditions.

25.1.2 Regulatory Notification and Reporting

Enbridge will notify and submit reports to agencies if specified by applicable permit conditions.

25.2 HYDROSTATIC TEST DISCHARGES

Hydrostatic testing involves filling the new pipeline segments with water acquired in accordance with applicable permits (refer to Section 26.0), raising the internal pressure level, and holding that pressure for a specific period of time per federal DOT specifications. Enbridge may hydrostatically test pre-built sections prior to installation using horizontal directional drilling (HDD) and/or guided bore techniques. Hydrostatic testing will occur in accordance with applicable appropriation and discharge permits.

25.2.1 Refueling

The operation and refueling of hydrostatic test equipment will be in accordance with the conditions outlined in Section 29.0.

25.2.2 Siting of Test Manifolds

Hydrostatic test manifolds will be installed where necessary to ensure proper test pressures and incorporates changes due to topography. Where feasible, Enbridge will incorporate minor adjustments to the test manifold locations to avoid placement in wetlands and riparian areas. However, completely avoiding the placement of a test manifold in a wetland may not always be possible. The appropriate ECDs will be installed where the EI determines they are necessary.

25.2.3 Water Sampling

Enbridge will collect and analyze samples of discharge water from hydrostatic tests as specified in applicable permits.

25.2.4 Best Management Practices

Prior to hydrostatic testing the pipeline, the pipe will be prepared using a cleaning pig. Any debris from the pigging operation will be collected and disposed of at an Enbridge approved location or in accordance with the Project-specific permits. Upon completion of the cleaning operation, the pipe will be filled with water and the hydrotest will be started.

Following testing, the test is depressurized and the water is discharged according to applicable permit conditions. Upland discharges will occur within a well-vegetated area with an appropriate dewatering structure such as a geotextile filter bag and/or a hay bale structure lined with geotextile fabric. Direct discharges to surface waters, will occur in accordance with applicable permits.

Discharge rates will be in accordance with the applicable permit conditions. In the event the applicable permits do not identify a maximum discharge rate, EIs will monitor and adjust as necessary to avoid scouring, erosion, or sediment transport from the discharge location. The total volume of water discharged will be determined using a flow meter (or equivalent with Enbridge approval).

To minimize the potential for introduction and/or spread of invasive species due to new mainline hydrostatic testing activities, Enbridge will discharge the hydrotest water to the same source location unless specified otherwise in applicable permits. If water is used to test multiple test sections, it will be relayed back to the source water through the pipeline for final discharge (unless specified otherwise in applicable permits).

26.0 WATER APPROPRIATION

26.1 GENERAL

Water may be drawn from local sources, such as lakes, streams, and private or municipal wells for construction activities such as dust control, horizontal directional drilling/guided boring, trench dewatering, and hydrostatic testing.

The intake hose will be suspended off of the stream or lake bottom and equipped with a screen, or equivalent device, to prevent fish uptake. During appropriation, the adequate waterbody flow rates and volumes will be maintained to protect aquatic life and allow for downstream uses. The volume and rate of appropriation will be monitored to comply with applicable permit conditions.

26.2 WATER SOURCES

Water will only be appropriated from Enbridge-approved sources and in accordance with applicable permits. No additives will be used, without written approval from Enbridge and in accordance with applicable permits.

26.3 FLOW MEASUREMENT

The appropriation rate and total volumes will be measured with a flow meter (or equivalent) and the data provided to Enbridge, as required by the applicable permits.

26.4 WATER SAMPLING

Where required by permit conditions, Enbridge will sample the water during appropriation. The Contractor will assist Enbridge in obtaining these samples.

26.5 REGULATORY NOTIFICATION AND REPORTING

Enbridge will notify appropriate agencies of the time of appropriations if required by applicable permit conditions. Enbridge will submit reports regarding the volume and quality of the water withdrawn if required by the applicable permits.

27.0 WINTER CONSTRUCTION

Grading of the right-of way can continue through the winter months in accordance with Section 7.0. Any snow within the ROW will be plowed by pushing off to the side prior to grading activities. If soils are frozen down to the topsoil/subsoil level and grading of the ROW results in mixing of these layers, alternative procedures such as ripping to the topsoil subsoil layer prior to grading activities will be implemented to avoid mixing.

The area of open excavation will be minimized during winter construction. Backfill of the trench will continue through the winter months in accordance with Section 14.0. However, if weather conditions result in frozen backfill placement into the trench, topsoil restoration will be delayed until soils thaw to allow for any subsidence of the trench to be mitigated with grading of subsoils. Once grading of subsoil occurs, full topsoil restoration can occur.

Topsoil restoration may continue through the winter months in accordance with Section 15.0. If snow is on the ROW it will be removed by pushing off the construction area prior to topsoil restoration. If weather conditions preclude effective soil decompaction treatment, topsoil restoration may continue utilizing one of the two following options:

- Perform soil decompaction through the topsoil to a deeper depth when soils become dry enough for effective soil compaction treatment. If decompaction cannot occur through the topsoil to the required subsoil depth, the topsoil will be stripped prior to decompaction when conditions are conducive.
- Enbridge may elect to forego decompaction if the landowner agrees to either complete the work himself or hires a third party to complete the work at a later date.

Seeding may continue through the winter months in accordance with Section 21.0. This includes the requirements for dormant seeding (including mulching) with the addition of cool season grasses to improve the likelihood of successful revegetation. Drill seeding will be the primary method unless soil conditions preclude this method. Upon topsoil restoration, seeding must occur within 48 hours or earlier to avoid seeding on frozen ground.

If winter conditions preclude cleanup and topsoil restoration, the area will be stabilized and temporary ECDs will remain in place until installation of permanent erosion control measures is complete. Depending on site and weather conditions, Enbridge will require the use of dormant seeding, mulching, and/or installation of erosion control blanket on stream banks or other sensitive locations in accordance with Section 8.0.

Refer to the Project-specific Winter Plan (Appendix H) for additional information on winter construction, including installation and maintenance of erosion and sediment controls, and site stabilization.

28.0 WASTE MANAGEMENT

The Contractors will handle, store, and dispose of all solid and hazardous materials and wastes they generate as a result of the Project. The Contractor will determine if the materials and wastes associated with the Project classify as hazardous materials and/or wastes in accordance with applicable federal and/or state criteria. The Contractor will provide documentation to Enbridge to substantiate findings of the regulatory status of wastes or generated as a result of the Project.

The Contractor will collect all waste materials, including oil or other waste liquids generated as a result of equipment maintenance, daily in suitable or approved containers (i.e., labeled and meeting any relevant regulatory requirements). On a routine basis, the Contractor will remove the containers of waste from the site and properly dispose of them. Throughout the duration of the Project, the Contractor will clean up areas to the satisfaction of Enbridge. The Contractor is responsible for proper off-site disposal of all wastes generated during the Project. No wastes are to be left on Enbridge property, along the ROW, or buried in an excavation or otherwise disposed of on Enbridge property or ROW.

28.1 HAZARDOUS WASTES

If a Contractor generates a hazardous waste from materials they have brought on-site (e.g., paint clean-up solvents, waste paints, etc.), they are responsible for proper waste collection, storage, and disposal in accordance with all applicable regulations.

28.2 ABRASIVE BLAST DEBRIS

The Contractor will contain and collect spent abrasive blast materials and place into appropriate containers. The Contractor is responsible for covering the containers with appropriate means of rainwater and stormwater control to prevent said waters from entering or exiting the container. The Contractor is responsible for disposal of the spent abrasive in accordance with applicable federal, state and local regulatory requirements. The Contractor is responsible for determining if the spent abrasive is classified as a hazardous or special waste, as defined by applicable federal and state regulations. If the spent abrasive is a hazardous waste as a direct result of constituents of an Enbridge facility or equipment, Enbridge will coordinate proper disposal with the Contractor as previously discussed.

29.0 SPILL PREVENTION, CONTAINMENT, AND CONTROL MEASURES

This section describes planning, prevention and control measures to minimize impacts resulting from spills of fuels, petroleum products, or other regulated substances as a result of construction. The Contractor will implement these measures, unless Enbridge indicates otherwise.

29.1 PLANNING AND PREVENTION

Enbridge requires its Contractors to implement proper planning and preventative measures to minimize the likelihood of spills, and to quickly and successfully clean up a spill should one occur. This section sets forth minimum standards for handling and storing regulated substances and cleaning up spills. Potential sources of construction-related spills include machinery and equipment failure, fuel handling, transfer accidents and storage tank leaks. The Contractor will be responsible for implementing, at a minimum, the following planning and prevention measures.

29.2 ROLES AND RESPONSIBILITIES

29.2.1 Spill Coordinator

The Contractor will designate a Spill Coordinator, subject to Enbridge approval. For all construction related spills, the Spill Coordinator will:

- report all spills to the Enbridge Representative immediately;
- report spills to appropriate federal, state and local agencies as soon as possible (subject to EI verification);
- mobilize on-site personnel, equipment, and materials for containment and/or cleanup commensurate with the extent of the spill;
- assist the Emergency Response Contractor (refer to a list of potential contractors provided in Appendix C) and monitor containment procedures to ensure that the actions are consistent with the requirements of this section;
- in consultation with Enbridge and appropriate agencies, determine when it is necessary to evacuate spill sites to safeguard human health;
- in consultation with Enbridge, coordinate with appropriate agencies the need to contact additional parties or agencies; and
- complete a Spill Report Form (refer to Appendix D) within 24-hours of the occurrence of a spill, regardless of the size of the spill.

29.2.2 Environmental Inspector

The EI will monitor the Contractor's compliance with the provisions of this section to ensure that the Contractor makes the appropriate agency notifications, allocates spill resources, and accomplishes clean-up in accordance with applicable agency requirements

29.3 TRAINING

The Contractor will train all employees handling fuels and other regulated substances to follow spill prevention procedures. The Contractor will train all employees who handle fuels and other regulated substances to prevent spills and to quickly and effectively contain and clean up spills that may occur in accordance with applicable regulations.

29.4 EQUIPMENT

- Each construction crew will have adequate absorbent materials on hand to enable the rapid cleanup of any spill which may occur.
- The Contractor will maintain spill kits containing a sufficient quantity of absorbent and barrier materials to adequately contain and recover foreseeable spills. These kits will include, but are not limited to absorbent pads, straw bales, absorbent clay, sawdust, floor-drying agents, spill containment barriers, plastic sheeting, skimmer pumps, and holding tanks. The Contractor will locate this equipment near fuel storage areas and other locations as necessary to be readily available to control foreseeable spills.

- Suitable plastic lining materials will be available for placement below and on top of temporarily-stored contaminated soils and materials.
- All fueling vehicles, and where necessary, service vehicles, will carry materials adequate to control foreseeable spills. Such material will include but not be limited to absorbent pads, commercial absorbent material, plastic bags with ties, and shovels.
- The Spill Coordinator will inform all Contractor personnel and the EIs of the locations of spill control equipment and materials, and have them readily accessible during construction activity.
- All fuel nozzles will include functional automatic shut-offs.
- Fuel trucks transporting fuel to on-site construction equipment will travel only on approved access roads.

29.5 SUPERVISION AND INSPECTION

The Contractor will perform a pre-construction inspection and test of all equipment to ensure that it is in good repair. During construction, the Contractor will regularly inspect hoses, pipes, valves, and tanks to ensure equipment is free of leaks. The Contractor will remove from service any equipment found to be leaking or in need of repair and repair prior to resuming work.

29.6 STORAGE AND HANDLING OF FUELS/HAZARDOUS LIQUIDS

29.6.1 Fuel Storage - General

The Contractor will follow proper fuel storage practices, including, but not limited to the following:

- Fuel storage will be at Contractor yards only (unless Enbridge approves otherwise in advance).
- Install signage at and adjacent to fuel storage areas to include "Fuel Storage Area – No smoking within 50 feet."
- Keep tools and materials to stop the flow of leaking on-site. Such equipment will include, but not be limited to, plugs of various sizes, 3M tank patches, a hammer, assorted sizes of metal screws with rubber washers, a screwdriver, and plastic tape.
- Store fuels, lubricants, waste oil, and any other regulated substances in aboveground tanks only.
- Storage tanks and containers will conform to all applicable industry codes (e.g., NFPA, UFC).
- Utilize a secondary containment structure at each fuel storage site providing a minimum containment volume equal to 150 percent of the volume of the largest storage vessel.
- Secondary containment areas will not have drains. If visual inspection indicates that no spillage has occurred in the secondary containment structure, the Contractor may discharge accumulated water in accordance with Section 25.0. If spillage occurred in the structure, the Contractor will collect and dispose and/or recycle at a licensed facility.

29.6.2 Refueling

Contractor will make all efforts to dispense fuel during daylight hours. Construction personnel will monitor fuel dispensing operations at all times. Personnel monitor at both ends of the hose during fueling unless both ends are visible and are readily accessible by one person.

29.6.3 Refueling, Maintenance, and Fuel Storage near Wetlands and Waterbodies

Enbridge requires that the storage of petroleum products, refueling, maintenance, and lubricating operations take place in upland areas that are more than 100 feet from wetlands, streams, and waterbodies (including drainage ditches), and water supply wells. In addition, the Contractor will store hazardous materials, chemicals, fuel and lubricating oils, and perform concrete coating activities outside these areas.

In certain instances, refueling or fuel storage may be unavoidable due to site-specific conditions or unique construction requirements (e.g., continuously operating pumps or equipment on barges). An EI must approve these locations in advance.

Site-specific precautions, in addition to those practices described above, will be implemented when refueling or maintenance activities are required within 100 feet of streams, wetlands or other waterbodies. These precautions include, but are not limited to:

- Keeping adequate amounts of absorbent materials and containment booms on hand to enable the rapid cleanup of any spill which may occur;
- Using secondary containment for fuel storage and refueling of continuously operating pumps ;
- Secondary containment structures will provide a containment volume of at least 150 percent of the storage vessel, and allow for at least one foot of freeboard; and
- Providing adequate lighting for these locations and activities.

29.6.4 Overnight parking

Enbridge does not allow overnight parking of equipment (including but not limited to light plants, generators, pumps, and machinery) within 100 feet of a wetland or waterbody unless the Contractor implements special containment and with advance approval from an EI.

29.7 INITIAL SPILL MANAGEMENT

29.7.1 Immediate Response

Immediately upon learning of any fuel, oil, hazardous material or other regulated substance spill, or upon learning of conditions that will lead to an imminent spill, the person discovering the situation will:

- Initiate actions to contain the fluid that has spilled or is about to spill, and initiate action to eliminate the source of the spill to the maximum extent that is safely possible.
- Notify the crew foreman and/or the Spill Coordinator and provide them with the following information:
 - Location and cause of the spill;
 - The type of material spilled; and
 - Whether the spill has reached or is likely to reach any surface water.

Upon learning of a spill or a potential spill the Spill Coordinator will:

- Assess the situation and determine the need for further action;

- Direct subsequent activities and/or further assign responsibilities to other personnel; and
- Notify the EI.

29.7.2 Mobilization

The Spill Coordinator will mobilize on-site personnel, equipment, and materials for containment and/or cleanup commensurate with the extent of the spill. If the Spill Coordinator feels that a spill is beyond the scope of on-site equipment and personnel, the Spill Coordinator will immediately notify the Construction Superintendent that an Emergency Response Contractor is necessary to contain and/or clean up the spill. Appendix C contains a list of potential Emergency Response Contractors. The Spill Coordinator will assist the Emergency Response Contractor and monitor containment procedures to ensure that the actions are consistent with the requirements of this Section.

In the event of a suspected Enbridge pipeline spill (or from an adjacent pipeline), Enbridge's Emergency Pipeline Control Center will be notified at 1-800-858-5253 (24-hours/day), as well as the Enbridge EI. Actions requiring emergency response will be coordinated by Enbridge.

29.8 SPILL NOTIFICATION RESPONSIBILITIES

29.8.1 Notification Volumes

The Contractor's Construction Superintendent or representative will notify the Enbridge Representative and the EI immediately of any spill of a petroleum product or hazardous liquid, regardless of volume.

29.8.2 Spill Report Form

The Spill Coordinator will complete a Spill Report Form (Appendix D) for each release of a regulated substance, regardless of volume and submit to the EI within 24 hours of the occurrence of a spill. Enbridge may also require the Contractor to provide follow-up written reports, associated laboratory analyses, and other documentation separately on a site-specific basis as directed by the EI.

29.8.3 Agency Notification

The Contractor will report spills to appropriate federal, state and local agencies as soon as possible. Appendix E includes a listing of federal, state, and local agencies including reporting thresholds and timeframes.

29.9 SPILL CONTAINMENT AND CLEANUP

In the event of a spill, the Contractor will abide by all applicable federal, state and local regulations. Specific cleanup measures for both upland and wetland/waterbody spills are described below.

29.9.1 Spill Control - Upland Areas

- If a spill should occur during refueling operations, **STOP** the operation.
- The Contractor will identify and contain the source of the spill immediately.
- For large spills on land, contain and pump immediately into tank trucks.
- The Contractor will place absorbent material(s) placed over spills to minimize spreading and to reduce its penetration into the soil.

- The Spill Coordinator, in consultation with the EI and appropriate agencies, determine when spill sites require evacuation to safeguard human health. Evacuation parameters will include consideration for the potential of fire, explosion, and hazardous gases.
- The Contractor will treat and/or dispose of the spilled material, spent absorbent materials, and contaminated soil in accordance with all applicable federal, state, and local agency requirements.

29.10 SPILL CONTROL - WETLANDS AND WATERBODIES

In addition to the above measures, the following conditions apply if a spill occurs near or into a wetland or waterbody, regardless of size:

- If a spill occurs during refueling operations, **STOP** the operation.
- The Contractor will use absorbent booms and pads to contain and recover released materials in standing water.
- If necessary, for large spills in waterbodies, The Contractor will secure an Emergency Response Contractor to further contain and clean up the spill.
- The Contractor will excavate contaminated soils in wetlands and temporarily place them on plastic sheeting in a bermed area, a minimum of 100 feet away from the wetland. The Contractor will cover contaminated soils with plastic sheeting while storing temporarily and dispose of as soon as possible, in accordance with Section 29.11.

29.11 STORAGE AND DISPOSAL OF CONTAMINATED MATERIALS

- Appendix C lists potential treatment and disposal facilities for contaminated materials, petroleum products, and other construction-related wastes. The Contractor should recycle those wastes, such as motor oil, where there is an established recycling program available.
- The Contractor will store and dispose of all contaminated soils, absorbent materials, and other wastes in accordance with all applicable state and federal regulations.
- The Contractor will only use licensed carriers to transport contaminated material from the site to a disposal facility.

The Contractor will cover contaminated soils with plastic sheeting while being stored temporarily and properly dispose of as soon as possible, in accordance with Section 28.0.

30.0 DRILLING FLUID RESPONSE, CONTAINMENT, AND NOTIFICATION PROCEDURES

The following information applies to all HDD and Direct Pipe crossing. Site-specific details for each proposed HDD/Direct Pipe crossing are included in site-specific plans, provided under separate cover.

Construction of a pipeline may include the use of trenchless methods known as the HDD and guided/road bore methods. Throughout this section, both methods are referred to collectively as “drilling”. While the HDD method always includes the use of drilling fluid, the guided or road bore method might use drilling fluid or only use water to power and lubricate the bore. The HDD drilling fluids/mud consists primarily of water mixed with inert bentonite clay. Under certain conditions and with Enbridge approval, an additive

may need to be mixed with the drilling fluids/mud for viscosity or lubricating reasons. Only non-hazardous additives will be used and Safety Data Sheets will be maintained on-site.

This section elaborates on measures to be implemented if an inadvertent release of drilling fluid occurs despite prevention efforts. Prior to the commencement of drilling operations, the Contractor will inform construction personnel involved who will be the responsible party(ies) for release containment and response. The Contractor will ensure that the appropriate response personnel and containment equipment are on site for each drill/bore.

30.1 ON-SITE OBSERVATION DURING CONSTRUCTION

During construction of a drilled crossing, Contractor personnel will monitor the pipeline route throughout the process, as follows:

- The Contractor will inform construction observers on what to watch for and will make them aware of the importance of timely detection and response actions to any release of drilling fluid.
- Construction observers will have appropriate, operational communication equipment (e.g., radio and cell phones) available at all times during installation of the directionally drilled crossing, with the ability to communicate directly with the HDD operator.
- During the pilot hole drilling and reaming phases, monitoring for loss of drilling fluid consists of closely scrutinizing the amount of fluid returns coming to the drill pit or shaker tank and monitoring the amount of makeup drilling fluid required in the mixing tanks. If the HDD operator identifies a sustained loss in fluid pressure or loss of circulation:
 - The operator will immediately notify the construction observers of the assumed position of the drill tool
 - The Contractor will visually monitor the appropriate portion of the drill path at the drill tool location to determine if an inadvertent return occurred. The Contractor may perform this monitoring by walking or by using a boat, as appropriate.
- Construction observers, EI(s), or the Enbridge HDD craft inspector have the authority to order installation of containment structures, if necessary, and to require additional response measures if deemed appropriate.

30.2 CONTAINMENT, RESPONSE, AND CLEAN-UP EQUIPMENT

Enbridge requires the Contractor to prepare and implement a contingency plan for inadvertent returns and provide the following equipment:

- Weed-free straw bales, or absorbent pads
- Sandbags
- Geotextile booms
- Trash pumps
- Storage tanks or barrels
- Light towers
- Silt fence
- Post pounders
- Shovels
- Squeegees
- Ice augers
- Snowmobile/ATV
- Boat
- Chainsaw
- Vacuum trucks
- Backhoes
- Geotextile or plastic sheeting
- Turbidity barriers

30.3 RESPONSE

The Contractor's contingency plan for inadvertent fluid returns will include the following:

- Procedure for notification of site, office, and Enbridge personnel
- Monitoring procedure for loss of circulation indicators
- Procedures for monitoring fluid pressure and ranges for acceptable annular pressure
- Decision points and procedures for suspending drilling operations
- Detailed descriptions of all monitoring (e.g., the annular pressure tool)
- An inventory of equipment and materials to be on-site for containment
- Containment methods in upland and wetland/waterbody locations

In the event an inadvertent drilling fluid release is observed, the EI and the Contractor will assess to determine the amount of fluid being released and potential for the release to reach sensitive resource areas (e.g., wetlands and waterbodies). Response measures will vary based on location of inadvertent release.

30.4 CLEAN-UP

The following measures will be implemented in the event of an inadvertent return:

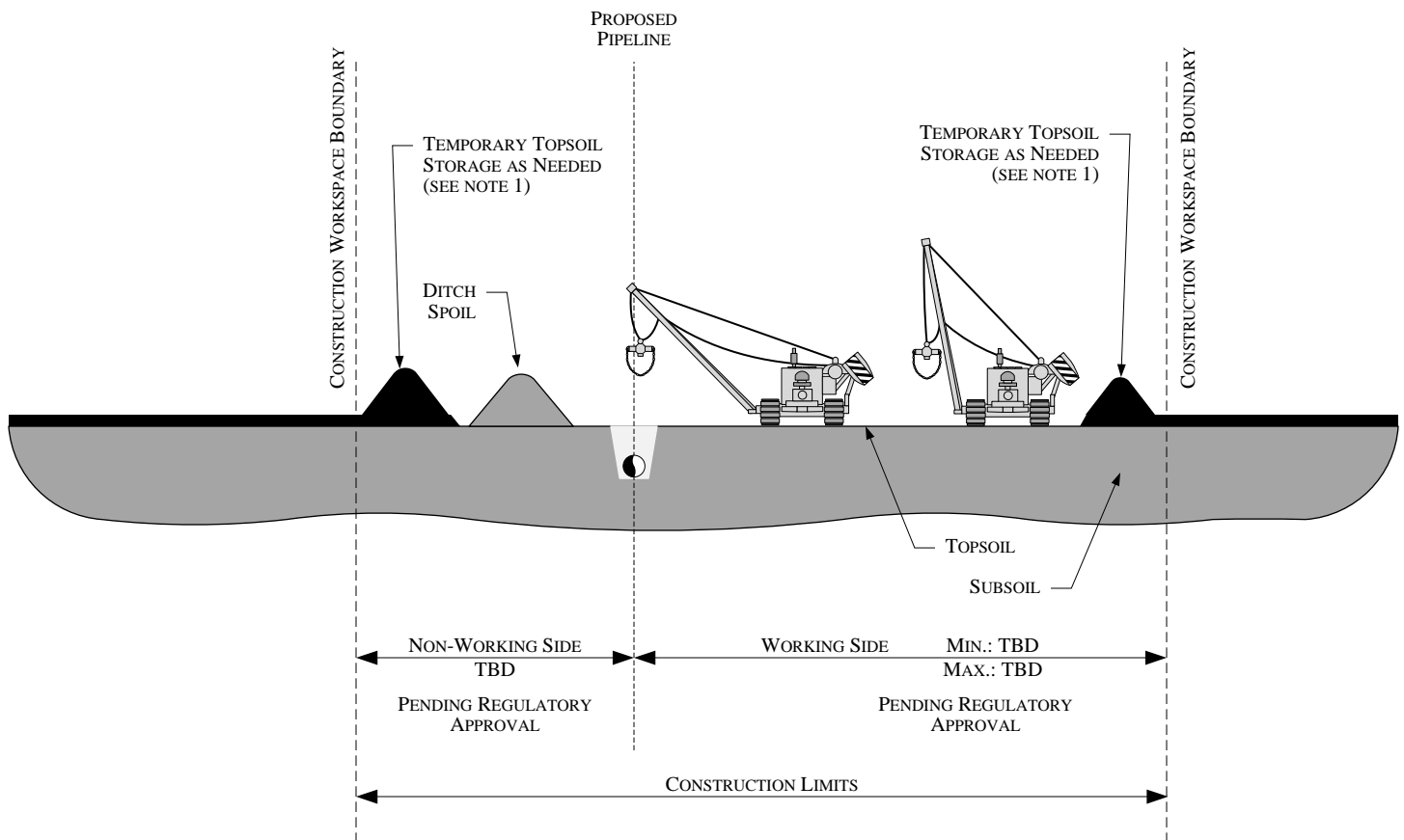
- Cleaning up drilling fluid by hand using hand shovels, buckets and soft-bristled brooms without causing extensive ancillary damage to existing vegetation. Employing clean water washes Enbridge deems beneficial and feasible.

- Pumping out containment structures and scraping the ground surface to bare topsoil without causing undue loss of topsoil or ancillary damage to existing and adjacent vegetation.
- Collecting material in containers for temporary storage prior to removal from the site.
- The EI, in consultation with Enbridge and/or the applicable agencies, will regularly evaluate the potential for secondary impact from the clean-up process and clean-up activities terminated if physical damage to the site exceeds the benefits of removal activities.

30.5 RESTORATION AND POST-CONSTRUCTION MONITORING

Following cleanup activities, restoration and revegetation of affected areas will be completed in accordance with this EPP and all applicable permits. Enbridge will monitor the release site as appropriate to assure adequate restoration.

Figures



PROFILE

NOTES:

1. STOCKPILE TOPSOIL SEPARATELY FROM DITCH SPOIL AS SHOWN OR IN OTHER CONFIGURATIONS APPROVED BY THE COMPANY
2. TWO FEET (2') MINIMUM SEPARATION OR BARRIER BETWEEN TOPSOIL AND SUBSOIL



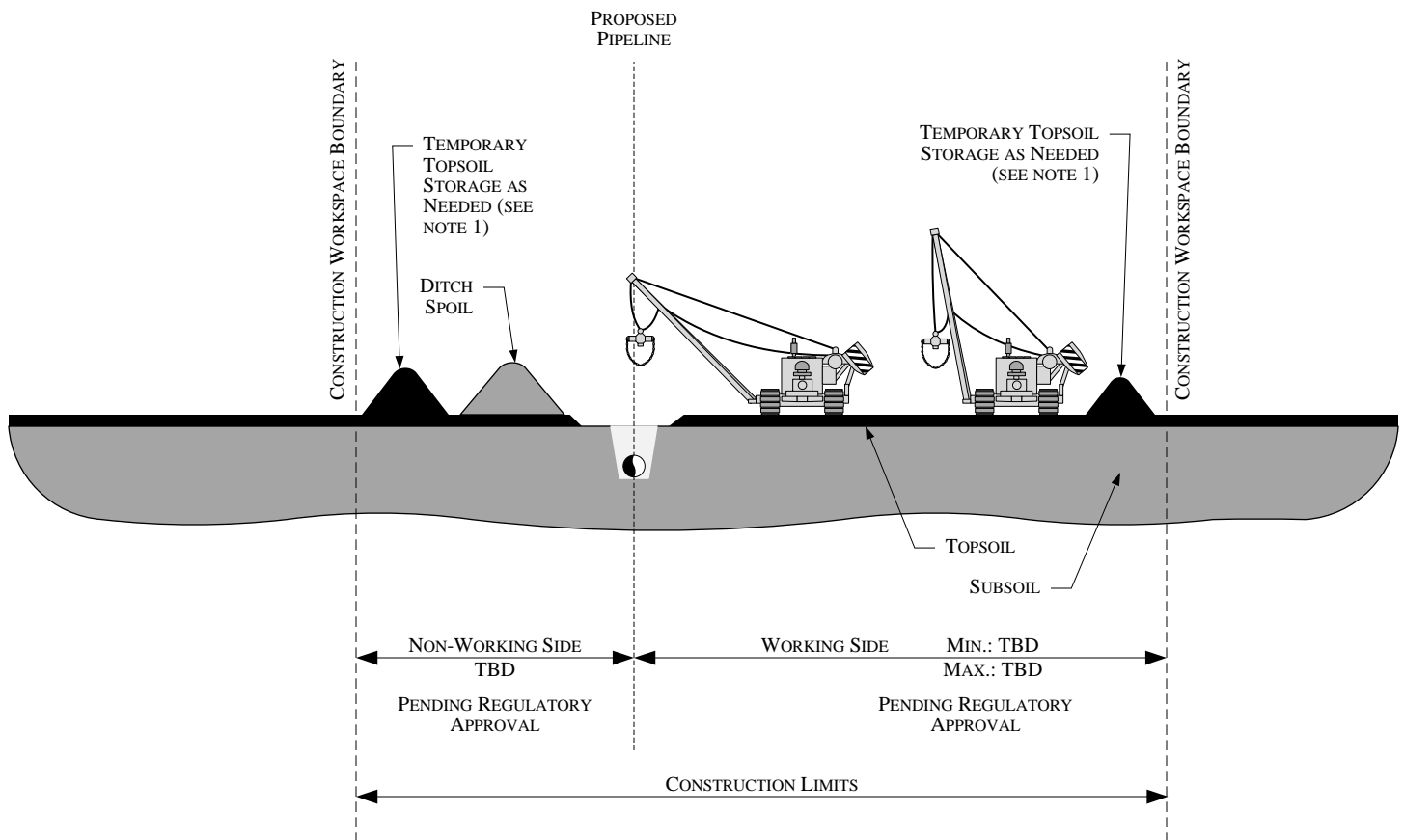
Figure 1
Environmental Protection Plan
 Typical Topsoil Segregation – Full Right-of-Way

Scale: NTS

Date: 10/11/2016

Revised: 12/17/2019

Location: M:\Department Tasks\EPP Figures w\Borders\



PROFILE

NOTES:

1. STOCKPILE TOPSOIL SEPARATELY FROM DITCH SPOIL AS SHOWN OR IN OTHER CONFIGURATIONS APPROVED BY THE COMPANY
2. TWO FEET (2') MINIMUM SEPARATION OR BARRIER BETWEEN TOPSOIL AND SUBSOIL



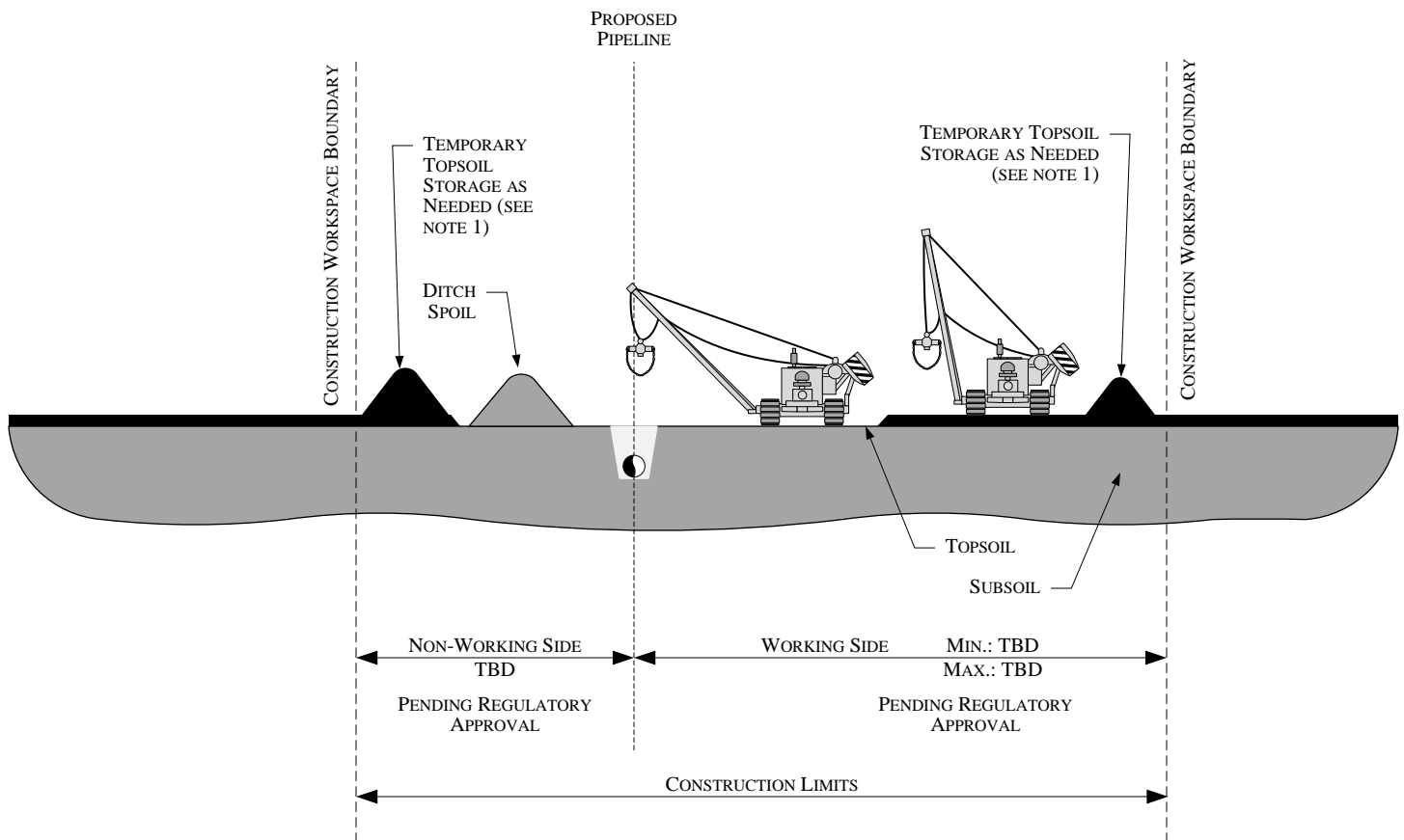
Figure 2
Environmental Protection Plan
 Typical Topsoil Segregation – Trench Line Only

Scale: NTS

Date: 10/11/2016

Revised: 12/17/2019

Location: M:\Department Tasks\EPP Figures w\Borders\



PROFILE

NOTES:

1. STOCKPILE TOPSOIL SEPARATELY FROM DITCH SPOIL AS SHOWN OR IN OTHER CONFIGURATIONS APPROVED BY THE COMPANY
2. TWO FEET (2') MINIMUM SEPARATION OR BARRIER BETWEEN TOPSOIL AND SUBSOIL



Figure 3
Environmental Protection Plan
 Typical Topsoil Segregation – Modified Ditch Plus
 Spoil Side

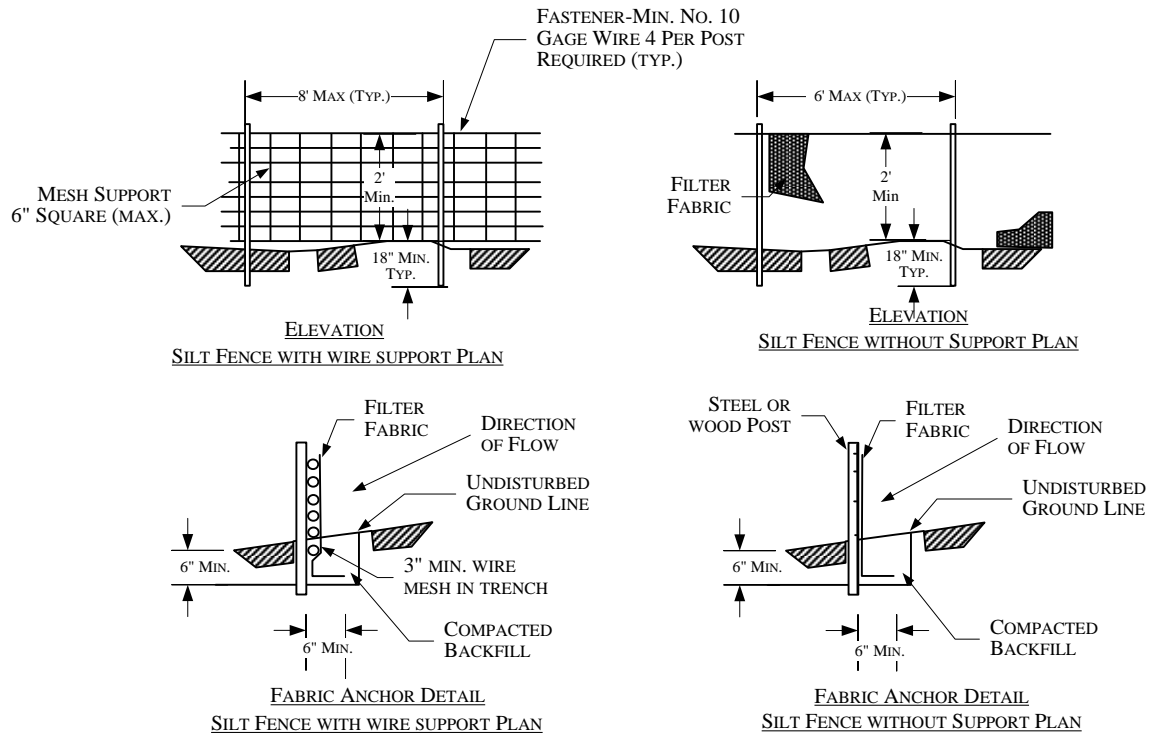
Scale: NTS

Date: 10/11/2016

Revised: 12/17/2019

Location: M:\Department Tasks\EPP Figures w\Borders\

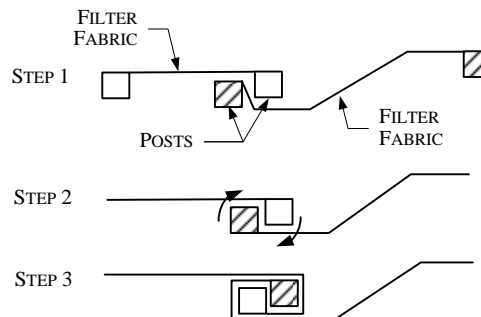
SILT FENCE PLAN (NTS)



NOTES:

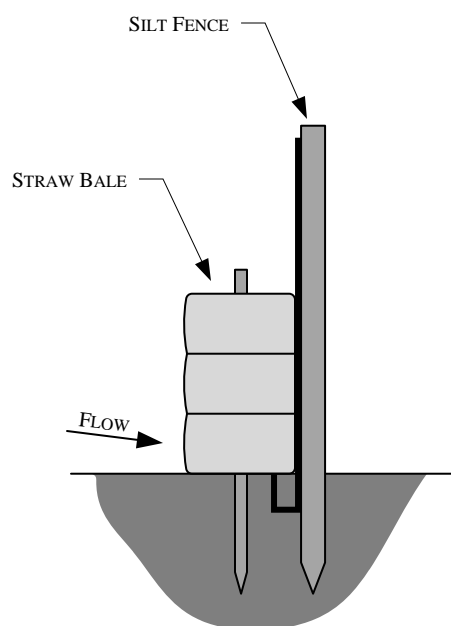
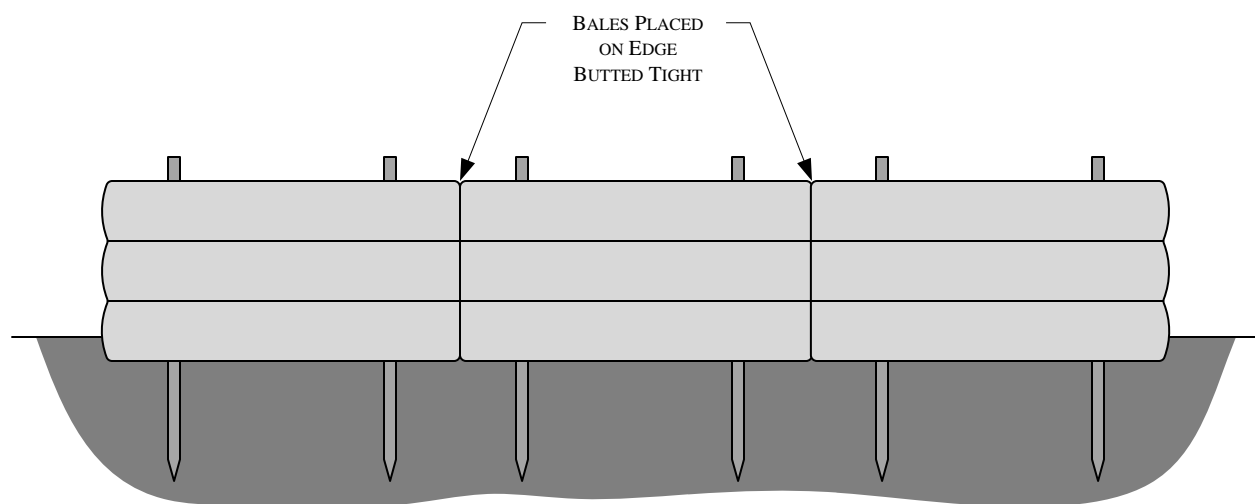
1. WIRES OF MESH SUPPORT SHALL BE MIN. GAGE NO. 12.
2. FILTER FABRIC SHALL MEET THE REQUIREMENTS OF THE SPECIFICATION WITH EQUIVALENT OPENING SIZE OF AT LEAST 30 FOR NONWOVEN AND 50 FOR WOVEN. (SIEVE NO.)
3. THE POSTS USED TO SUPPORT THE SILT FENCE SHOULD BE HARDWOOD MATERIAL WITH A MINIMUM CROSS SECTIONAL AREA OF 4 INCHES SQUARE AND 4 FEET LONG. METAL POSTS SHOULD BE USED IN AREAS THAT POND WATER.

ATTACHING TWO SILT FENCES

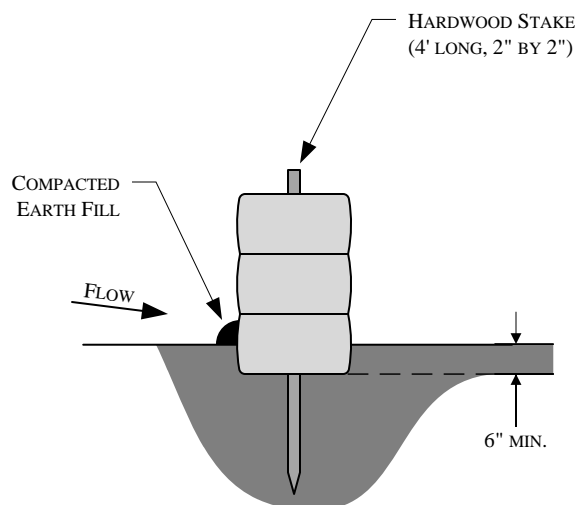


NOTES:

1. PLACE THE END POST OF THE SECOND FENCE INSIDE THE END POST OF THE FIRST FENCE.
2. ROTATE BOTH POSTS AT LEAST 180 DEGREES IN A CLOCKWISE DIRECTION TO CREATE A TIGHT SEAL WITH THE FABRIC MATERIAL.
3. DRIVE BOTH POSTS A MINIMUM OF 18 INCHES IN THE GROUND AND BURY THE FLAP.

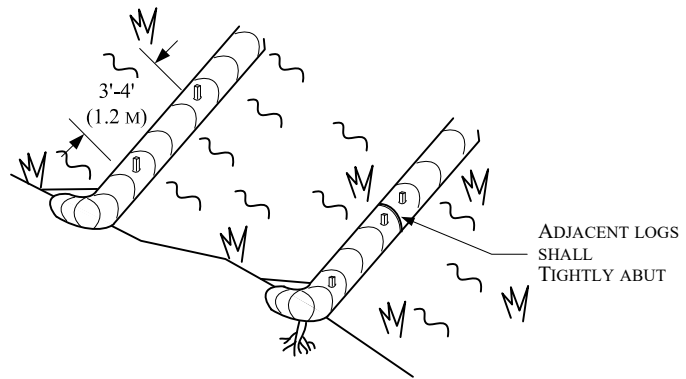


STRAW BALES AND SILT FENCE

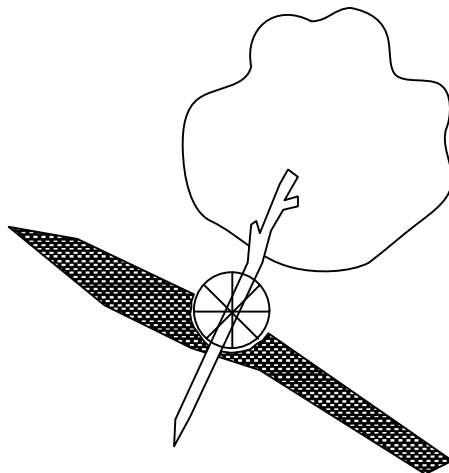
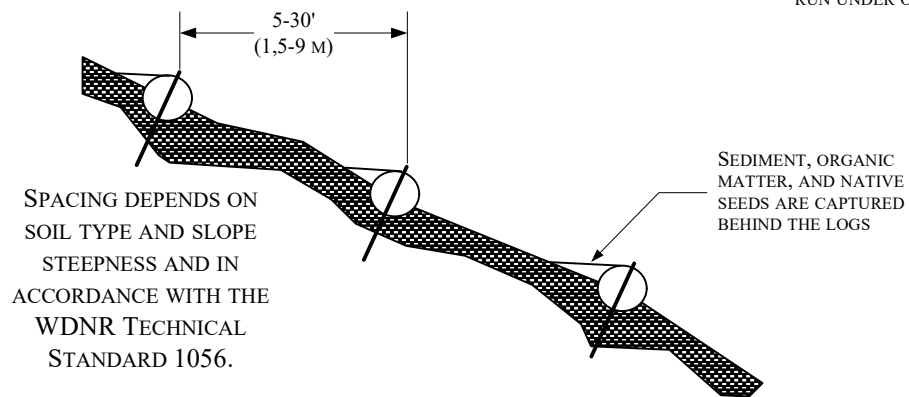


STRAW BALES ONLY

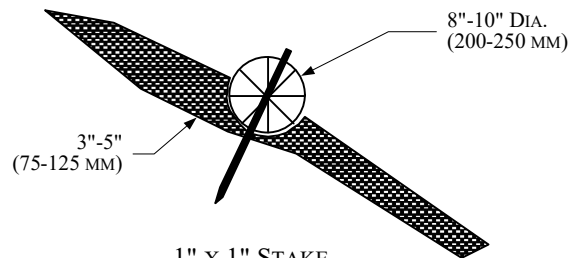
BIOLOGS SHOULD BE PLACED AND STAKED SECURELY ALONG SLOPE CONTOURS. TRENCH SHOULD BE APPROX. 3" X 5".



RUNOFF MUST NOT BE ALLOWED TO RUN UNDER OR AROUND THE LOG.



LIVE STAKE
(WILLOW, DOGWOOD, OR
OTHER NATIVE SPECIES)



1" X 1" STAKE

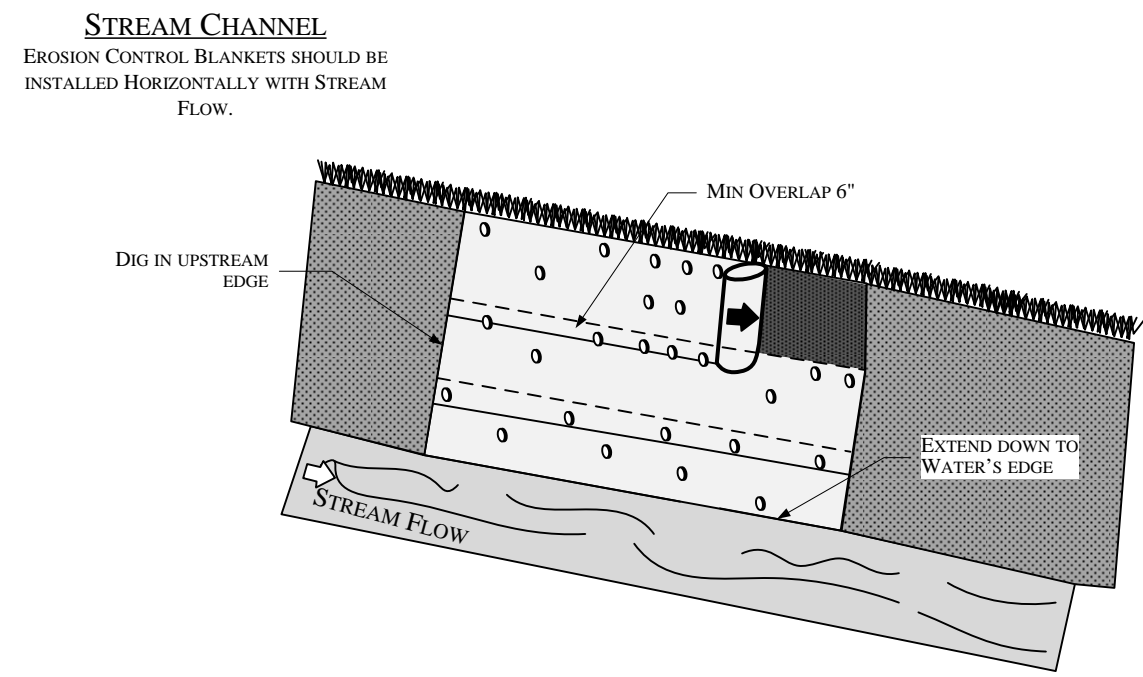
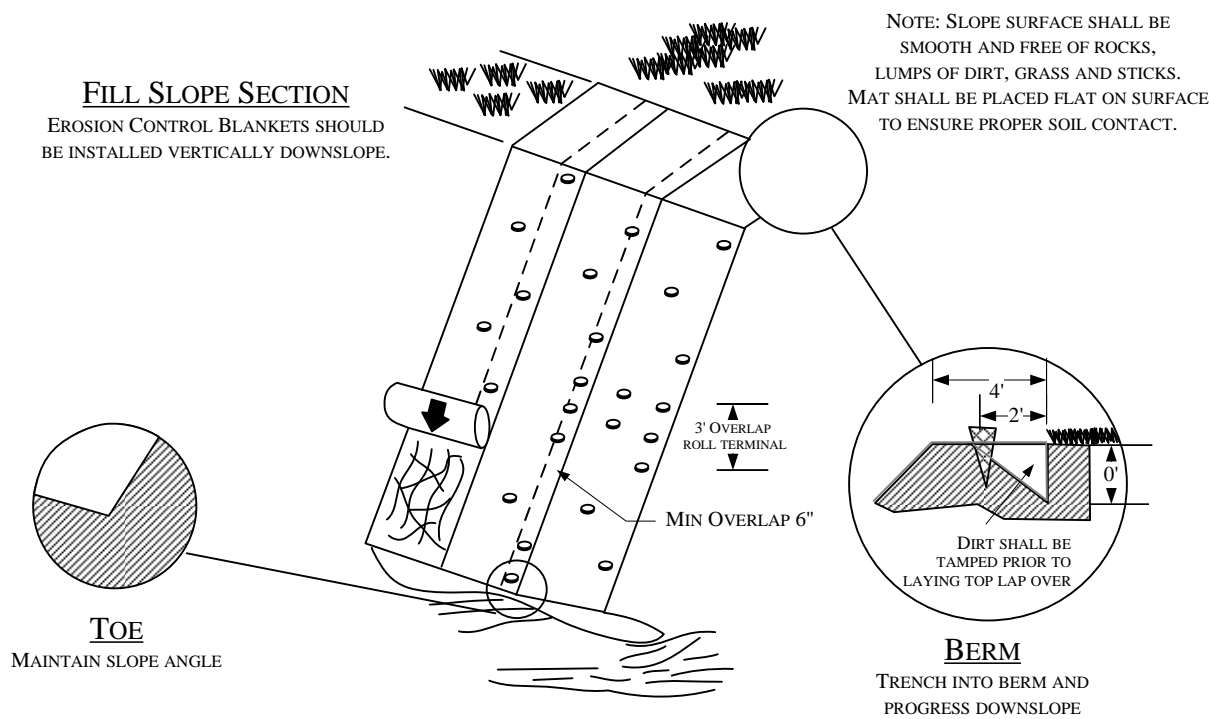
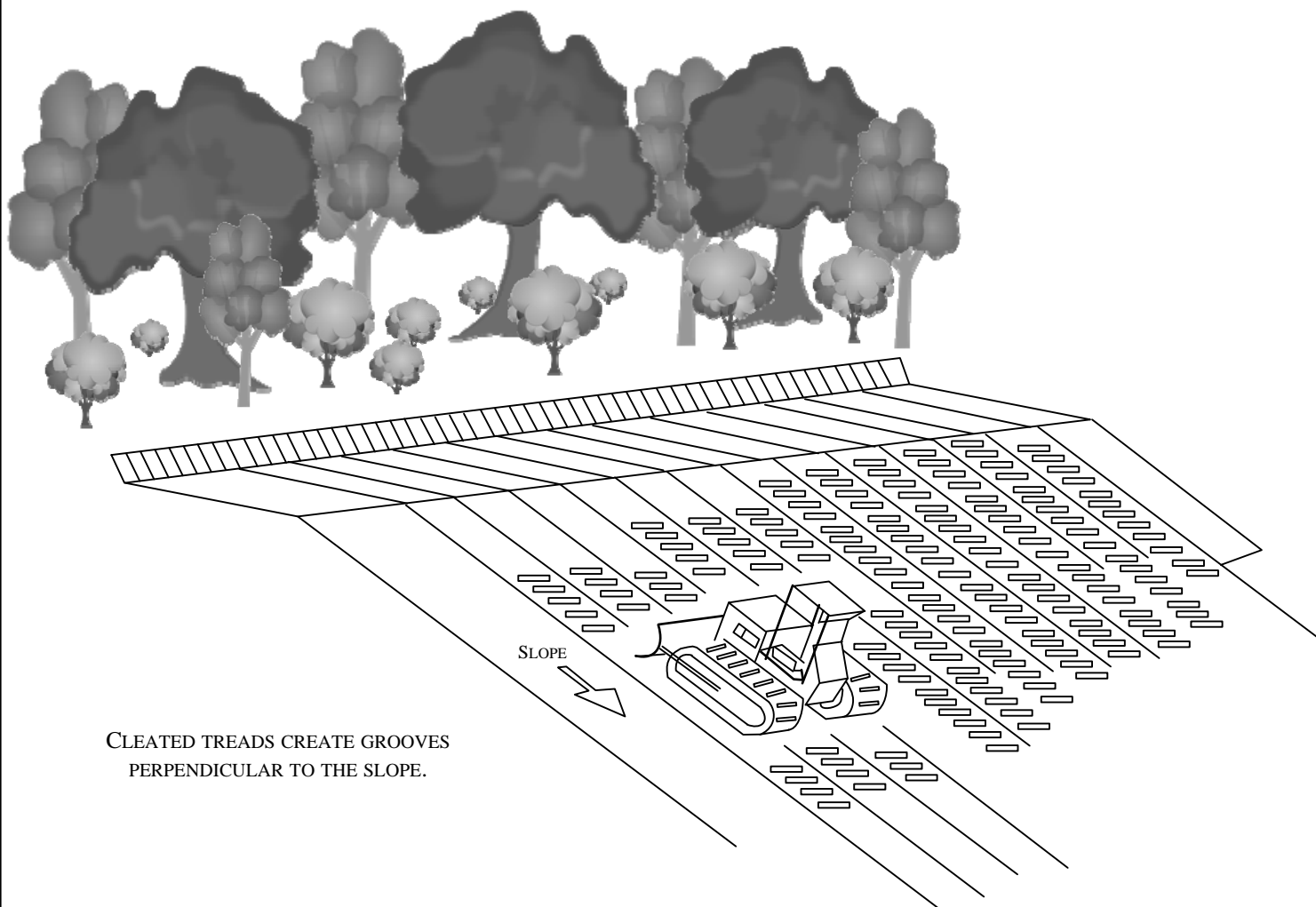


Figure 7
Environmental Protection Plan
Typical Erosion Control Blanket Installation

Scale: NTS
Date: 11/3/2016
Revised: 3/21/2017
Location: M:\Department Tasks\EPP Figures w\Borders\



CLEATED TREADS CREATE GROOVES
PERPENDICULAR TO THE SLOPE.

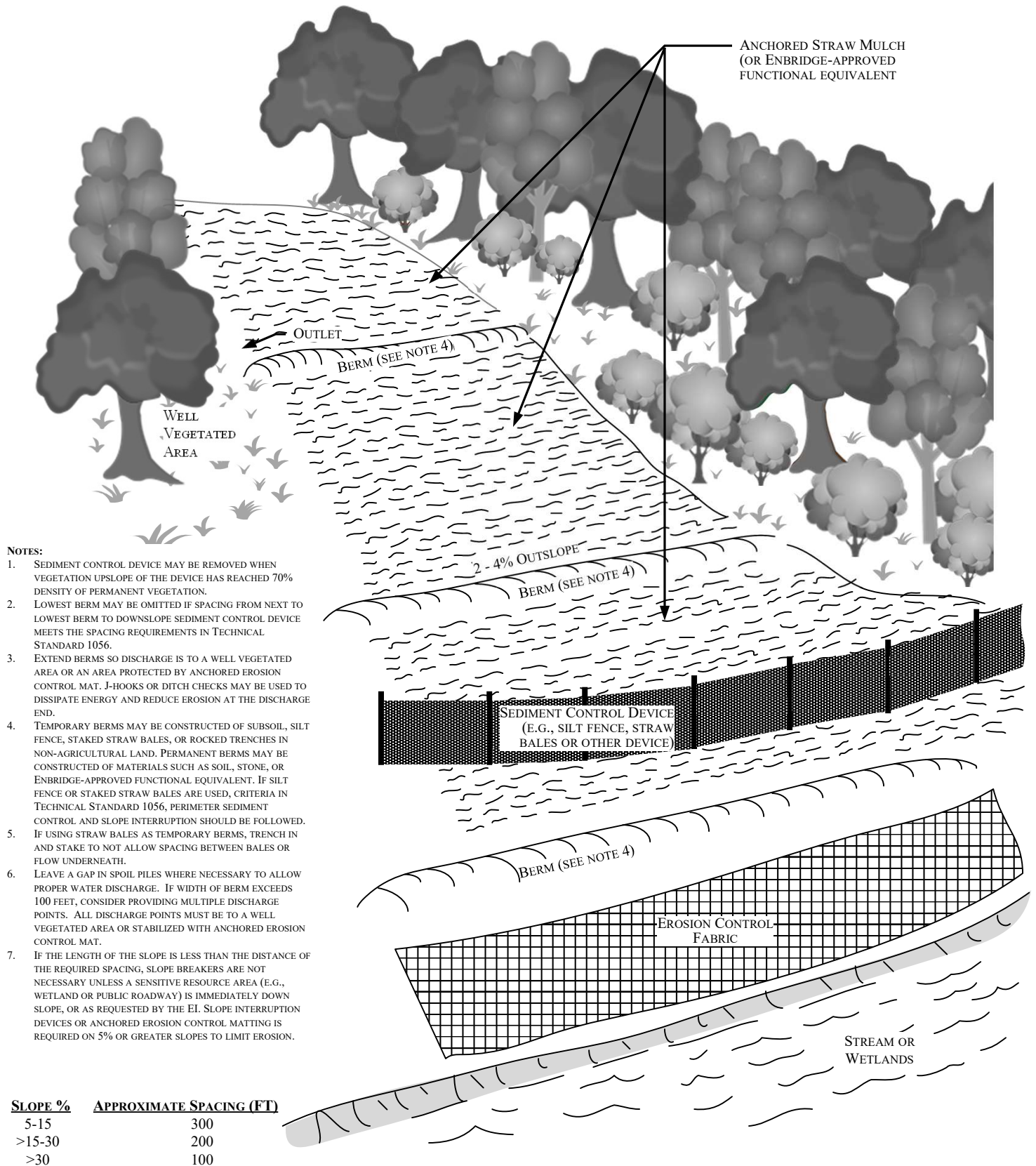


Figure 9

Environmental Protection Plan

Typical Temporary or Permanent Berms (Perspective View)

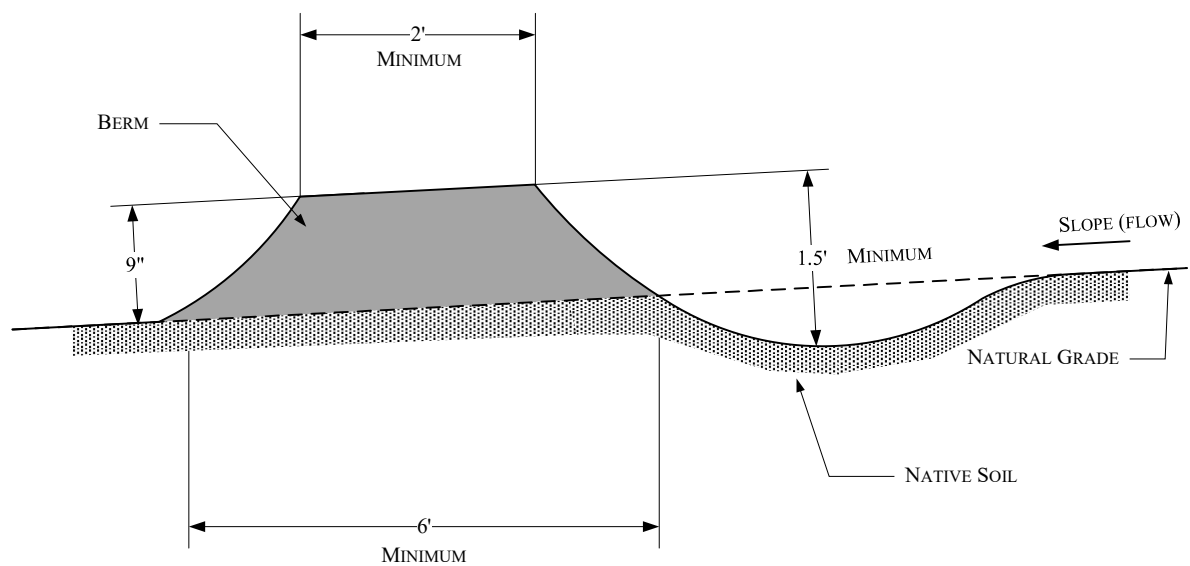
Scale: NTS

Date: 11/14/2000

Revised: 2/2/2024

Location: C:\Users\Randall.Cutting\Desktop\EPP\





NOTES

1. BERMS SHALL BE CONSTRUCTED WITH 2 TO 4 PERCENT OUTSLOPE.
2. BERMS SHALL BE OUTLETED TO WELL-VEGETATED STABLE AREAS, SEDIMENT CONTROL DEVICES OR ROCK APRONS.
3. BERMS SHALL BE SPACED AS DESCRIBED IN FIGURE 9 AND FIGURE 11.
4. ADDITIONAL INFORMATION INCLUDED ON OTHER DRAWINGS.
5. MINIMUM DIMENSIONS ARE SHOWN. SPACING MAY BE DECREASED IF FIELD CONDITIONS DICTATE.



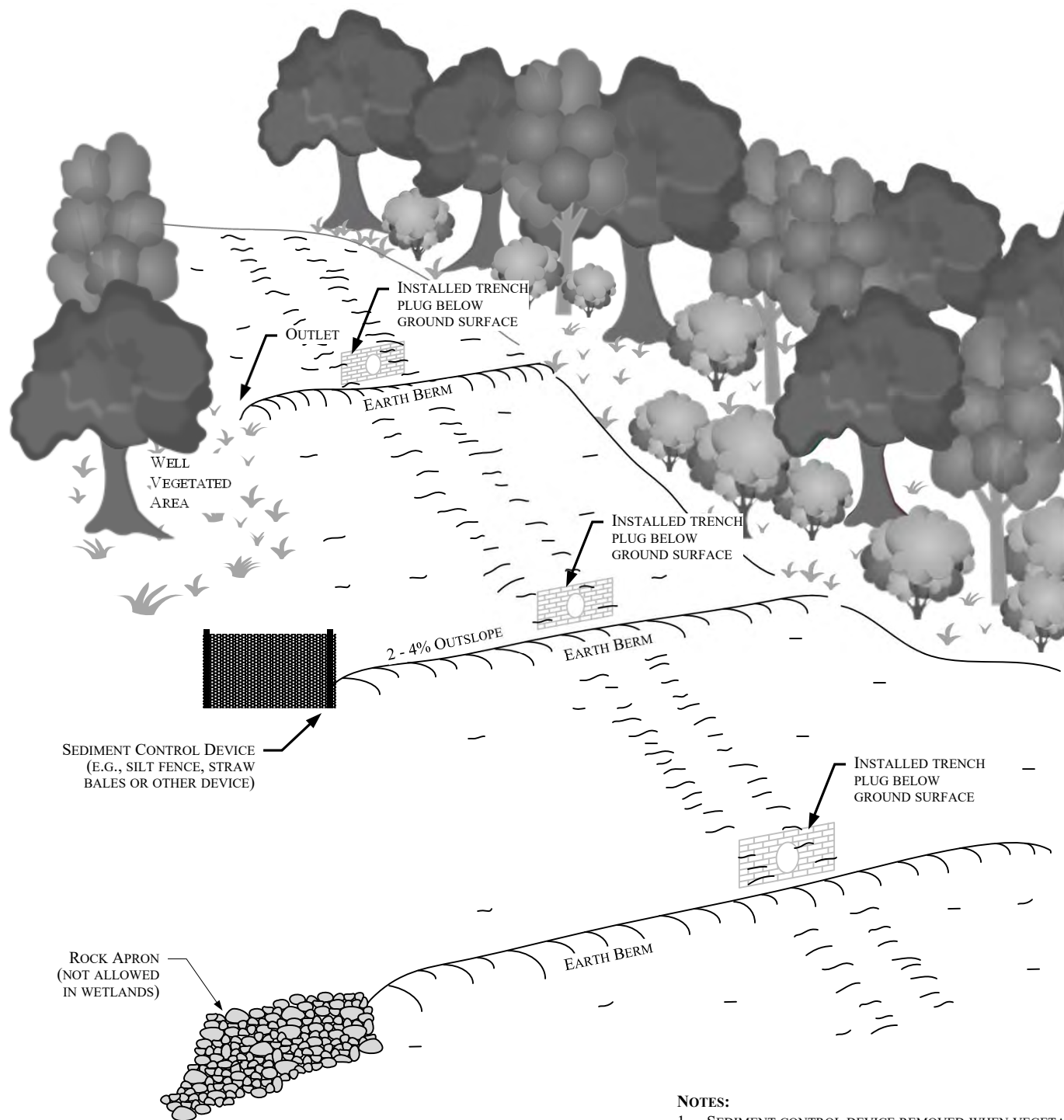
Figure 10
Environmental Protection Plan
 Typical Temporary or Permanent Berms (Elevation View)

Scale: NTS

Date: 11/14/2000

Revised: 2/2/2024

Location: C:\Users\Randall.Cutting\Desktop\EPP\



<u>SLOPE %</u>	<u>APPROX. SPACING (FT)</u>
3-5	250
5-15	200
15-25	150
>25	<100

NOTES:

1. SEDIMENT CONTROL DEVICE REMOVED WHEN VEGETATION ESTABLISHED.
2. LOWEST BERM MAY BE OMITTED IF SEDIMENT CONTROL DEVICES ARE INSTALLED AT THAT LOCATION, SUBJECT TO APPROVAL.
3. INSTALL SEDIMENT CONTROL DEVICES AT DISCHARGE END OF EARTHEN BERMS AS NECESSARY TO DISSIPATE ENERGY AND PREVENT EROSION.



Figure 11
Environmental Protection Plan
 Permanent Slope Breakers (Perspective View)

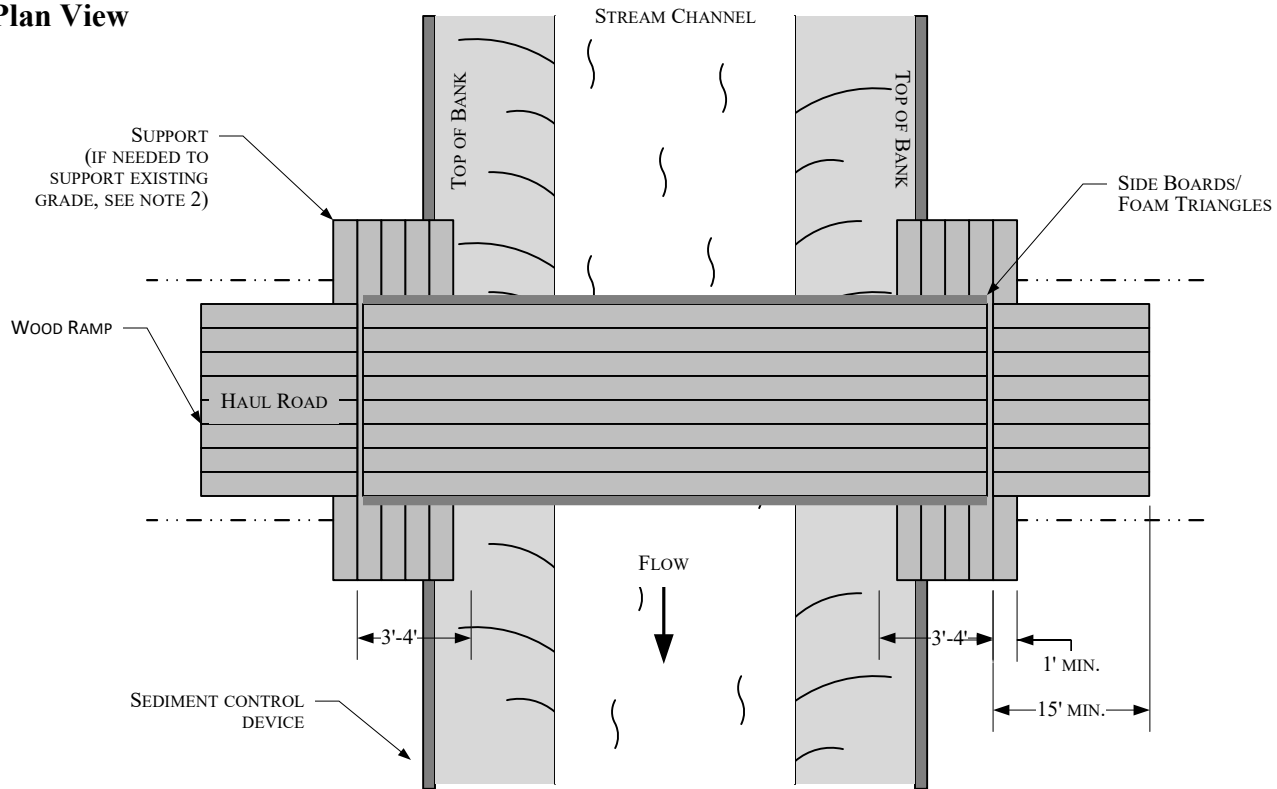
Scale: NTS

Date: 11/14/2000

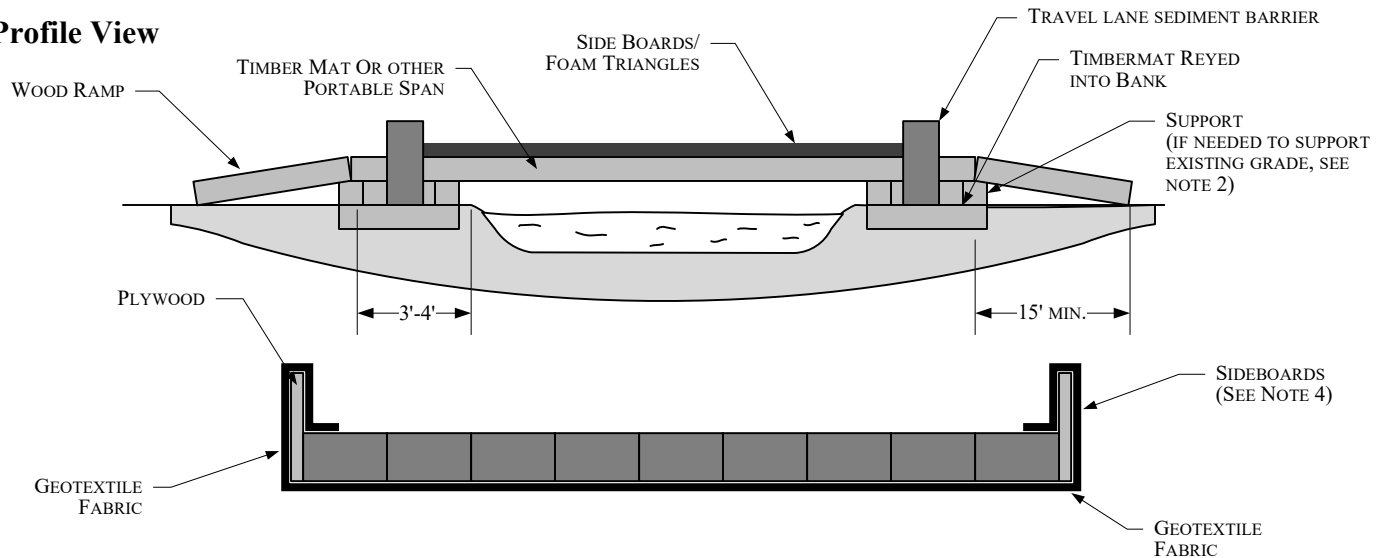
Revised: 3/3/2017

Location: M:\Clients\D-F\EL\BadRiver\Documents\

Plan View



Profile View



NOTES:

1. INSPECT BRIDGE OPENING PERIODICALLY AND FOLLOWING RAINFALLS OF OVER $\frac{1}{2}$ ". REMOVE ANY DEBRIS RESTRICTING FLOW AND DEPOSIT IT AT AN UPLAND SITE OUTSIDE OF FLOODPLAIN.
2. INSPECT BRIDGE ELEVATION SO BRIDGE REMAINS SUPPORTED ABOVE OHWM AND DOES NOT SINK INTO BANK.
3. ADDITIONAL SUPPORT MUST BE ADDED ON TOP OF BANK IF INITIAL SUPPORT STARTS TO SETTLE.
4. SIDEBARDS WILL BE INSTALLED ON TEMPORARY BRIDGES TO MINIMIZE THE POTENTIAL FOR SEDIMENT TRANSPORT. SIDEBARDS MAY BE CONSTRUCTED OUT OF PLYWOOD, OR EQUIVALENT, AND AFFIXED TO THE OUTER SIDES OF THE BRIDGE. GEO-TEXTILE FABRIC, OR EQUIVALENT, MUST ALSO BE ADEQUATELY SECURED TO THE UNDERSIDE OF THE BRIDGE TO PREVENT MATERIAL FROM FALLING THROUGH THE BRIDGE DECK. THE GEO-TEXTILE FABRIC OR AN EQUIVALENT SHOULD BE SECURED TO THE BOTTOM OF THE BRIDGE AND WRAPPED AROUND THE SIDEBARDS IN A CONTINUOUS FASHION.

Figure 12

Environmental Protection Plan
Typical Span Type Bridge

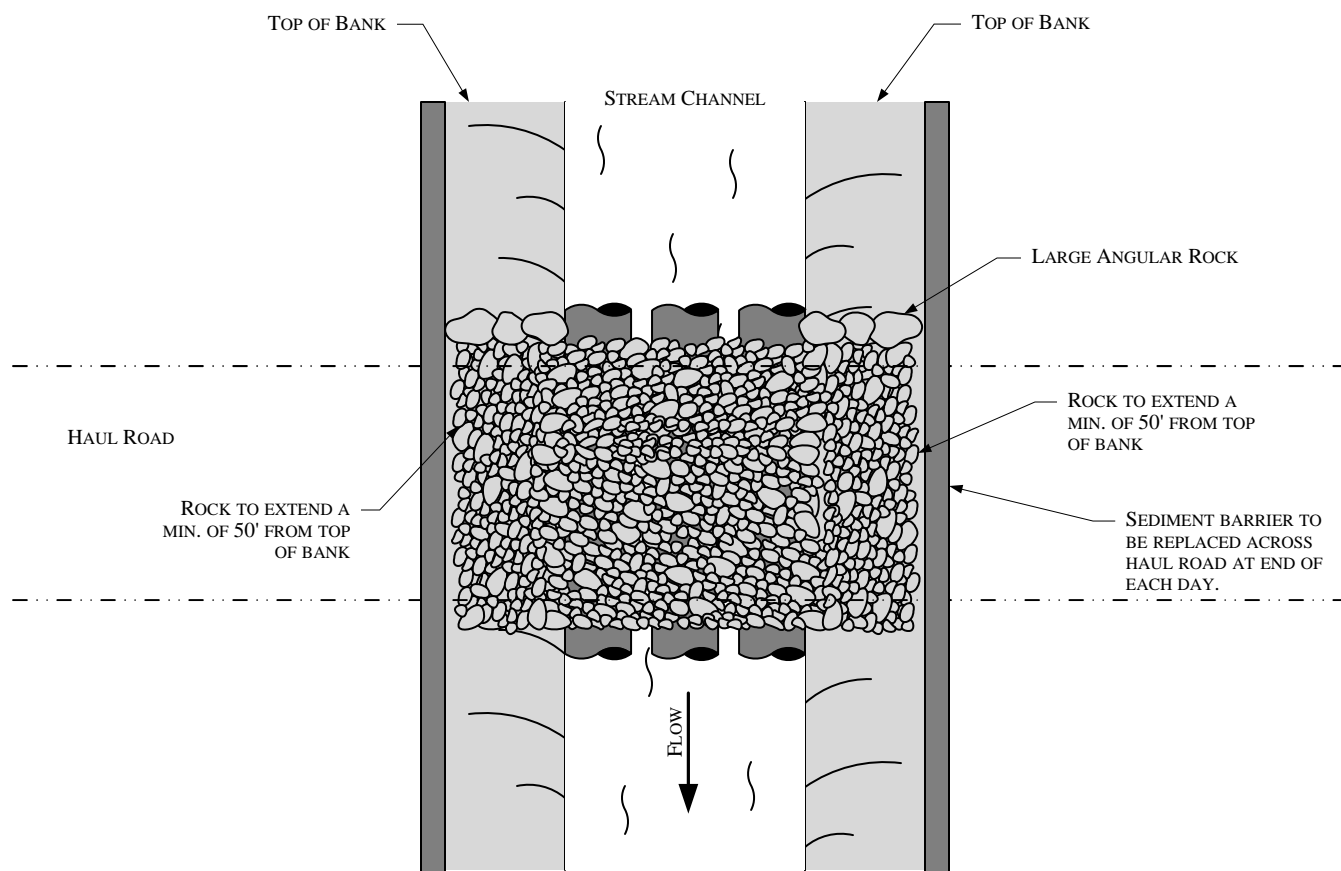


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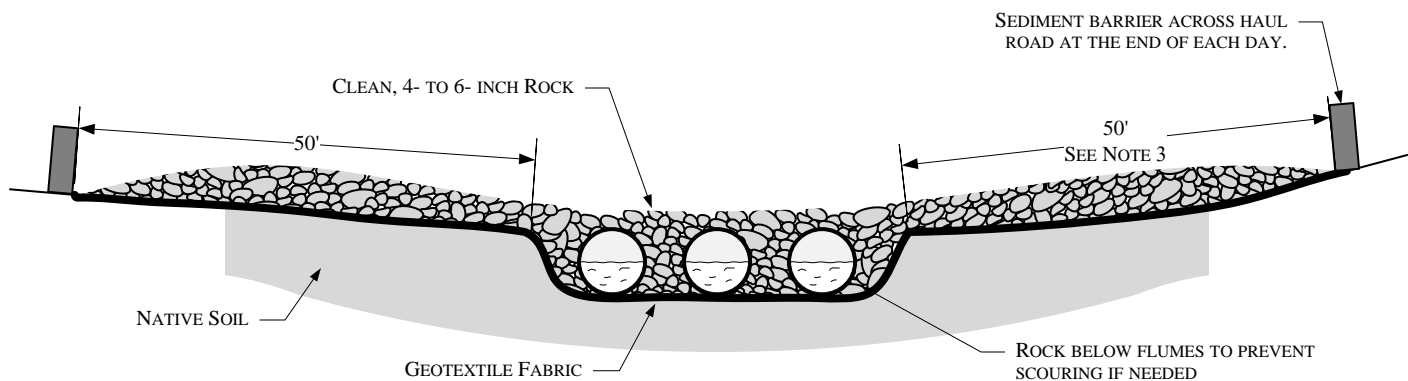
Date: 11/16/2016

Revised: 2/2/2024

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PLAN VIEW
(NOT TO SCALE)



NOTES:

1. STEEL FLUME PIPE(S) SIZED TO ALLOW FOR STREAM FLOW AND EQUIPMENT LOAD.
2. SEDIMENT BARRIER SHALL BE PLACED ACROSS BRIDGE ENTRANCE EVERY NIGHT.
3. NOT PERMISSIBLE IN AGRICULTURAL FIELDS.

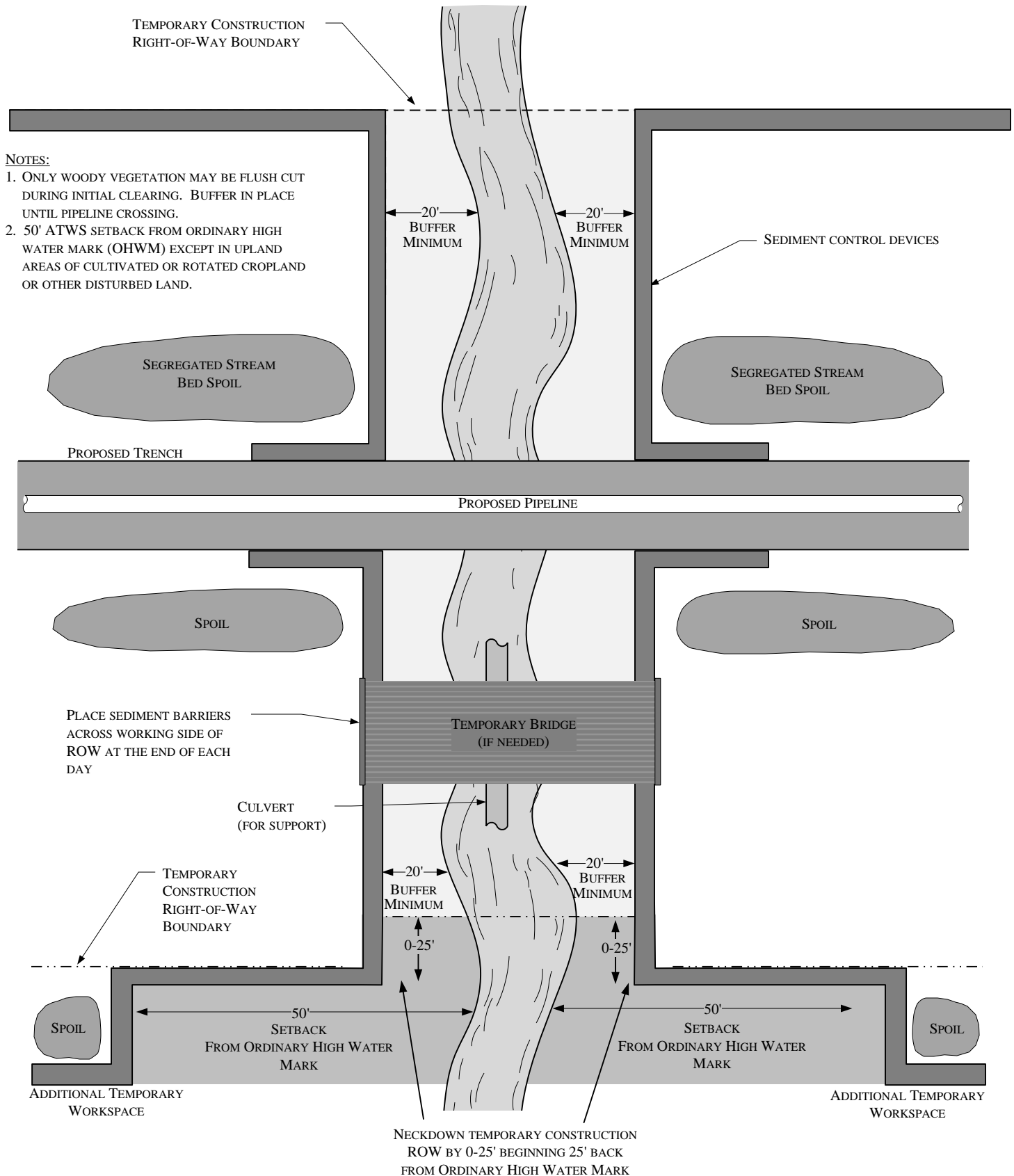


Figure 14
Environmental Protection Plan
 Typical Waterbody Crossing Method
 Open-Cut Wet Trench Method

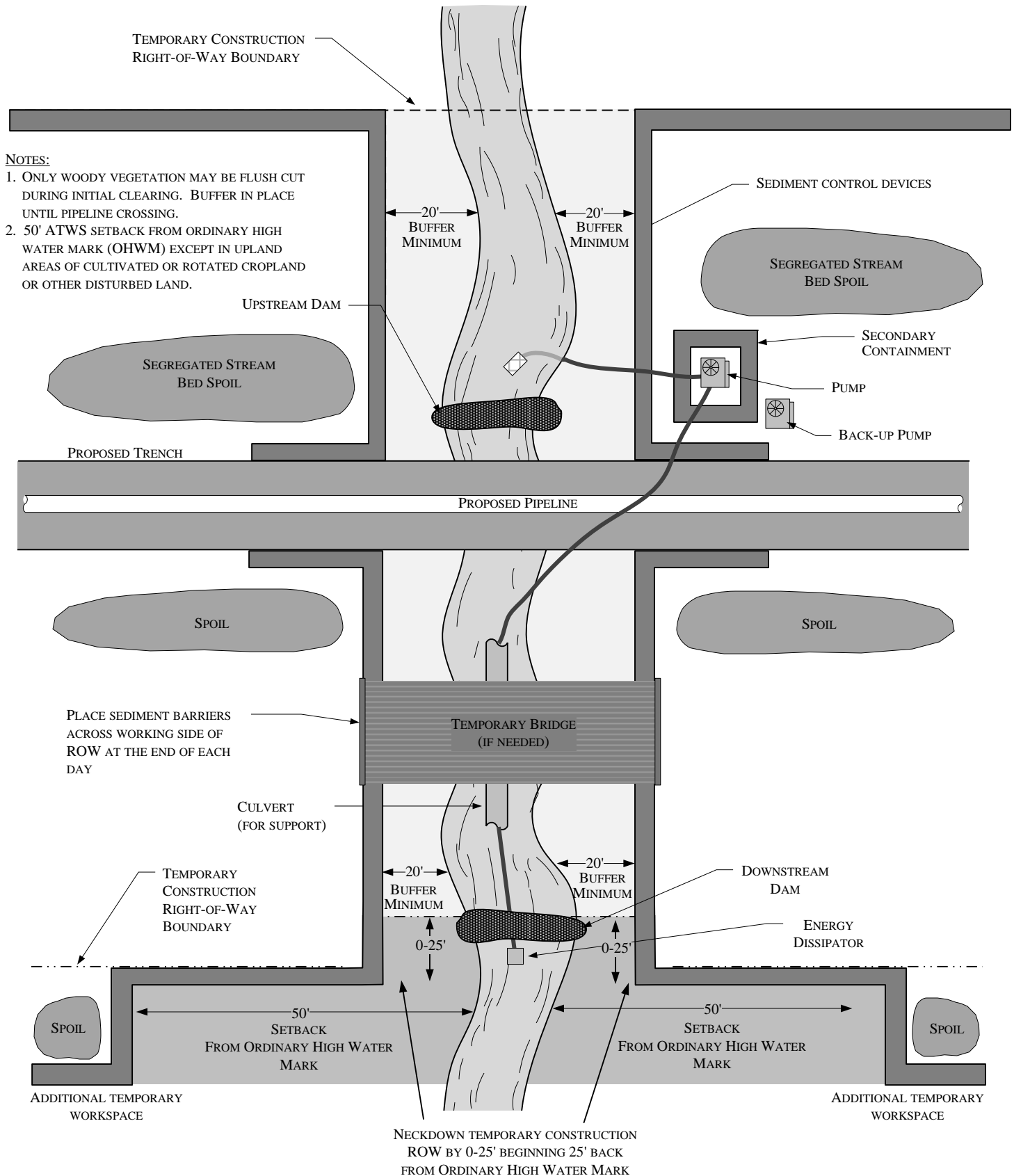


Figure 15
Environmental Protection Plan
 Typical Waterbody Crossing Method
 Dam and Pump Method

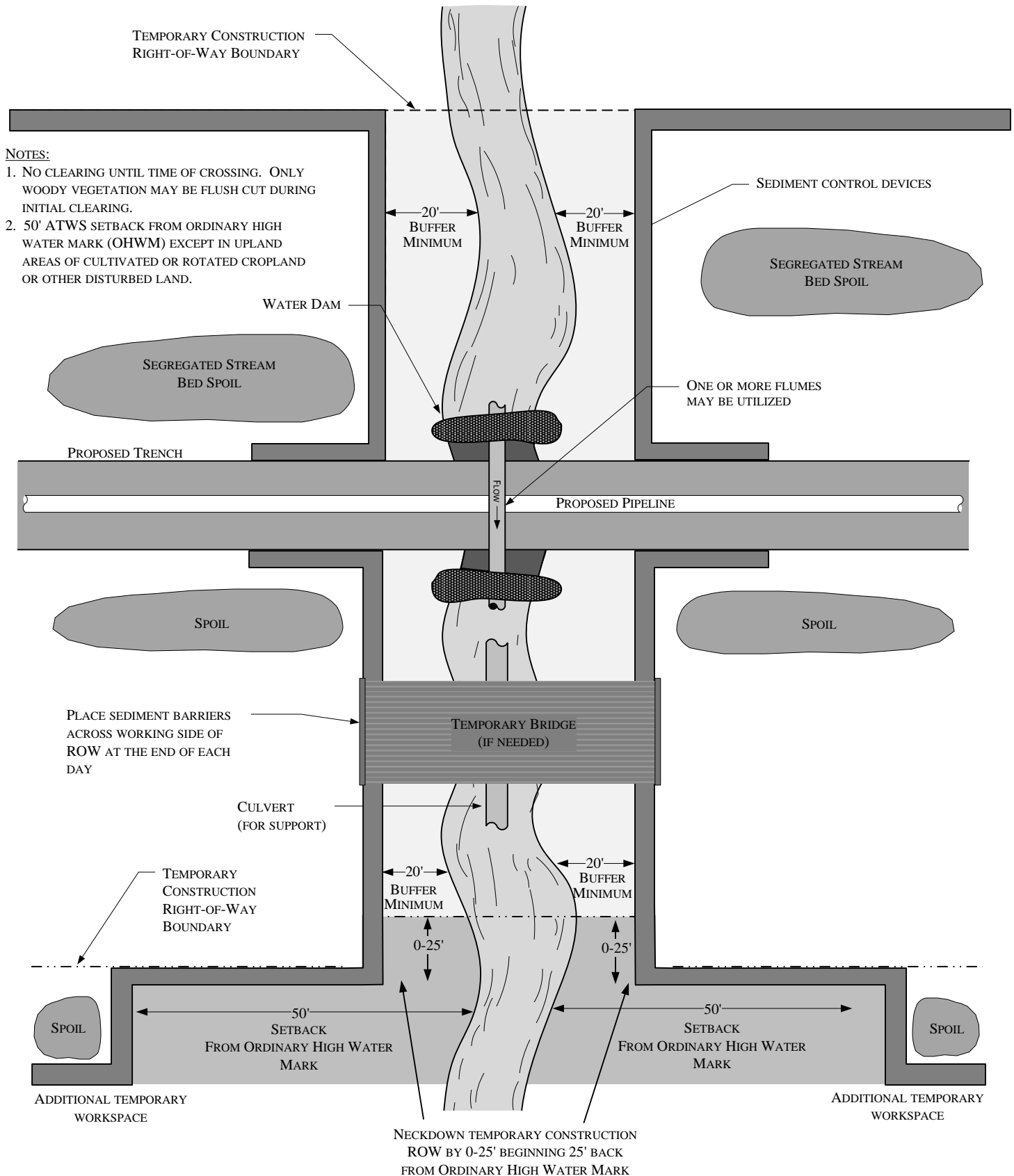
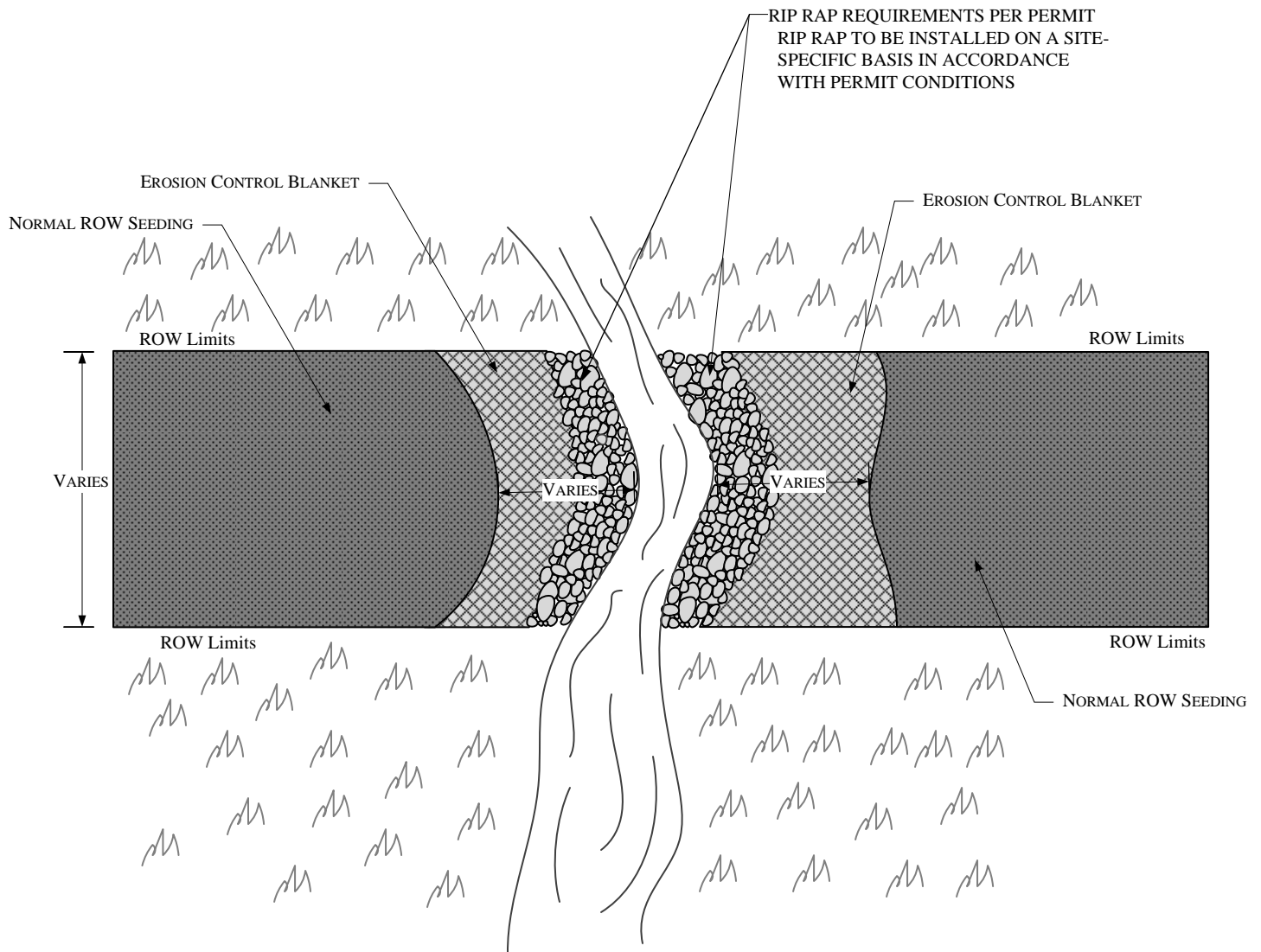


Figure 16
Environmental Protection Plan
 Typical Waterbody Crossing Method
 Flume Method



Scale: NTS
Date: 11/14/2000
Revised: 3/21/2017
Location: M:\Department Tasks\EPP Figures w\Borders\



NOTE:
 PLACE BLANKET A MINIMUM OF ONE (1) FOOT
 UNDER RIP RAP. EXTEND BLANKET FROM
 MEAN HIGH WATER LEVEL TO SEVERAL FEET
 BEHIND HIGH BANK.



Figure 17
Environmental Protection Plan
 Typical Final Stream Bank Stabilization
 Rip Rap & Erosion Control

Scale: NTS

Date: 11/30/2016

Revised: 3/21/2017

Location: M:\Department Tasks\EPP Figures w\Borders\

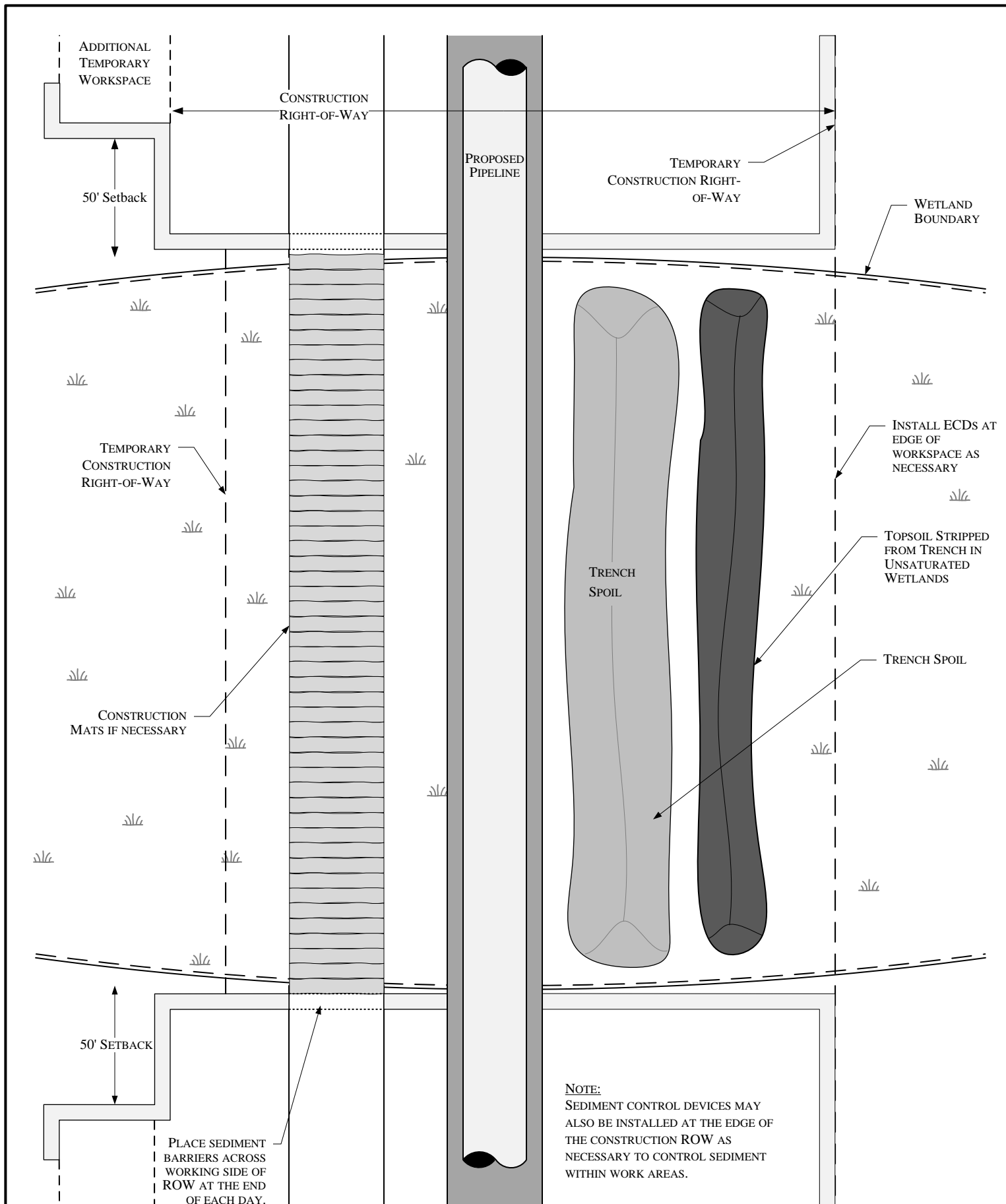


Figure 18a

Environmental Protection Plan
Typical Wetland Crossing Method



Scale: NTS

Date: 12/1/2016

Revised: 3/21/2017

Location: M:\Department Tasks\EPP Figures w\Borders\

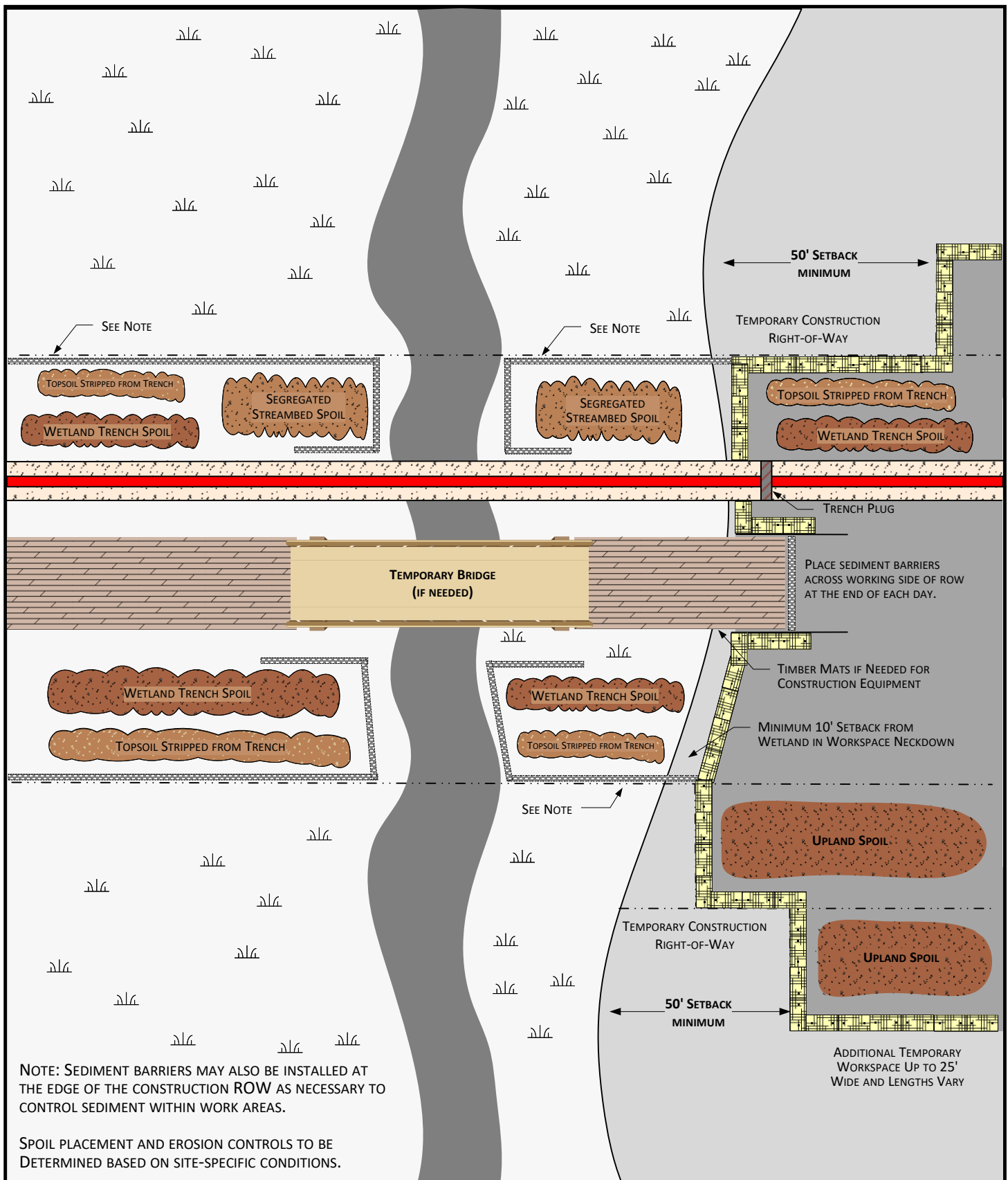


Figure 18c
Erosion and Sediment Control Plan
 Typical Open Cut Waterbody Crossing
 Method within Wetland Crossing Method



DEWATERING DISCHARGE IN WELL VEGETATED UPLANDS

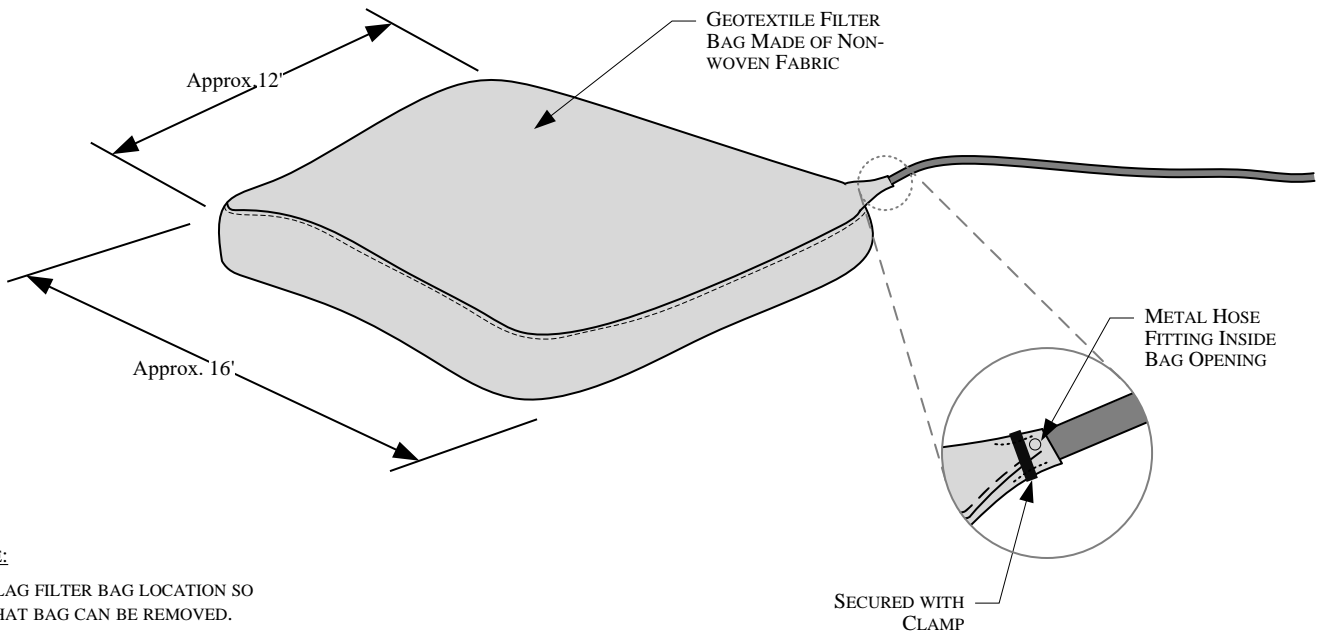
WELL VEGETATED
UPLAND AREA

NOTES:

1. PUMP INTAKE HOSE MUST BE SECURED AT LEAST ONE FOOT ABOVE THE TRENCH BOTTOM.
2. DEWATER INTO FILTERING MECHANISM.

DISCHARGE HOSE
SECONDARY CONTAINMENT
INTAKE HOSE

GEOTEXTILE FILTER BAG



NOTE:

1. FLAG FILTER BAG LOCATION SO THAT BAG CAN BE REMOVED.



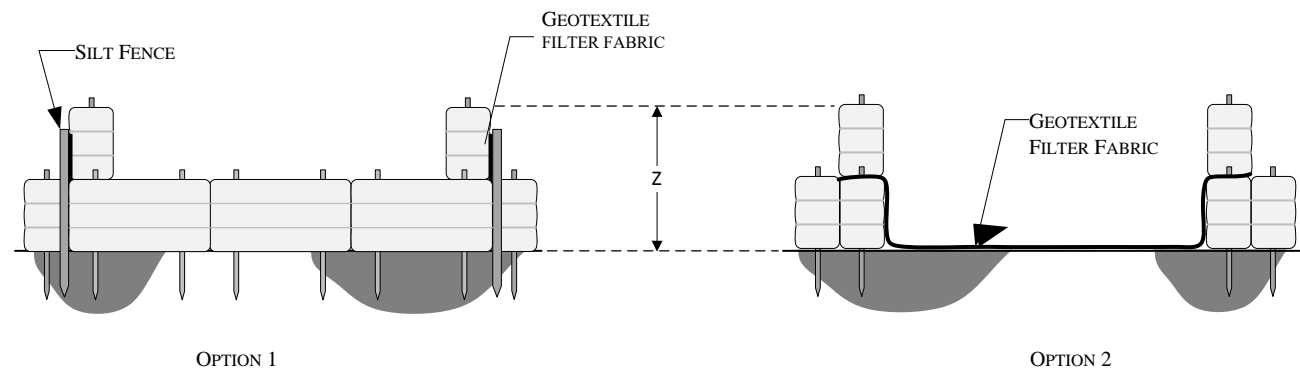
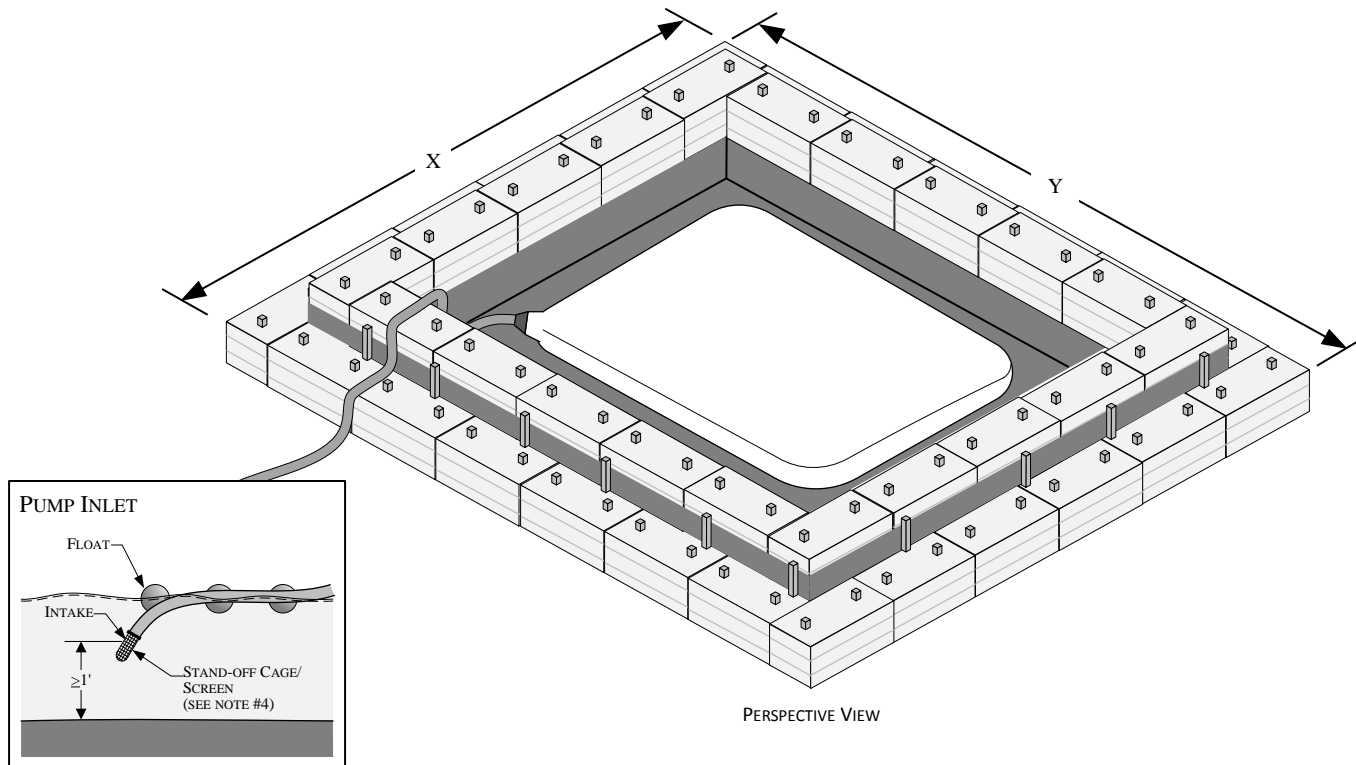
Figure 19
Environmental Protection Plan
Typical Dewatering Measures

Scale: NTS

Date: 11/21/2016

Revised: 12/13/2019

Location: M:\Department Tasks\EPP Figures w\Borders\



DEWATERING STRUCTURE SIZING GUIDANCE

TYPICAL MINIMUM SUMP DIMENSIONS (FEET)		MAXIMUM PUMPING RATE GALLONS PER MINUTE
X	Y	
10	20	300
15	20	350
20	20	400
20	25	450
25	25	500
25	30	550
30	30	600

NOTE: TYPICAL DIMENSIONS AND MAXIMUM PUMPING RATES ARE BASED ON INDUSTRY EXPERIENCE, BEST MANAGEMENT PRACTICES, AND PUMP SIZE (4' - 8').

NOTES:

1. ARRANGE THE STRAW BALES TO THE X AND Y DIMENSIONS REQUIRED TO ACCOMMODATE ANTICIPATED PUMPING RATES. SEE DEWATERING STRUCTURE SIZING GUIDANCE.
2. LINE ENTIRE STRUCTURE WITH GEOTEXTILE FILTER FABRIC.
3. SILT FENCE ENDS MUST BE WRAPPED TO JOIN TWO SECTIONS - OPTION 1.
4. INSTALL SILT FENCE 2-INCHES ABOVE TOP OF STRAW BALE, AND ANCHOR A MINIMUM OF 8 INCHES STRAIGHT DOWN - OPTION 1.
5. SILT FENCE POST STAKING MUST BE 4-FEET OR LESS - OPTION 1.
6. DEWATERING INTAKE HOSE MUST BE SUPPORTED AT LEAST 1-FOOT FROM BOTTOM OF TRENCH BEING DEWATERED.
7. FILTER BAG WITHIN THE BASIC STRUCTURE IS OPTIONAL BASED ON SITE-SPECIFIC PARAMETERS AND/OR CONSTRAINTS - OPTION 2.



Figure 20
Environmental Protection Plan
Straw Bale Dewatering Structure

Scale: NTS

Date: 11/23/2016

Revised: 07/30/2021

Location: M:\Department Tasks\EPP Figures w\Borders\

Appendix A

Equipment Cleaning Log



Equipment Cleaning Log

Form Completed By: _____

Date: _____ Time: _____

Location of Equipment (tract & milepost): _____

Equipment Type: _____

Equipment ID (e.g., company, unique ID number): _____

Cleaning Method: (check all that apply)

- ☐ Scrape Down
- ☐ Steam Wash Blow Down (compressed air)
- ☐ Power/Pressure Wash (water)
- ☐ Other (Describe): _____

Comments: _____

Appendix B

Seed Mixes

WISCONSIN SEED MIXES

Based on precipitation and general soil types the following seed mixes will be used in Wisconsin:

Table B-1 WI Seed Mix 1 – Standard Upland Seed Mix		
<u>Use:</u> Wisconsin state-wide in upland areas <u>Seeding Rate:</u> 15.0 pounds/acre PLS drilled or 30.0 pounds/acre PLS broadcast without the companion crop Double the rate of the companion crop when broadcast seeding <u>Notes:</u> <i>Enbridge Environment must approve substitutions in advance</i>		
Species: Preferred Varieties (if available)	Pounds/Acre PLS	Percent of Mix
Perennial Ryegrass	2	17.0
Canada Wild-rye	4	33.0
Switchgrass: unimproved native variety	4	33.0
Timothy	2	17.0
Subtotal	12	100.0 ¹
Associated Companion Crop Mix		
Oats for summer seeding; or Winter Wheat for seeding in late fall (dormant) or spring	16	80.0
Annual Ryegrass or Slender Wheat Grass	4	20.0
Companion/Cover Crop Subtotal	20	100.0
GRAND TOTAL (pounds)	32	100.0¹
¹ May not equal 100 percent due to rounding		

Table B-2
WI Seed Mix 2 – Native Sedge/Wet Meadow Mixture

Use: Wisconsin state-wide in unsaturated Wet Meadow wetland areas

Seeding Rate: See below summary.

Notes: Enbridge Environment must approve substitutions in advance

Common Name	Botanical Name	Indicator Status	Seeds/oz.	Seeds/ft ²	% of Mix
Brome, fringed	<i>Bromus ciliata</i>	FACW	10,000	1.5	8.1
Blue-joint grass	<i>Calamagrostis canadensis</i>	OBL	280,000	8.2	1.6
Wild-rye, Virginia	<i>Elymus virginicus</i>	FACW-	4,200	3.2	42.3
Manna grass, reed	<i>Glyceria grandis</i>	OBL	80,000	4.7	3.2
Manna grass, fowl	<i>Glyceria striata</i>	OBL	160,000	4.7	1.6
Bluegrass, fowl	<i>Poa palustris</i>	FACW+	118,000	16.7	7.1
Sedge, bottlebrush	<i>Carex comosa</i>	OBL	30,000	2.2	4.3
Sedge, pointed- broom	<i>Carex scoparia</i>	FACW	84,000	1.5	1.0
Sedge, tussock	<i>Carex stricta</i>	OBL	53,000	0.8	0.8
Sedge, Common fox	<i>Carex stipata</i>	OBL	34,000	2.0	3.2
Sedge, fox	<i>Carex vulpinoidea</i>	OBL	100,000	5.9	3.2
Rush, slender	<i>Juncus tenuis</i>	FAC	1,000,000	11.0	0.2
Torry's Rush	<i>Juncus toryi</i>	OBL	1,600,000	5.9	0.6
Bulrush, green	<i>Scirpus atrovirens</i>	OBL	460,000	16.9	2.0
Wool grass	<i>Scirpus cyperinus</i>	OBL	1,700,000	6.2	0.2
Milkweed, marsh	<i>Asclepias incarnata</i>	OBL	4,800	0.4	5.0
Aster, swamp	<i>Aster puniceus</i>	OBL	80,000	5.9	4.0
Aster, flat-topped	<i>Aster umbellatus</i>	FACW	67,000	1.5	1.2
Joe-pye weed	<i>Eupatorium maculatum</i>	OBL	95,000	0.7	0.4
Boneset	<i>Eupatorium perfoliatum</i>	FACW+	160,000	1.2	0.4
Goldenrod, grass- leaved	<i>Euthamia graminifolia</i>	FACW-	350,000	1.0	0.2
Sneezeweed	<i>Helenium autumnale</i>	FACW+	130,000	0.8	0.3
Sunflower, serrated	<i>Helianthus grosseserratus</i>	FACW-	15,000	0.2	0.6
Lobelia, great-blue	<i>Lobelia siphilitica</i>	FACW+	500,000	2.9	0.3
Monkey flower	<i>Mimulus ringens</i>	OBL	2,300,000	6.8	0.2
Mint, mountain	<i>Pycnanthemum virginianum</i>	FACW+	220,000	1.3	0.3
Meadow-rue, purple	<i>Thalictrum dasycarpum</i>	FACW	11,000	0.1	0.4
Vervain, blue	<i>Verbena hastata</i>	FACW+	93,000	2.2	1.3
Alexanders, Golden	<i>Zizia aurea</i>	FACW	11,000	1.0	5.0

Recommended Rate: 5.0 (PLS lbs/acre)

SUMMARY

Mix Seeds Per Square Foot	Mix Seeds Per Square Yard	Mix Seeds Per Acre
121	1,093	5,290,320
% by wt. Grasses	% by wt. Graminoids	% by wt. Forbs
64.0	15.0	21.0
% by Seed Count Grasses	% by Seed Count Graminoids	% by Seed Count Forbs
32.1	43.2	24.7

Table B-3
WI Seed Mix 3 – Native Wet Prairie Mixture

Use: Wisconsin state-wide in unsaturated Wet Prairie wetland areas

Seeding Rate: See below summary.

Notes: Enbridge Environment must approve substitutions in advance

Common Name	Botanical Name	Indicator Status	Seeds/oz.	Seeds/ft ²	% of Mix
Bluestem, big	<i>Andropogon gerardi</i>	FAC-	10,000	3.7	15.3
Brome, fringed	<i>Bromus ciliata</i>	FACW	10,000	1.8	7.7
Blue-joint grass	<i>Calamagrostis canadensis</i>	OBL	280,000	6.2	0.9
Wild-rye, Virginia	<i>Elymus virginicus</i>	FACW-	4,200	2.0	19.9
Manna grass, reed	<i>Glyceria grandis</i>	OBL	80,000	2.9	1.5
Manna grass, fowl	<i>Glyceria striata</i>	OBL	160,000	3.5	0.9
Switchgrass	<i>Panicum virgatum</i>	FAC+	14,000	3.1	9.2
Bluegrass, fowl	<i>Poa palustris</i>	FACW+	118,000	9.6	3.0
Indian grass	<i>Sorghastrum nutans</i>	FACU+	12,000	2.0	6.7
Cord grass, prairie	<i>Spartina pecinata</i>	FACW+	6,600	1.1	6.9
Sedge, tussock	<i>Carex stricta</i>	OBL	53,000	0.7	0.5
Sedge, fox	<i>Carex vulpinoidea</i>	OBL	100,000	3.7	1.5
Bulrush, green	<i>Scirpus atrovirens</i>	OBL	460,000	7.7	0.7
Wool grass	<i>Scirpus cyperinus</i>	OBL	1,700,000	18.7	0.5
Anemone, Canada	<i>Anemone canadensis</i>	FACW	8,000	0.09	0.5
Milkweed, marsh	<i>Asclepias incarnata</i>	OBL	4,800	0.1	1.4
Aster, swamp	<i>Aster puniceus</i>	OBL	80,000	2.4	1.2
Aster, flat-topped	<i>Aster umbellatus</i>	FACW	67,000	1.5	0.9
Tic-trefoil, showy	<i>Desmodium canadense</i>	FAC-	5,500	0.8	6.1
Joe-pye weed	<i>Eupatorium maculatum</i>	OBL	95,000	1.7	0.8
Boneset	<i>Eupatorium perfoliatum</i>	FACW+	160,000	2.4	0.6
Goldenrod, grass- leaved	<i>Euthamia graminifolia</i>	FACW-	350,000	2.0	0.3
Sneezeweed	<i>Helenium autumnale</i>	FACW+	130,000	2.39	0.8
Sunflower, serrated	<i>Helianthus grosseserratus</i>	FACW-	15,000	0.3	0.7
Blazingstar, tall	<i>Liatris pycnostachya</i>	FAC-	11,000	0.1	0.5
Lobelia, great-blue	<i>Lobelia siphilitica</i>	FACW+	500,000	1.4	0.1
Monkey flower	<i>Mimulus ringens</i>	OBL	2,300,000	6.4	0.1
Mint, mountain	<i>Pycnanthemum virginianum</i>	FACW+	220,000	1.2	0.3
Vervain, blue	<i>Verbena hastate</i>	FACW+	93,000	1.0	0.5
Ironweed	<i>Veronia fasciculata</i>	FACW	24,000	0.1	0.3
Culver's root	<i>Veronicastrum virginicum</i>	FAC	800,000	8.8	0.5
Alexander's, golden	<i>Zizia aurea</i>	FAC+	11,000	2.4	9.2

Recommended Rate: 5.0 (PLS lbs/acre)

SUMMARY

Mix Seeds Per Square Foot	Mix Seeds Per Square Yard	Mix Seeds Per Acre
102	884	4,436,283
% by wt. Grasses	% by wt. Graminoids	% by wt. Forbs
72.0	3.0	24.0
% by Seed Count Grasses	% by Seed Count Graminoids	% by Seed Count Forbs
35.0	30.0	35.0

Table B-4
WI Seed Mix 4 - Waterbody Banks Seed Mix

Use: Wisconsin state-wide on waterbody banks

Seeding Rate: 8.255 pounds/acre PLS drilled or 16.510 pounds/acre PLS broadcast without the companion crop

Double the rate of the companion crop when broadcast seeding

Notes: *Enbridge Environment must approve substitutions in advance*

Species: Preferred Varieties (if available)	Pounds/Acre PLS	Percent of Mix
American slough grass: Common	1.500	18.2
Blue-joint grass: Common	0.100	1.2
Reed manna grass: Common	0.200	2.4
Fowl manna grass: Common	0.100	1.2
Fowl bluegrass: Common	1.800	21.8
Rice cut-grass: Common	0.250	3.0
Annual ryegrass: Common	0.900	10.9
Tussock sedge: Common	0.100	1.2
Fox sedge: Common	0.300	3.6
Green bulrush: Common	0.100	1.2
Wool grass: Common	0.005	0.1
River bulrush: Common	0.250	3.0
Soft-stem bulrush: Common	0.100	1.2
March milkweed: Common	0.100	1.2
Flat-topped aster: Common	0.300	3.6
Joe-pye weed: Common	0.300	3.6
Boneset: Common	0.250	3.0
Sneezeweed: Common	0.250	3.0
Spotted touch-me-not: Common	0.100	1.2
Great blue lobelia: Common	0.100	1.2
Monkey flower: Common	0.100	1.2
Mountain mint: Common	0.100	1.2
Giant goldenrod: Common	0.250	3.0
Blue vervain: Common	0.350	4.2
Ironweed: Common	0.350	4.2
Total	8.255	100.0¹
Companion Crop		
Slender wheatgrass: Adanac, Pryor, Revenue, Primar, First Strike	3.000	100.0
Total Seed	11.255	100.0¹
¹ May not equal 100 percent due to rounding		

Appendix C
Emergency Response Contractors/Disposal and Treatment
Facilities

Emergency Response Contractors/Disposal and Treatment Facilities

The Contractor will dispose of all wastes according to applicable federal, state, and local requirements. A listing of potential Emergency Spill Response Contractors and waste disposal facilities is provided below. This list was developed from state-wide data bases. This list represents firms operating at the time the data base was produced. The Contractor is responsible for verifying if a contractor or facility is currently operating under appropriate permits or licenses. The Contractor is responsible for ensuring wastes are disposed of properly.

Spill Response Contractors		
Company	City/State	Phone Number
Wisconsin		
REI Engineering, Inc	Wausau, WI	(715) 675-9784 (877) REI-SPIL
WRR Environmental Services	Eau Claire, WI	(800) 727 8760
WIDOT	24-hour Emergency Response number	(800) 943-003
Wisconsin - The Contractor should consult with the WDNR Northern Regional Spill Coordinator (John Sager: phone (715) 365-8959) for assistance when selecting a spill response contractor.		

Waste Disposal/Treatment Facilities		
Facility	City/State	Telephone
Wisconsin		
Waste Management – Ashland Transfer Station	Ashland, WI	(855) 292-6029
Ashland City Landfill	Ashland, WI	(715) 682-9672
J B Disposal Inc	Butternut, WI	(715) 769-3676
Bad River Recycling	Ashland, WI	(715) 682-3771

Please note: Some facilities may have limitations on amounts, types of materials, etc.

*May accept crude oil-impacted soils and/or wastes from oil field exploration and production activities.

Appendix D
Spill Report Form



Spill Report Form

(The Contractor Spill Coordinator must complete this for any spill, regardless of size, and submit the form to the Enbridge Representative within 24 hours of the occurrence)

Date of Spill: _____ Date of Spill Discovery: _____

Time of Spill: _____ Time of Spill Discovery: _____

Name and Title of Discoverer: _____

Type of material spilled and manufacturer's name: _____

Legal Description of spill location to the quarter section: _____

Directions from nearest community: _____

Estimated volume of spill: _____

Weather conditions: _____

Topography and surface conditions of spill site: _____

Spill medium (pavement, sandy soil, water, etc.): _____

Proximity of spill to surface waters: _____

Did the spill reach a waterbody? _____ Yes _____ No

If so, was a sheen present? _____ Yes _____ No

Describe the causes and circumstances resulting in the spill: _____

Describe the extent of observed contamination, both horizontal and vertical (i.e., spill-stained soil in a 5-foot radius to a depth of 1 inch): _____

Describe immediate spill control and/or cleanup methods used and implementation schedule: _____

Current status of cleanup actions: _____

Name and Company for the following:

Construction Superintendent: _____

Spill Coordinator: _____

Enbridge Representative: _____

Person Who Reported the Spill: _____

Environmental Inspector: _____

Form completed by: _____ Date: _____

Appendix E
Spill Reporting-Agency Contacts

Spill Reporting Contacts			
Agency	Reporting Criteria	When	Phone Number
Federal Contacts			
National Response Center	Release of a hazardous substance in an amount equal to or greater than its reportable quantity under CERCLA Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on the water's surface, or leaves sludge or emulsion beneath the surface	Immediately	(800) 424-8802
Environmental Protection Agency (EPA) Region V, WI	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on the water's surface, or leaves sludge or emulsion beneath the surface	Immediately	(312) 353-2000
State Contacts			
Wisconsin Department of Natural Resources	>one gallon of gasoline on a pervious surface >5 gallons of petroleum on a pervious surface	Immediately	24-hour Toll Free Hotline for Reporting Spills 1 (800) 943-0003
County Contacts – Wisconsin			
Ashland County Emergency Management	As Needed		Non-Emergency: (715) 682-7023 opt 1
Iron County Emergency Management	As Needed		Stacy Ofstad (715) 561-3266
Bayfield County Emergency Management	As Needed		Jan Victorson, EM Coordinator (715) 373-6113

Appendix F
Wisconsin Storm Water Construction Technical Standards

Land Application of Additives for Erosion Control

(1050)

Wisconsin Department of Natural Resources
Technical Standard

I. Definition

The land application of products containing water-soluble and non-soluble *additives*¹ (products that are added to soil to create soil particle bonding) to temporarily reduce erosion. Products include *polyacrylamide (PAM)* and other *polymers*.

II. Purpose

The purpose of this practice is to reduce erosion deposition from wind and water on construction sites and agricultural lands until vegetation is established.

III. Conditions Where Practice Applies

This practice is intended for direct soil surface application to sites where the timely establishment of vegetation may not be feasible or where vegetative cover is absent or inadequate. Such areas may include agricultural lands where plant residues are inadequate to protect the soil surface and construction sites where land disturbing activities or winter shutdown prevent establishment or maintenance of a cover crop.

This practice is intended for land application of additives (with an established *allowable usage rate*) when runoff could enter *surface waters of the state* as defined by the Wisconsin Department of Natural Resources (WDNR) ch. NR 102, Wis. Adm. Code. Additives shall not be directly applied to *surface waters of the state*.

IV. Federal, State and Local Laws

Additive application shall comply with all federal, state, and local laws, rules or regulations governing additives. The operator is responsible for securing required permits. This standard does not contain the text of the federal, state, or local laws governing additives.

V. Criteria

A. Toxicity Criteria

¹ Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

Where additives could discharge to surface waters of the state, the WDNR reviews toxicity data for the *additive mixture* based on the guidance titled [“Water Quality Review Procedures for Additives”](#).

This technical standard outlines the toxicological analysis of land applied additive mixtures to arrive at an allowable usage rate (in mg/l or ppm) that is environmentally benign, harmless to fish, aquatic organisms, wildlife, and plants. This guidance lists the toxicity test results, parameters, and physical information needed to enable the WDNR to calculate the allowable usage rate for the specific product.

When additives could discharge to groundwater, polyacrylamide additives shall have < 0.05% free acrylamide monomer by weight as established by the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA).

B. Application Criteria

1. Application rates shall not exceed manufacturer's written application rate recommendations or the WDNR *allowable application rate* (expressed in lbs/acre).
2. The allowable application rate (lbs/acre) is determined by multiplying the allowable usage rate (mg/l) by (lbs/acre)/1.4 mg/l.
3. The application method shall provide uniform coverage to the target area and avoid drift to non-target areas.
4. The manufacturer or supplier shall provide written instructions (including the *Material Safety Data Sheet* or the *Safety Data Sheet*) to ensure proper safety, storage, and mixing of their product. The manufacturer shall provide general written application methods based on site conditions (such as slope and soil type) and the product degradation rate and rainfalls before the need for re-application.

5. The additive shall be used in conjunction with other Best Management Practices (BMPs).
6. When used on bare soil, without seed or mulch, additives shall be used on slopes 3:1 or flatter.
7. Additives shall not be applied to channel bottoms.
8. Unused additive mixtures shall be minimized. Excess material shall not be applied at a rate greater than the allowable application rate. Disposal shall not occur in storm water conveyance systems (i.e., storm sewer manholes, storm sewer inlets, ditches, or culverts).
9. At the time of application, the applicator of the additive mixture shall document the following:
 - Name of applicator
 - Application rate in lbs/acre
 - Date applied
 - Product type
 - Weather conditions during application
 - Method of application

Copies of this documentation shall be entered into the contractor's monitoring log or a project diary and made available upon request.

10. The manufacturer or distributor shall provide the following for the applicator:
 - Labels affixed to the additive mixture containers that indicate the recommended application rate and the allowable application rate based on the allowable usage rate.
 - A product expiration date for the additive mixture based on product expiration dates of the polymer.
 - General written application methods.
 - Written instructions to provide proper safety, storage, and mixing of the product.

C. Product Review Criteria

1. Toxicity test results for the additive mixtures shall be submitted to: Runoff Management Section-Additive Review, WDNR, 101 South Webster St., P.O. Box 7921, Madison, WI 53707, as a pre-qualification for field use.

The WDNR will review the toxicity test (water flea minimum) results and will provide a written product allowable usage and application rate.

2. The additive mixture shall be resubmitted for toxicity testing if any portion of the mixture is altered subsequent to its receiving an allowable application rate. Such alterations may include:
 - The amendment of base additive and/or any other additives.
 - The ratios of individual components.
3. Additives reviewed with regard to toxicity may still be subject to additional performance evaluation by end users.
4. Land applied additives intended for use on WisDOT sponsored projects shall be reviewed through the WisDOT pre-approval process for erosion control materials. Information can be found at the [WisDOT product acceptability list \(PAL\)](#).

Questions may be sent to:

New Products Engineer, WisDOT, Technology Advancement, 3502 Kinsman Blvd., Madison, WI 53704.

VI. Considerations

The following are additional recommendations, which may enhance the use of or avoid problems with the practice.

- A. Additive mixtures may be tested for erosion control performance under ASTM D6459, as modified in the American Association of State Highway and Transportation Officials (AASHTO) National Transportation Product Evaluation Program (NTPEP) work plan for erosion control products and sediment retention devices. Information about this program may be obtained at: <http://www.ntpep.org/Pages/default.aspx>.
- B. Adding seed to the additive provides additional erosion protection beyond the life of the additive.
- C. Anionic (negative charge) additives are recommended and are less toxic than cationic (positive charge) additives, which are highly toxic to fish.

Note: The WisDOT will not approve the use of cationic polyacrylamide.

- D. Additives not containing a mulch component do not enhance vegetation establishment and need to be combined with another practice for that purpose.
- E. Using a minimum 30 foot setback when applying an anionic polyacrylamide mixture near waters of the state is recommended.
- F. Applying an additive mixture to soil may provide benefits of improved water quality, infiltration, soil fertility, and visibility by reducing wind and water erosion.
- G. For erosion control, the additive may be applied upgradient of lands planted in food crops.
- H. Application of additives may be particularly effective in the following situations:
 - During rough grading operations
 - Phased construction projects
 - Stockpiles
 - After final grading and before paving or final seeding and planting
 - Sites having a winter shutdown
 - Agricultural lands where plant residues are inadequate
 - Sites receiving final landscaping, but where adequate vegetation cannot be established prior to winter.
- I. Application of additives may be ineffective in the following situations:
 - When the soil surface is pure sand or gravel with no fines.
 - When applied over snow cover.
- J. Visible tracer or colorant to visually track application is recommended.
- K. Additive mixtures may be applied in liquid and granular forms.
- L. Application rates of additive mixtures may need to be adjusted based on soil type, slope, and type of erosion targeted (i.e., wind or water). Based on manufacturer's recommendations, higher application rates may be necessary when applied in granular form, but cannot exceed the allowable application rate.
- M. Additive mixtures combined with water are very slippery and can be a safety hazard. Care must be taken to prevent spills of additive mixtures onto paved surfaces. During an application of additive

mixture, prevent over-spray from reaching pavement as pavement will become slippery.

- N. Care should be taken when applying additive mixtures in liquid form on saturated slopes due to the possibility of slope structural failure. Additive mixtures may be applied to steeper slopes when used with other erosion control BMPs such as seed and mulch or erosion mat.

VII. Specifications

Erosion control and storm water management plans specifying additive mixtures for erosion control shall be consistent with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

VIII. Operation and Maintenance

Maintenance will consist of reapplying additive mixtures to disturbed areas, including high use traffic areas, which interfere in the performance of this practice. Additive mixtures may lose effectiveness in as little as two months due to weather conditions. Additive mixtures should be reapplied in areas where wind or rill erosion is apparent and whenever an area has been graded, driven upon, or otherwise disturbed since the additive mixture was last applied. Representative additive locations shall be inspected at least once per week to evaluate effectiveness.

IX. References

Bubenzer, G.D., and Patterson, A.E., *Intake Rate: Sprinkler Infiltrometer*, Method of Soil Analysis, Part 1, Physical and Mineralogical Method, Second Edition, Chapter 33, pp. 845-870. (Agronomy Monograph Series #9, 1982).

"Water Quality Guidelines for the Great Lakes System" 40 CFR 132 (1995)

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Roa-Espinosa, A., Bubenzer, G.D. and Miyashita, E., *Determination of PAM Use in Erosion Control on Construction Sites*, 1st Inter-Regional Conference on Environment-Water: Innovative Issues in Irrigation and Drainage, Lisbon, Portugal, September 1998 (Portuguese National Committee of ICID, 1998).

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Wisconsin Department of Natural Resources 2004. State of Wisconsin Aquatic Life Toxicity Testing Methods Manual 2nd Edition. (<http://dnr.wi.gov/topic/wastewater/WET.html>).

Wisconsin Department of Natural Resources. 2014. *Whole Effluent Toxicity Program Guidance Document, Revision #9*. (<http://dnr.wi.gov/topic/wastewater/WETguidance.html>)

X. Definitions

Additive (I): Substance, typically a commercial product including cellulose, starch, and glucosamides; vegetable-based gums (e.g., guar, plantago) or rubber (e.g., natural latex) materials used as mulch tackifiers; and pre-mixed products containing natural or synthetic binding agents combined with a fibrous or mulch component (e.g., bonded-fiber matrix), that has the potential to be directly discharged to a *surface water of the state* and may cause

toxicity to fish and aquatic organisms.

Additive Mixture (V.A): Any reference to additive mixtures refers to the whole manufactured product, including the polymer and any additives.

Allowable Application Rate (V.B.1) is expressed in lbs/acre and is based on the product allowable usage rate.

Allowable Usage Rate (III): Identifies the concentration (expressed in mg/l) as calculated using the procedures described in the "[Water Quality Review Procedures for Additives](#)" guidance, below which a product is not expected to cause acute toxicity in the aquatic environment.

Material Safety Data Sheet or Safety Data Sheet (V.B.4): Provide basic information on a material or chemical product intended to help someone work safely with the material. This includes a brief synopsis of the hazards associated with using a material, how to use it safely, and what to do if there is an emergency. The retail distributor and/or manufacturer as per OSHA's Hazard Communication Standard, 29 CFR 1910.1200, must provide MSDS, with the purchase of potentially hazardous products.

Polyacrylamide (I): A generic term for polymers made up of many repeating units of the monomer acrylamide (a simple organic compound).

Polymer (I): Polymers are materials that are either natural or synthetic and that have a chain of carbon-based molecules that are identical, repeating units. Polymers can be positively charged (cationic), negatively charged (anionic) or have no charge (non-ionic).

Surface Waters of the State (III): "Surface" refers to the sub portion of the waters of the state that discharge at the surface. "Waters of the State", as defined by s. 283.01(20), Wis. Stats, means those portions of Lake Michigan and Lake Superior within the boundaries of Wisconsin, all lakes, bays, rivers, streams, springs, ponds, wells, impounding reservoirs, marshes, water courses, drainage systems and other surface water or groundwater, natural or artificial, public or private within the state or under its jurisdiction, except those waters which are entirely confined and retained completely upon the property of the person.

Wisconsin Department of Natural Resources

Technical Standard

Non-Channel Erosion Mat

1052

DEFINITION

A protective soil cover made of straw, wood, coconut fiber or other suitable plant residue, or plastic fibers formed into a mat, usually with a plastic or biodegradable mesh on one or both sides. Erosion mats are rolled products available in many varieties and combinations of material and with varying life spans.

PURPOSE

The purpose of this practice is to protect the soil surface from the erosive effect of rainfall and prevent erosion during the establishment of grass or other vegetation, and to reduce soil moisture loss due to evaporation. This practice applies to both *Erosion Control Revegetative Mats (ECRM)* and *Turf-Reinforcement Mats (TRM)*.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to erosion mat selection for use on erodible slopes.

This standard is not for *channel* erosion. For channel applications, reference WDNR Technical Standard (1053) Channel Erosion Mat.

Be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of erosion mat. This standard does not contain the text of federal, state, or local laws.

CRITERIA

Products

Use erosion mat products identified on the Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL).

Selection

Use WisDOT PAL classes and types to select and specify erosion mat.

Select the appropriate erosion mat based on site specific slope and slope length conditions in accordance with the WisDOT Facilities Development Manual (FDM Section 10-5) Slope Erosion Control Matrix.

Select erosion mat that will last long enough for turf grass or other vegetation to become densely established.

Use only mats containing exclusively organic material (no plastic) in or near *waterways* or other sensitive areas.

Installation

Install and anchor erosion mat in accordance with manufacturer's instructions.

At the time of installation, retain material labels and manufacturer's installation instructions until the site has been stabilized.

Install ECRMs after topsoil is placed and seeding is complete.

Install TRMs in conjunction with placement of topsoil, followed by ECRM installation.

Install erosion mat so that it bears completely on the soil surface.

Use staples that are at least 6 inches long.

Do not install Class I or Class II - Type B products that incorporate photo- or bio-degradable netting after September 1st of a given year.

CONSIDERATIONS

Use Class I Urban mats in locations where shortly mowed turf grasses are to be established.

ECRMs without topsoiling and seeding can be used for temporary soil stabilization during the non-growing season or for periods of inactivity.

Slope interruption products that are designed, installed and maintained in accordance with DNR Interim Manufactured Perimeter Control and Slope Interruption Products Technical Standard 1071 can be used to reduce slope length.

Some erosion mat products can have detrimental effects on local wildlife. Plastic netting without independent movement of strands can easily entrap small animals moving through the area, leading to dehydration, desiccation, and eventually mortality. Netting that contains biodegradable thread with the "leno" or "gauze" weave (contains strands that can move independently) have the least impact on wildlife.

PLANS AND SPECIFICATIONS

Prepare plans and specifications in accordance with the criteria of this standard and describe the requirements for applying the practice to achieve its intended use.

OPERATION AND MAINTENANCE

Inspect erosion mat at least weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.

If there are signs of rilling under the mat, install more staples or more frequent anchoring trenches. If rilling becomes severe enough to prevent establishment of vegetation, remove the section of mat where the damage has occurred. Fill the eroded area with topsoil, compact, reseed and replace the section of mat, trenching and overlapping ends per manufacturer's recommendations. Additional staking is recommended near where rilling was filled.

In situations where soil type, topography, or other conditions result in poor observed performance, use multiple practices such as adding mulch under the mat, or installing appropriately placed check devices to reduce local velocity.

If the reinforcing plastic netting has separated from the mat, remove the plastic and if necessary replace the mat.

Complete maintenance as soon as possible with consideration to site conditions.

REFERENCES

WisDOT "Erosion Control Product Acceptability List" is available online at:

<http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrcs/tools/pal/default.aspx>

DEFINITIONS

Erosion Control Revegetative Mats (ECRM) (II): A blanket like covering laid on top of a prepared seed bed to protect the soil and seed from the erosive forces of nature.

Turf-Reinforcement Mats (TRM) (II): Helps to permanently stabilize the soil by acting as reinforcement for the roots of the vegetation. This open weaved, synthetic mat is installed on top of soil and filled with topsoil and seeded. As the vegetation grows, the roots intertwine into the mat and reinforces the turf.

Channel: A constructed swale or ditch designed to convey storm water.

Waterways: Natural watercourses such as lakes or streams.

Wisconsin Department of Natural Resources

Technical Standard

Channel Erosion Mat

1053

DEFINITION

A protective soil cover made of straw, wood, coconut fiber or other suitable plant residue, or plastic fibers formed into a mat, usually with a plastic or biodegradable mesh on one or both sides. Erosion mats are rolled products available in many varieties and combinations of material and with varying life spans.

PURPOSE

The purpose of this practice is to protect the *channel* from erosion, or to act as turf reinforcement during or after the establishment of grass or other vegetation in the channel. This practice applies to *Erosion Control Revegetative Mats (ECRM)* and *Turf-Reinforcement Mats (TRM)*.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies where storm runoff drains in channels in intermittent flow and vegetation is to be established. Some products may have limited applicability in projects adjacent to navigable *waterways* due to potential wildlife entrapment.

Be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of erosion mat. This standard does not contain the text of federal, state, or local laws.

CRITERIA

Products

Use channel erosion mat products identified on the Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL).

Selection

Use WisDOT PAL classes and types to select and specify erosion mat.

Select the appropriate erosion mat based on the calculated shear stress, given drainage area characteristics and channel geometry for the design storm depth.

If applicable, select the appropriate channel erosion mat based on site channel grade and channel length in accordance with the WisDOT Facilities Development Manual (FDM Section 10-5) Channel Erosion Control Matrix.

Select erosion mat that will last until turf grass or other vegetation becomes densely established.

Installation

Install and anchor erosion mat in accordance with manufacturer's instructions.

At time of installation, retain material labels and manufacturer's installation instructions until the site has been stabilized.

Install ECRMs after topsoil is placed and seeding is complete.

Install TRMs in conjunction with placement of topsoil, followed by ECRM installation.

Install erosion mat so that it bears completely on the soil surface.

Use staples that are at least 6 inches long.

CONSIDERATIONS

Some erosion mat products can have detrimental effects on local wildlife. Plastic netting without independent movement of strands can easily entrap small animals moving through the area, leading to dehydration, desiccation, and eventually mortality. Netting that contains biodegradable thread with the "leno" or "gauze" weave (contains strands that can move independently) have the least impact on wildlife.

PLANS AND SPECIFICATIONS

Prepare plans and specifications in accordance with criteria of this standard and describe requirements for applying the practice to achieve its intended use.

OPERATION AND MAINTENANCE

Inspect erosion mat at least weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.

If there are signs of erosion under the mat, install more staples or more anchor trenches. If erosion becomes severe enough to prevent vegetation, remove the section of mat where the damage has occurred. Fill eroded area with topsoil, compact, reseed and replace the section of mat, trenching and overlapping ends per manufacturer's recommendations. Additional staking is recommended at points of repaired erosion.

In situations where soil type, topography, or other conditions result in poor observed performance, use multiple practices such as adding additional mulch under the mat, or installing appropriately placed check devices to reduce local velocity.

If the reinforcing plastic netting has separated from the mat, remove the plastic and replace the mat, if necessary.

Complete maintenance as soon as possible with consideration to site conditions.

REFERENCES

WisDOT "Erosion Control Product Acceptability List" is available online at:

<http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrcs/tools/pal/default.aspx>

DEFINITIONS

Channel: A constructed swale or ditch designed to convey storm water.

Channel Erosion: The deepening and widening of a channel due to soil loss caused by flowing water.

Erosion Control Revegetative Mats (ECRM) (II): A blanket like covering laid on top of a prepared seed bed to protect the soil and seed from the erosive forces of nature.

Turf-Reinforcement Mats (TRM) (II): Helps to permanently stabilize the soil by acting as reinforcement for the roots of the vegetation. This open weaved, synthetic mat is installed on top of soil and filled with topsoil and seeded. As the vegetation grows, the roots intertwine into the mat and reinforces the turf.

Waterways: Natural watercourses such as lakes or streams.

Sediment Bale Barrier (Non-Channel) (1055)

Wisconsin Department of Natural Resources
Technical Standard

I. Definition

A temporary sediment barrier consisting of a row of entrenched and anchored straw bales, hay bales or equivalent material used to intercept sediment-laden sheet flow from small drainage areas of disturbed soil.

II. Purpose

The purpose of this practice is to reduce slope length of the disturbed area and to intercept and retain transported sediment from disturbed areas.

III. Conditions Where Practice Applies

A. This standard applies to the following applications where:

1. Erosion occurs in the form of *sheet and rill erosion*¹. There is no concentration of water flowing to the barrier (*channel erosion*).
2. Where adjacent areas need protection from sediment-laden runoff.
3. Effectiveness is required for less than 3 months.
4. Conditions allow for the bales to be properly entrenched and staked as outlined in the Criteria Section V.

B. Under no circumstance shall sediment bale barriers be used in the following applications:

1. Below the ordinary high watermark or placed perpendicular to flow in streams, swales, ditches or any place where flow is concentrated.

2. Where the maximum gradient upslope of the sediment bale barriers is greater than 50% (2:1).

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of the sediment bale barrier. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Placement

1. At a minimum, sediment bale barriers shall be placed in a single row, lengthwise on the contour, with the ends of adjacent sediment bale barriers tightly abutting one another. The holes between bales shall be chinked (filled by wedging) with straw, hay or equivalent material to prevent water from escaping between the bales.
2. The maximum allowable slope lengths contributing runoff to a sediment bale barrier are specified in Table 1.

¹ Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used in the text.

Table 1.	
Slope	Barrier Row Spacing
< 2%	100 feet
2 to 5%	75 feet
5 to 10%	50 feet
10 to 33%	25 feet
33 to 50%	20 feet
> 50%	Not Permitted

3. Sediment bale barriers shall not be placed perpendicular to the contour.
 4. The end of the sediment bale barrier shall be extended upslope to prevent water from flowing around the barrier ends.
- B. Height – Installed sediment bale barrier shall be a minimum of 10 inches high and shall not exceed a maximum height of 20 inches from ground level.
- C. Anchoring and Support
1. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a sediment bale barrier and the length of the proposed barrier to a minimum depth of 4 inches. After bales are staked and chinked, the excavated soil shall be backfilled and compacted against the barrier. Backfill to ground level on the down slope side. On the upslope side of the sediment bale barrier backfill to 4 inches above ground level.
 2. At least two wood stakes, "T" or "U" steel posts, or ½ inch rebar driven through at equidistance along the centerline of the barrier shall securely anchor each bale. The minimum cross sectional area for wood stakes shall be 2.0 by 2.0 inches nominal. The first stake in each bale shall be driven toward the previously laid bale to force the bales together. Stakes shall be driven a minimum 12-inches into the ground to securely anchor the sediment bale barriers.
 3. Bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales

in order to prevent deterioration of the bindings.

VI. Considerations

- A. Improper placement as well as improper installation and maintenance of sediment bale barriers will significantly decrease the effectiveness of this practice.
- B. Sediment bale barriers should not be used upslope of the disturbed area.
- C. A double row of sediment bale barriers may be installed in areas where additional protection is needed.
- D. For safety, place all anchoring flush with the sediment bale barrier or cap any exposed anchoring device.

VII. Plans and Specifications

- A. Plans and specifications for installing sediment bale barriers shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:
 1. Location of sediment bale barrier
 2. Contributory drainage area
 3. Schedules
 4. Standard drawings and installation details
 5. Restoration after removal
- B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

- A. Sediment bale barriers shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.
- B. Damaged or decomposed sediment bale barriers, any undercutting, or flow channels

around the end of the sediment bale barriers shall be repaired.

- C. Sediment shall be properly disposed of once the deposits reach 1/2 the height of the sediment bale barrier.
- D. Sediment bale barriers and anchoring devices shall be removed and properly disposed of when they have served their usefulness, but not before the upslope areas have been permanently stabilized.
- E. Any sediment deposits remaining in place after the sediment bale barrier is no longer required shall be dressed to conform to the existing grade, prepared and seeded.

IX. Definitions

Channel Erosion (III.A.1): The deepening and widening of a channel due to soil loss caused by flowing water. As rills become larger and flows begin to concentrate soil detachment occurs primarily as a result of shear. The transport capacity of the flow in a channel is based on the availability of sediment and is a monatomic function of velocity.

Sheet and Rill Erosion (III.A.1): Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. As flow becomes more concentrated rills occur. As soil detachment continues or flow increases, rills will become wider and deeper forming gullies.

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
TECHNICAL STANDARD
PERIMETER SEDIMENT CONTROL AND SLOPE INTERRUPTION
1056

DEFINITION

A practice used to intercept sheet flow from small areas of disturbed soil and encourage ponding of runoff to allow sediment to settle out. Examples include silt fence and manufactured products such as wattles, sediment logs and geotextile socks filled with natural materials.

PURPOSE

The purpose of this standard is to reduce the discharge of sediment in runoff from small areas at construction sites. The standard includes common methods which may be used to meet this purpose.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies in areas of construction sites where only *sheet and rill erosion*¹ occur and sediment control is needed prior to discharge from the site. These are typically perimeter areas but may include internal areas (e.g., temporary soil stockpiles or part of a treatment train) if appropriate. This standard also applies in areas of construction sites where slope interruption devices are needed to minimize the potential for concentrated flow forming on long or steep slopes.

This standard does not apply to:

- Locations below the ordinary high water mark of waterways or within wetlands without reporting or non-reporting permit coverage from the Wisconsin Department of Natural Resources (WDNR);
- Any area of concentrated flow, including ditches or swales; or

Note: Manufactured products can be used as ditch checks in accordance with WDNR Technical Standard 1062 Ditch Check.

- In areas where the slope in the contributing drainage area is steeper than 50% (2H:1V).

Note: Runoff from slopes steeper than 50% should be directed to sediment basins/traps or a flat ponding area should be maintained between the toe of the slope and the perimeter sediment controls.

CRITERIA

This section establishes the minimum standards for design, installation and performance requirements.

General Criteria (Silt Fence and Manufactured Products)

Laws and Regulations. Comply with applicable federal, tribal, state, and local laws, rules, regulations, or permit requirements including but not limited to those relating to Diggers Hotline, safety, and spills. This standard does not contain the text of federal, tribal, state, or local laws.

Location. Locate perimeter sediment controls on the contour to the maximum extent possible to create temporary ponding areas where particle settling can occur with the ends extended upslope to prevent water from flowing around the ends (see Figure 1).

¹ Words in the standard that are shown in italics are described in the Glossary section. The words are italicized the first time they are used in the text.

Design Parameters. Install perimeter sediment controls to form a series of *J-Hooks* (see Figure 2) where needed to maximize ponding areas.

For contributing drainage areas with slopes steeper than 33% (3H:1V) (e.g., soil stockpiles), maintain a ponding area between the toe of the slope and the perimeter sediment controls. The ponding area should be as flat as possible with perimeter sediment controls located at least 10 feet from the toe of the slope when possible. The 10-foot ponding area does not need to be considered toward the slope length and contributing drainage area limitations for slopes steeper than 33% (3H:1V) (see Tables 1 and 2).

Install perimeter sediment controls prior to disturbing the contributing drainage area.

Contributing Drainage Area – Silt Fence

Identify appropriate locations for silt fence so that slope lengths in the contributing drainage area do not exceed the criteria in Table 1.

Note: When contributing drainage area conditions are not appropriate for silt fence, runoff should be directed to sediment basins or traps.

Table 1				
Average Slope		Slope Length	Maximum Contributing Drainage Area Per 100 Feet of Silt Fence	
(%)	(H:V)	(Feet)	(Square Feet)	(Acres)
<2	<50:1	100	10,000	0.23
2 to 5	50:1 to 20:1	75	7,500	0.17
5 to 10	20:1 to 10:1	50	5,000	0.11
10 to 33	10:1 to 3:1	25	2,500	0.06
33 to 50	3:1 to 2:1	20	2,000	0.05

It is acceptable to use silt fence relief ditch checks (see Figure 3) where a low point in a silt fence line is unavoidable, provided the contributing drainage area to the low point is less than one acre.

When silt fence relief ditch checks are used, design and install the ditch check component in accordance with WDNR Technical Standard 1062 Ditch Check. Install silt fence relief openings that are between 3 and 8 feet wide based on the size of the contributing drainage area.

Contributing Drainage Area – Manufactured Products

Identify appropriate locations for manufactured perimeter control products so that slope lengths in the contributing drainage area do not exceed the criteria in Table 2 for the selected product height class in Table 3.

Note: When contributing drainage area conditions are not appropriate for manufactured products, runoff should be directed to sediment basins or traps.

Table 2					
Average Slope		Slope Length (feet) per Product Height Class			
(%)	(H:V)	I	II	III	IV
<2	<50:1	30	55	75	100
2 to 5	50:1 to 20:1	25	40	55	75
5 to 10	20:1 to 10:1	15	30	40	50
10 to 33	10:1 to 3:1	10	15	20	25
33 to 55	3:1 to 2:1	5	10	15	20

Table 3	
Product Height Class	Product Height (inches)
Class I	6-9
Class II	10-15
Class III	16-20
Class IV	> 20

It is acceptable to use manufactured perimeter control products for slope interruption when installed in rows that are spaced in accordance with Table 2 (see Figure 4).

Use product manufacturer recommendations if more restrictive than Table 2.

Material Specification – Silt Fence

Use geotextile consisting of either woven or non-woven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Non-woven fabric may be needle punched, heat bonded, resin bonded, or combinations thereof.

Use geotextile that meets the criteria in Table 4.

Table 4		
Test Requirement	Method	Value ¹
Minimum grab tensile strength in the machine direction	ASTM D 4632	120 lbs. (550 N)
Minimum grab tensile strength in the cross machine direction	ASTM D 4632	100 lbs. (450 N)
Maximum apparent opening size equivalent standard sieve	ASTM D 4751	No. 30 (600 µm)
Minimum permittivity	ASTM D 4491	0.05 scc ⁻¹
Minimum ultraviolet stability percent of strength retained after 500 hours of exposure	ASTM D 4355	70%

¹ All numerical values represent minimum / maximum average roll values. (For example, the average minimum test results on any roll in a lot should meet or exceed the minimum specified values.)

Material Specification – Manufactured Products

Use temporary ditch check products identified on the WisDOT Erosion Control Product Acceptability List (PAL) or manufactured perimeter control and slope interruption products identified on the Wisconsin Department of Safety and Professional Services (DSPS) Approved Product List.

NOTE: Temporary ditch check products on the WisDOT PAL have product heights of at least 12 inches. It is acceptable to use smaller versions of these products for perimeter control or slope interruption applications.

For products filled with compost, use compost that meets WDNR Specification S100 Compost for Storm Water Management.

For products filled with reused materials regulated as solid waste, use materials that have received a WDNR exemption under NR 500, Wis. Adm. Code.

For products that include water-applied additives, use water applied additives that comply with WDNR allowable usage rates.

Note: WDNR maintains a list of additive allowable usage rates at <https://dnr.wisconsin.gov/topic/Wastewater/Additives.html>

Installation – Silt Fence (see Figure 5)

Install silt fence with a minimum height of 24 inches above the ground surface.

Anchor silt fence by constructing a trench on the upslope side of the fence or use a slicing machine that provides anchoring equivalent to a trench.

Construct an anchoring trench that is at least 4 inches wide and 6 inches deep. Spread the excess fabric in the trench, backfill the trench with soil and compact the soil.

Install wood support posts on the downslope side of the silt fence that support the full height of the fence. Use hardwood posts (e.g., oak, hickory) with a minimum size of 1-1/8 inch by 1-1/8 inch and at least 4 feet long.

Space support posts along the silt fence no more than 3 feet apart for non-woven fabric or 8 feet apart for woven fabric and install the posts at least 2 feet below the ground surface.

Staple silt fence on the upslope side of the posts in at least 3 places using at least 0.5-inch staples. At the end posts, wrap the fabric so that the staples are not visible.

Use silt fence with support cords or tension tape near the top of the fence and tighten to provide top support.

When joints are necessary, joint two lengths of silt fence using either the Twist Method or the Hook Method as shown on Figure 5.

Use silt fence with support cords or tension tape near the top of the fence and tighten to provide adequate top support.

Use steel support posts only when needed in compacted soil conditions or locations where higher support strength is necessary. Steel support posts should be at least 5 feet long with a strength of 1.25 pounds per linear foot and projections for the attachment of fasteners. Fabric should be attached to steel posts in at least three places using 50-pound plastic tie straps or wire fasteners.

Installation – Manufactured Products

Overlap products a minimum 24 inches or as required by the manufacturer if more restrictive. Do not allow gaps between adjacent, overlapping products.

Stake or anchor as needed to maintain constant ground contact along the entire length of product and prevent lateral movement and/or floatation. Perform staking or anchoring per product manufacturer recommendations.

On disturbed ground, entrench a minimum of 2 inches to ensure continuous ground contact. On vegetated, erosion matted or frozen ground, products may be installed without entrenchment per product manufacturer recommendations.

To prevent undercutting, fill any gaps and ruts under the installed product with soil or *log-type product* filler media.

Do not stack products individually on top of one another unless allowed in the manufacturer's recommended installation procedures.

CONSIDERATIONS

The following are not required but are recommendations:

- (1) Consider drainage patterns during all phases of construction to avoid subjecting perimeter controls to concentrated flows or runoff from drainage areas that exceed the slope or slope length criteria.
- (2) Avoid using perimeter sediment controls to define property boundaries or construction limits. This approach can result in perimeter control installations that are not installed on contour, creating low points where overtopping or undercutting occurs.
- (3) When placing silt fence near trees, take care to minimize damage to the root system. Avoid compaction and root cutting within 1.5 feet multiplied by the inch diameter of the tree (for example: for 10-inch trees keep out a 15-foot radius from the trunk).
- (4) In wooded areas, use manufactured products instead of silt fence when tree preservation is a goal.
- (5) Protect perimeter controls from damage in areas of active construction or heavy traffic using flagging or other methods to improve visibility.
- (6) To further support silt fence, use wire back silt fence or install staked straw bales (see WDNR Technical Standard 1055 Sediment Bale Barrier) on the down slope side.
- (7) To help ensure effectiveness, inspect and repair perimeter controls as necessary prior to forecasted rain events.
- (8) Where installation with wood posts is difficult, such as when hard or frozen ground is encountered, the use of steel post is recommended.
- (9) Steel posts can pose a hazard for snowmobiles and ATVs and should be avoided in areas where snowmobile and ATV traffic is possible.
- (10) Where perimeter control is placed adjacent to wetland boundaries, add high visibility fencing or signage to discourage intrusion into wetlands.
- (11) To prolong the life of log-type products, stakes should be crossed over the product instead of piercing the fabric.
- (12) For manufactured products that are filled with wood material, consider using recycled wood materials diverted from landfills.
- (13) It is acceptable to install redundant perimeter controls (e.g., double-row silt fence) adjacent to wetlands or other sensitive areas. However, redundant perimeter controls are considered one practice for design purposes.

PLANS AND SPECIFICATIONS

Specify the material options within the specifications for the project. Include the proposed product height class for manufactured perimeter control devices.

Depict the proposed location of perimeter controls on the erosion control plans in accordance with the criteria of this standard and describe the requirements for applying the practice to achieve its intended use. Include the location of J-hooks alignments where appropriate. Label locations where the placement requires modification after major grading operations.

OPERATIONS AND MAINTENANCE

General (Silt Fence and Manufactured Products)

Inspect perimeter sediment control practices at a minimum weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.

Repair or replace any perimeter sediment controls that are damaged or decomposed.

Remove accumulated sediment when deposits reach $\frac{1}{2}$ the height of the perimeter sediment control practice.

It is acceptable to install an additional row of silt fence upslope from the initial row provided the accumulated sediment has been removed from the initial row.

If a perimeter control practice becomes undermined, backfill the voids with soil and compacted to prevent water flow under the practice.

Remove perimeter sediment controls once the contributing drainage area is *permanently stabilized*. After removal, dispose of perimeter sediment controls properly.

Manufactured Products

If a manufactured product rolls out of position, reposition the product and secure with additional stakes.

Remove and replace destroyed or irreparable sections of log-type product with new log-type product or a second log-type product may be placed immediately upslope with a minimum 24-inch overlap beyond the deformation.

It is acceptable to repair *small holes* in a log-type product by stitching or wrapping a new piece of fabric around the product and securing. For log-type product with larger holes, rips, or tears, remove and replace with new product or a second log-type product may be placed immediately upslope with a minimum 24 inches of overlap beyond the hole, rip, or tear.

Re-form pinched, settled, or deformed log-type products to their original diameter by hand if possible or a second log-type product shall be placed immediately upslope with a minimum 24-inch overlap beyond the deformation.

REFERENCES

Wisconsin Department of Transportation, Erosion Control Product Acceptability List (PAL), <https://wisconsindot.gov/pages/doing-bus/eng-consultants/cnslt-rsrcs/tools/pal/default.aspx>.

Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, 2022. <https://wisconsindot.gov/pages/doing-bus/eng-consultants/cnslt-rsrcs/rdwy/stndspec.aspx>.

Wisconsin Department of Safety and Professional Services, Manufacturers of Approved Building Materials Database, <https://dsps.wi.gov/Pages/Programs/CommercialBuildings/Default.aspx>.

GLOSSARY

J-Hooks: A perimeter control installation method used to avoid long runs that have the potential to create a concentration of runoff in one section. J-Hooks break up the long run and create separate areas for ponding and settling to occur.

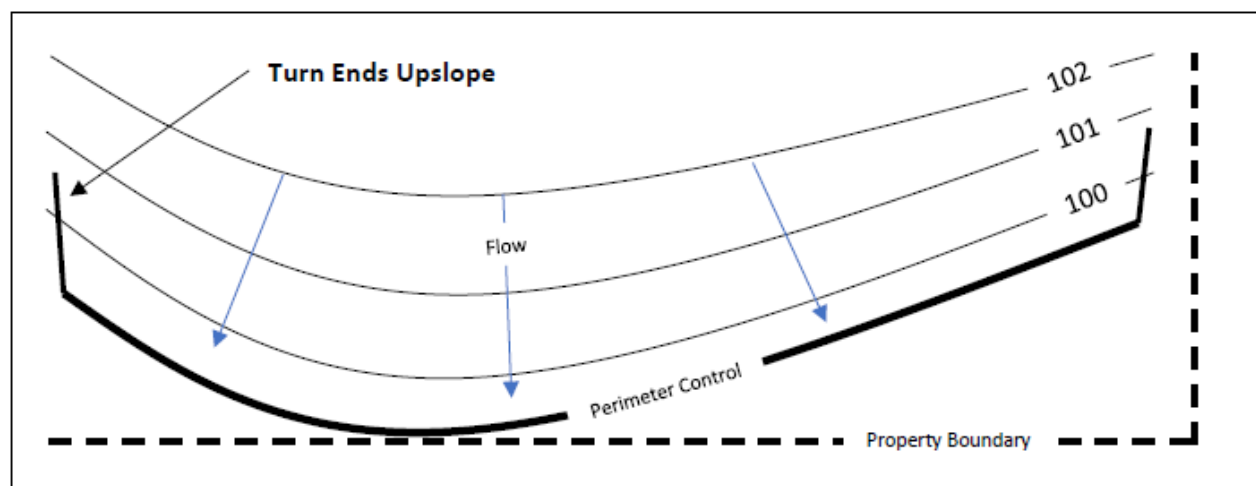
Log-Type Products: Sediment control products constructed of an outer sock of geotextile or other type of netting or permeable containment media surrounding an inner filtering media. Log-type products are commonly referred to as wattles or filter socks.

Permanently Stabilized: Disturbed areas in the contributing drainage area have been vegetated or covered so that perimeter sediment control is no longer needed.

Sheet and Rill Erosion: Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. Rills occur as flow starts to concentrate. As soil detachment continues or flow increases, rills will become wider and deeper forming gullies.

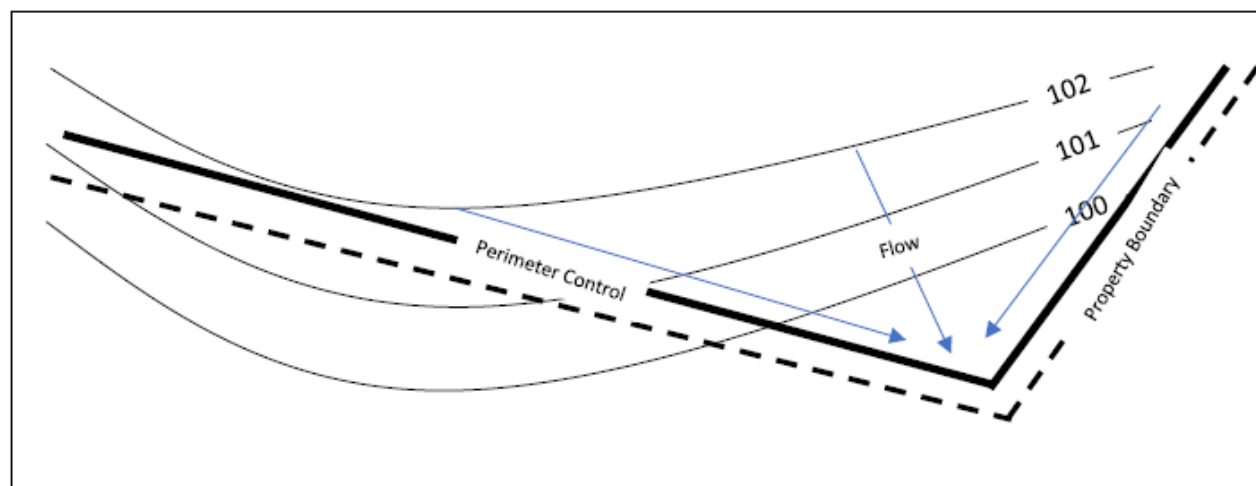
Small Holes: Holes that are less than 12 inches long and less than ½ inch wide located within the top 1/3rd of the log-type product.

**Figure 1:
Placement on Contour**



CORRECT PLACEMENT

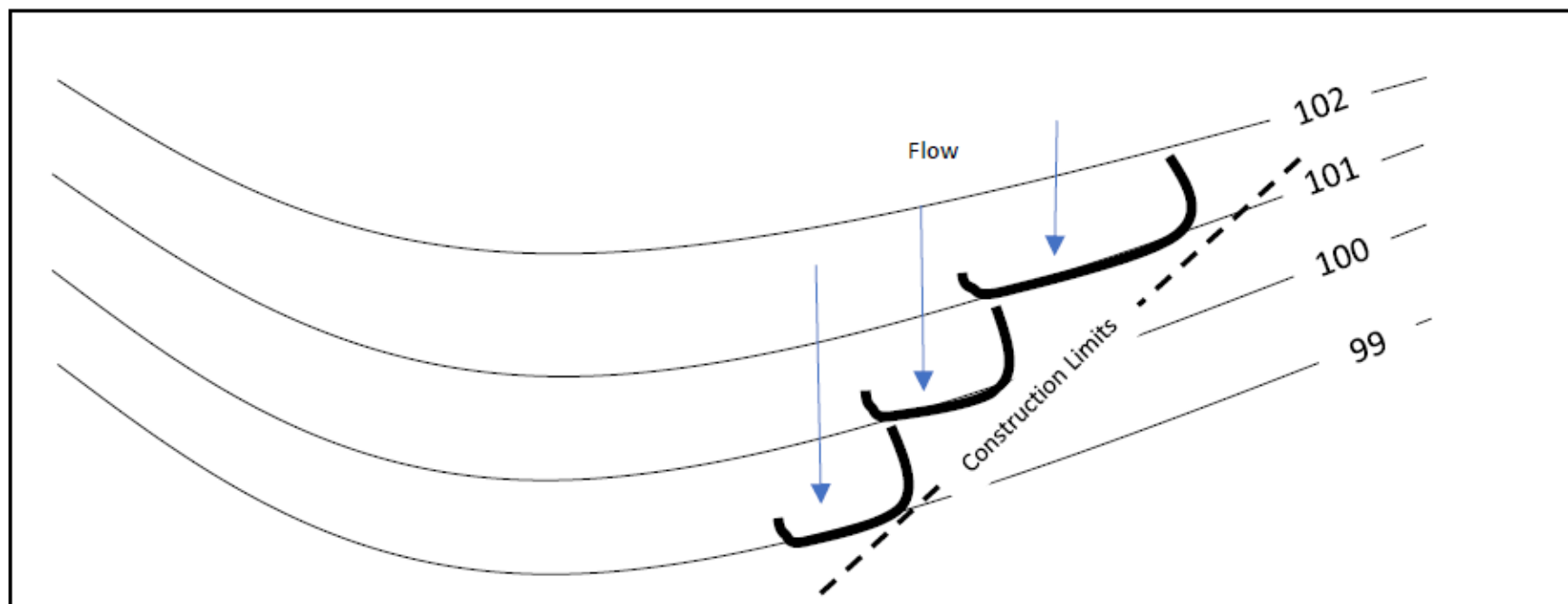
Install perimeter control on contour and turn the ends upslope. This will create the largest potential ponding area to maximize sediment removal efficiency.



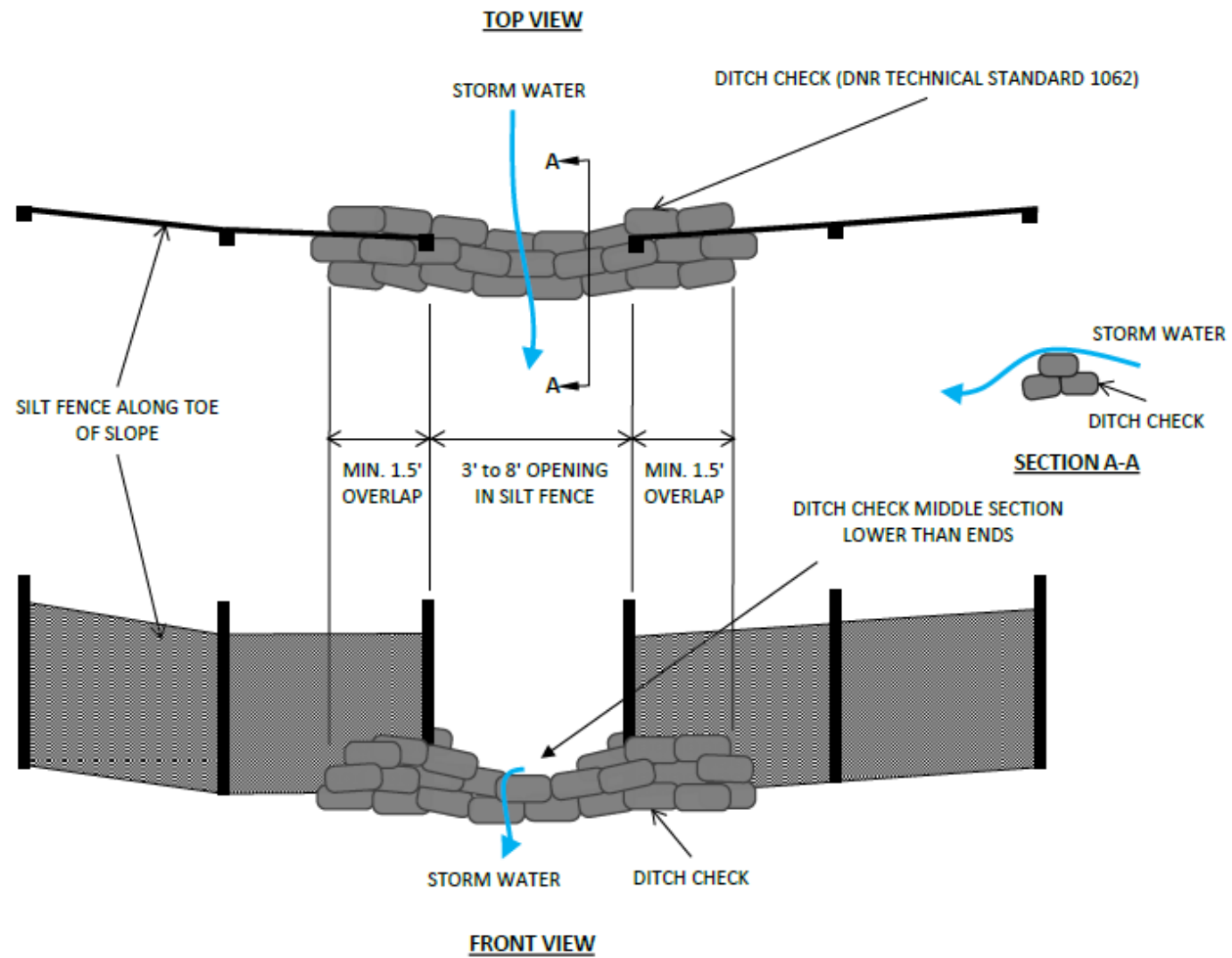
INCORRECT PLACEMENT

Do not install perimeter control along property boundaries, construction limits, roadways or other features that are not on contour. Installing perimeter control without regard to contour will cause runoff to concentrate at the low point and overwhelm the practice at this location.

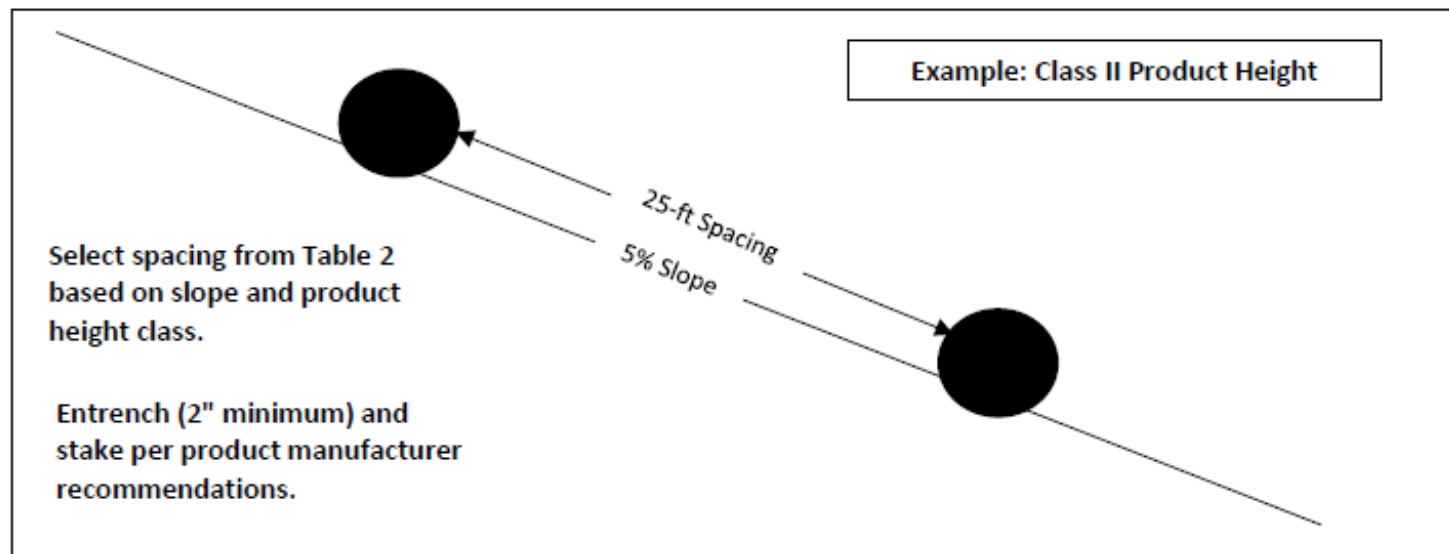
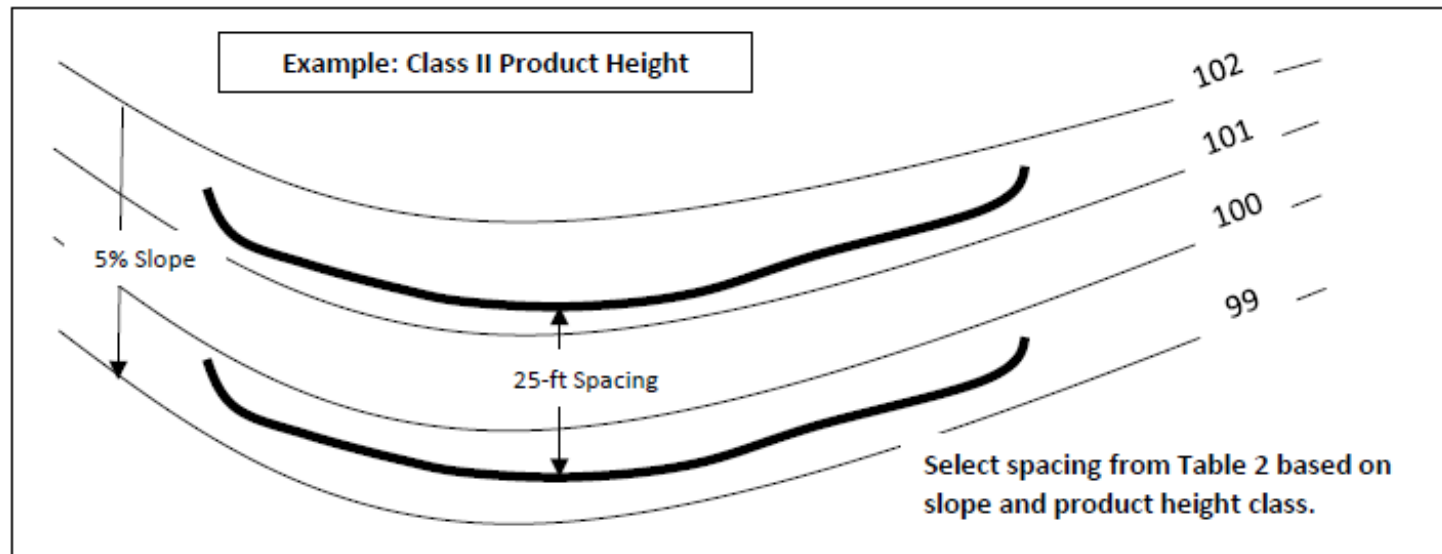
**Figure 2:
J-Hooks**



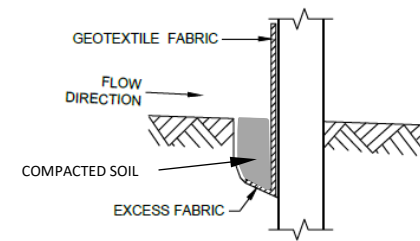
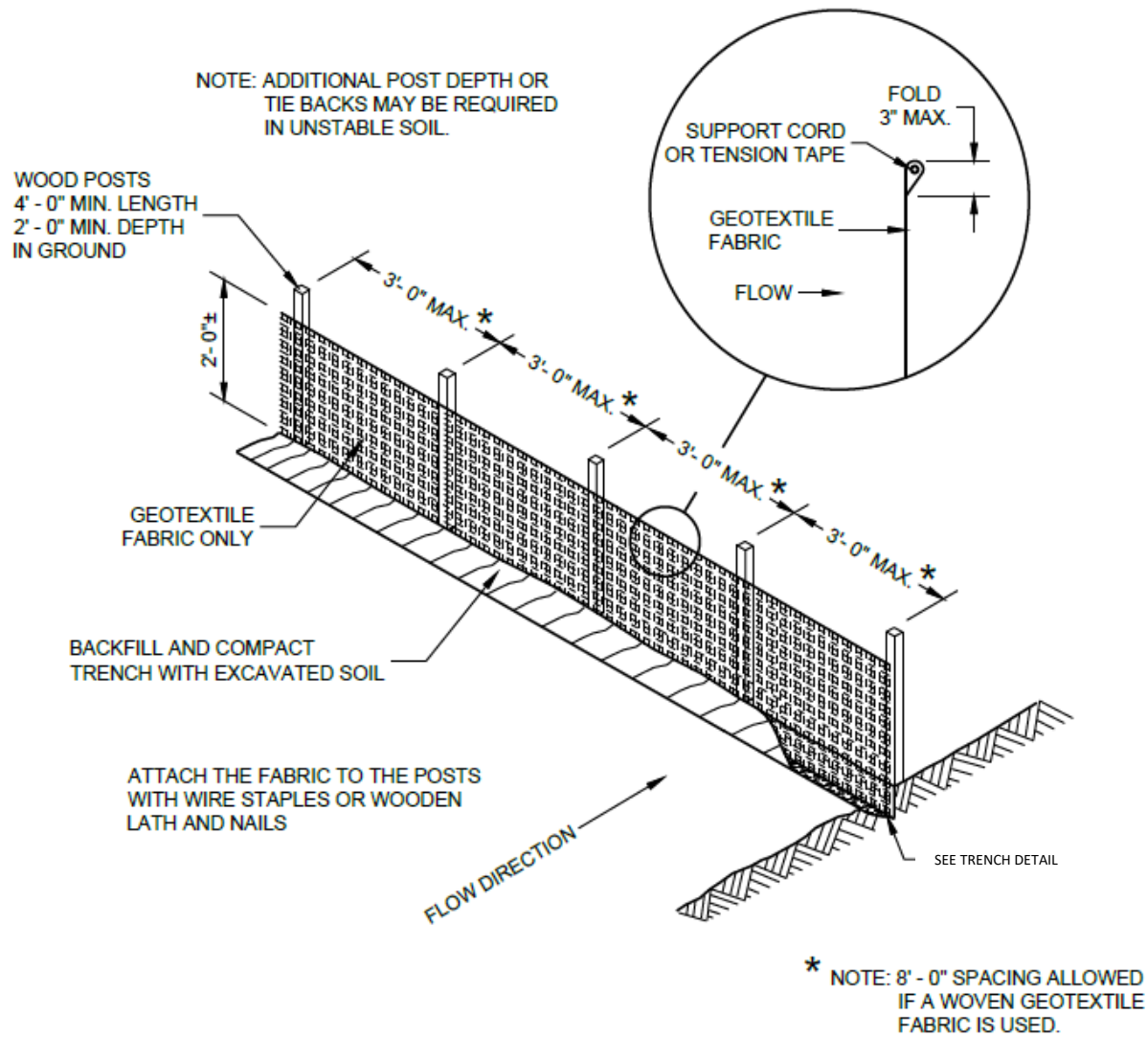
**Figure 3:
Silt Fence Relief**



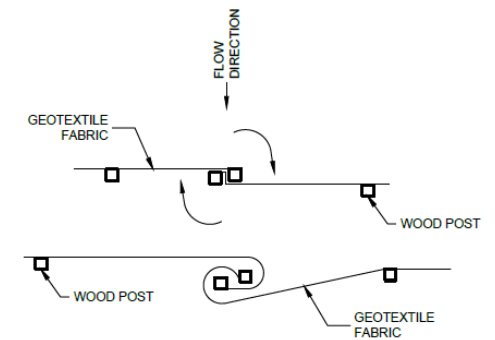
**Figure 4:
Slope Interruption**



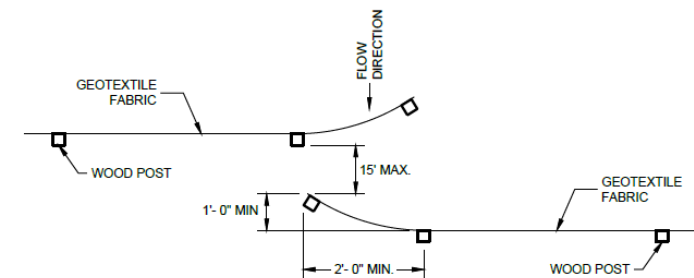
**Figure 5:
Silt Fence Installation**



TRENCH DETAIL



TWIST METHOD



HOOK METHOD

JOINING TWO LENGTHS OF SILT FENCE

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
TECHNICAL STANDARD
TRACKOUT CONTROL PRACTICES
1057

DEFINITION

A practice or combination of practices used to prevent, reduce, or mitigate *trackout*¹ of sediment.

PURPOSE

Land-disturbing construction activity generally creates conditions where a vehicle comes in contact with exposed soil, which is then transported off *site* and/or deposited onto streets and roadways. This sediment can then become a road hazard and be carried from streets into drainage infrastructure and discharged into waters of the state. The purpose of this standard is to identify common methods which may be used to prevent, reduce, and/or mitigate the tracking of sediment.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies where land-disturbing activity is likely to result in trackout.

CRITERIA

General Criteria

Be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the practice. This standard does not contain the text of federal, state, or local laws.

Install one of the following practices, or a combination of practices, to prevent, reduce, or mitigate tracking of sediment off *site*.

Trackout is best managed by implementing controls in the order below. These controls may be implemented in series where conditions warrant.

- (1) Prevent trackout with stabilized work surfaces and reduced vehicle contact with soil,
- (2) Reduce trackout with stone tracking pad, manufactured trackout control devices, or tire washing,
- (3) Mitigate trackout with street cleaning.

Select a device capable of supporting the vehicle load. Provide an alternate stabilized egress for oversized or overweight loads if needed.

Provide stable approaches to and from the practice.

Provide a stable driving surface from the practice to the off-site street or road.

Limit water use to minimize the discharge of sediment into drainage infrastructure.

Apply dust control measures when necessary to minimize generation of airborne dust while implementing trackout control practices.

Criteria Applicable to Stabilized Work Surfaces

Install aggregate, concrete, asphalt, manufactured mats, or other material in work areas and haul roads to minimize contact of vehicles with exposed soils and standing water (Figure 1).

Technical Standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your local WDNR office or the Standards Oversight Council office in Madison, WI at (608) 441-2677.

WDNR
July 2018

¹ Words in the standard that are shown in italics are described in the Definitions section. The words are italicized the first time they are used in the text.

Install signage or fencing as needed to support intended use.

This practice is applicable, but not limited, to the following areas:

- (1) Contractor staging areas and lay-down areas where major grading has been completed and soil stockpiles are not being constructed or removed,
- (2) Site trailer and construction employee parking areas,
- (3) Private property access routes,
- (4) Proposed parking areas,
- (5) Redevelopment sites, or
- (6) Short-term/low traffic access locations such as directional drilling pits.

Stabilized work surfaces may be used as a stand-alone practice if vehicles leaving the site are restricted to the stabilized surface and the surface is properly maintained.

If an administering authority determines that control is not being maintained, additional measures may be required.

Criteria Applicable to Stone Tracking Pads

Install the stone tracking pad to ensure vehicles that drive over exposed soil exit along the full length of the pad (Figure 2).

Use hard, durable, angular stone or recycled concrete meeting the gradation in Table 1. Where this gradation is not available, meet the gradation in Wisconsin Department of Transportation (DOT) 2018 Standard Specification, Section 312, Select Crushed Material. Use material substantially free from dirt, debris, steel, vegetable matter, and other deleterious material.

Table 1. Gradation for stone tracking pads

Sieve Size	Percent by weight passing
3"	100
2-1/2"	90-100
1-1/2"	25-60
3/4"	0-20
3/8"	0-5

Install the tracking pad across the full width of the access point, or restrict exiting traffic to a dedicated egress lane with a driving surface at least 12 feet wide.

Ensure the tracking pad is at least 50 feet long. If a 50-foot pad length is not possible due to site constraints, install the maximum length practicable and supplement with additional practices as needed to prevent or reduce trackout.

Where warranted due to soil type or high groundwater, underlay the stone tracking pad with geotextile fabric to minimize migration of underlying soil into the stone. Select fabric type based on soil conditions and vehicle loading.

Place the aggregate in a layer at least 12 inches thick.

Divert surface flows away from tracking pads or convey flow under and/or around using culverts and

swales. Direct runoff from tracking pads to sediment control practices.

Do not compact aggregate prior to use. Compaction, grouting, or other means of creating a smooth surface compromise the effectiveness of the tracking pad.

Remove stones lodged between the tires of dual wheel vehicles prior to leaving the construction site.

Criteria Applicable to Manufactured Trackout Control Devices

Install the manufactured trackout control device on a surface capable of supporting anticipated loads per manufacturer recommendations (Figure 3).

Situate the device to ensure vehicles that drive over exposed soil exit across the full length of the device. Provide a minimum device length of 32 feet for stand-alone installations. Add length if needed to reduce trackout in adverse conditions.

Criteria Applicable to Tire Washing

Select the type of washing station based on project conditions and water availability. If a wash rack is used, select a rack capable of supporting the vehicle loading.

Install the washing station on site in a stabilized area. If the device discharges untreated water, direct wash water to a sediment basin designed per the current Technical Standard 1064, Sediment Basin, or an equivalent device. Follow the current Technical Standard 1051, Water Application of Additives for Sediment Control, for flocculants used at the tire washing station. Return sediment collected in the sediment basin to the site or dispose of appropriately.

Direct vehicles that drive over exposed soil to exit through the station.

This practice may be applicable, but not limited, to the following areas:

- (1) Areas with prolonged periods or significant quantity of hauling on or off site, or
- (2) Sites which drain to a sensitive resource such as an Outstanding Resource Water or Exceptional Resource Water.

Perform tire washing per manufacturer's directions until the majority of sediment is removed from the tires.

Criteria Applicable to Street/Pavement Cleaning

Scrape and/or sweep pavements and gutters until a shovel-clean or broom-clean condition is obtained. Repeat as needed to maintain public safety and reduce sediment delivery to drainage infrastructure or water resources, and at the end of each work day.

Use available equipment or select equipment per the recommendations in Table 2.

Return sediment to the site or dispose of appropriately.

CONSIDERATIONS

- (1) An extended stabilized work surface such as a 150-foot long aggregate driveway within the site may be used as trackout control if sediment control is provided along the portions of driveways subject to sediment accumulation.
- (2) Other methods of trackout control may be utilized if they do not generate dust or result in discharge of untreated water to drainage infrastructure or water resources.

- (3) Manual removal of sediment from vehicles may be needed when working in heavy mud cannot be avoided.
- (4) Implement traffic guidance (e.g., signs, barriers, fences, flags) to restrict exiting traffic to the trackout device and prevent the circumvention of unfamiliar devices.
- (5) Inform drivers of device weight limits and the location of alternate stabilized egress for oversized and/or overweight loads.
- (6) Document in the erosion control plan whether stabilized impervious surfaces, such as staging areas, are temporary or permanent. Post-construction performance standards may apply in accordance with s. NR 151.121-128 or s. NR 151-421-249 Wis. Adm. Code.
- (7) Vehicles traveling across trackout control practices should maintain a slow constant speed.
- (8) Extend the tracking control length and/or implement additional trackout control practices to supplement primary control measures during major hauling operations, in heavy clay soils, or when conditions render the practice insufficient.
- (9) All trackout control practices, especially stone tracking pads, generally need more maintenance during and immediately after completion of major hauling operations.
- (10) If known soil and/or groundwater contamination is present on site as documented on the Bureau for Remediation and Redevelopment Tracking System (BRRTS on the Web) or has been identified through activities on site, then the potential for contamination transport should be assessed. If contamination is identified, impacted soil or water should be characterized and stored, treated or disposed of in compliance with applicable standards and rules. If this is a new contaminant release, consult Wisconsin Department of Natural Resources (DNR) staff in the regional Remediation and Redevelopment Program.
- (11) Methods of street cleaning vary based on project size, conditions, and availability of equipment. These methods require the contractor to follow OSHA standards for silica dust control and may require additional safeguards to meet current standards.

Table 2. Street cleaning methods

Method	Effective for:						Notes
	Larger clumps	Wet	Dry	Sand	Clay/Silt	Minimizing dust	
Shovel and broom by hand	Yes	Yes	Yes	Yes	Yes	Yes	Good for incidental tracking from low traffic sites or minor accumulations.
Power angle broom	Yes	Yes	Yes, with dust control	Yes	Yes	Less effective, but better with dust control	Harder to control collection of debris.
Power pick up broom	Yes	Yes	Yes, with dust control	Yes	Yes	Yes, with dust control	Generally will not get close to edges without a gutter broom, which is less effective. Use in reverse to maximum effects. Better dust control than angle broom.
Traditional street sweeper	Yes	Yes	Yes, with dust control	Yes	Yes	Yes, with dust control	May not be cost effective for low traffic sites. Better dust control than an angle broom.
High efficiency sweeper (vacuum or regenerative air)	No	No	Yes	Yes	Dry – Yes Wet – No	Yes	May not be cost effective for low traffic sites. Presents difficulties with larger material. Best option for dust control.

PLANS AND SPECIFICATIONS

Address the following in plans and specification:

- (1) Location, materials, and dimensions of all stabilized work surfaces,
- (2) Location of all points of egress with all trackout control practices shown,
- (3) Material specifications conforming to this standard,
- (4) Sequence or schedule for installation and removal of practices through different phases of construction; clearly indicate if stabilized work surfaces are temporary or permanent,
- (5) Standard drawings and installation, and
- (6) Stabilization after removal.

Include the responsible party by name, or by title if not known (e.g., general contractor, land owner).

Include the frequency of inspection and maintenance in plans, standard detail drawings, or specifications.

Amend onsite erosion control plans to reflect modifications during the life of the project, including relocation or addition of site entrances and exits.

OPERATION AND MAINTENANCE

Monitor all trackout control practices and nearby streets and roads at least daily during construction and more frequently during heavy use.

Clean and maintain all practices as needed to minimize trackout.

Accumulation of sediment on off-site pavement near a site exit is an indication that street cleaning is needed and on-site prevention and control measures need maintenance or are not adequate. Relocate or add practices when construction egress locations are changed or when current control measures are not reducing trackout.

Clean streets and roads as needed to maintain traction, minimize further spread of sediment, and reduce discharge to drainage infrastructure.

Clean trackout control devices, mats, and other reusable materials prior to transport to a new site to reduce the potential for spread of invasive species and minimize further spread of sediment.

Add signage, fencing, steel posts, and/or traffic barriers as needed to improve use of practices.

Stabilized Work Surface

Monitor stabilized work surface areas for soil deposits, standing water, and damage. Remove soil deposits daily through scraping and/or pavement cleaning, and repair damage as needed. Top dress gravel surfaces as needed. Replace or repair torn or damaged mats.

Stone Tracking Pad

Monitor tracking pads for compaction, soil deposits, and mixing of underlying soils and stone layers.

Maintain a loosened, rough surface by scraping, loosening, or top-dressing with additional aggregate.

Replace geotextile and stone if less-intensive maintenance efforts fail to reestablish effectiveness.

Add stone as needed to maintain the minimum pad thickness.

Replace damaged or crushed culverts under tracking pad.

Manufactured Trackout Control Device

Monitor and maintain devices to minimize shifting, rutting of adjacent surfaces, and structural failure.

Remove accumulated sediment as required to maintain the function of the device.

Replace missing or damaged elements such as bars or anchors, and remove and reset devices if they shift during use.

Fill ruts in adjacent surfaces with aggregate or paving materials. Maintain a stable surface between the device and street or road.

Tire Washing

Monitor tire washing station for sediment accumulation, clogged hoses, appropriate water levels, and effectiveness.

Remove accumulated sediment.

Replenish flocculant as needed, and replace or replenish water as needed.

Maintain hoses to minimize clogging or freezing.

For manufactured tire washing stations, maintain per manufacturer's recommendations.

Modify operations as needed during cold weather to minimize formation of ice-hazards on roadways.

DEFINITIONS

Aggregate: A composite mixture of hard, durable, mineral materials that have been mechanically processed.

Broom-clean: A pavement condition where no measurable material is collected when a push broom is pushed lightly across the surface. This is generally applicable in dry conditions.

Drainage infrastructure: Features present above or below grade for the purpose of collecting and transmitting storm water. These features include, but are not limited to, ditches, storm sewers, drainage inlets, flumes, and manholes.

Manufactured trackout control device: A device installed and maintained at an egress location for reducing trackout of sediments through flexing and vibrating tires.

Trackout: The relocation of material from its intended location to offsite surfaces by vehicles.

Shovel-clean: A pavement condition where no measurable material is collected when a flat-edged shovel is pushed across the surface. This is generally applicable in wet conditions.

Site: The area within the construction limits. Construction limits may change over the course of a project.

Vehicle: Cars, trucks, and other equipment capable of moving persons or property using tires or tracks.

REFERENCES

Wisconsin Council on Forestry, Invasive Species Best Management Practices for Transportation and Utility Rights-of-Way, <https://councilonforestry.wi.gov/Documents/InvasiveSpecies/ROW-Manual.pdf>

Wisconsin DNR, Outstanding and Exceptional Resource Waters, <http://dnr.wi.gov/topic/SurfaceWater/orwerw.html>

Wisconsin DNR, Storm Water Construction Technical Standards, http://dnr.wi.gov/topic/stormwater/standards/const_standards.html

Wisconsin DNR, Storm Water Post-Construction Technical Standards, http://dnr.wi.gov/topic/stormwater/standards/postconst_standards.html

Wisconsin Department of Transportation, *Select Crushed Material*, 2018 Standard Specification, Section 312, <http://wisconsindot.gov/rdwy/stndspec/ss-03-12.pdf>

Figure 1:
Example of a common setup that can be used to implement a stabilized surface area.

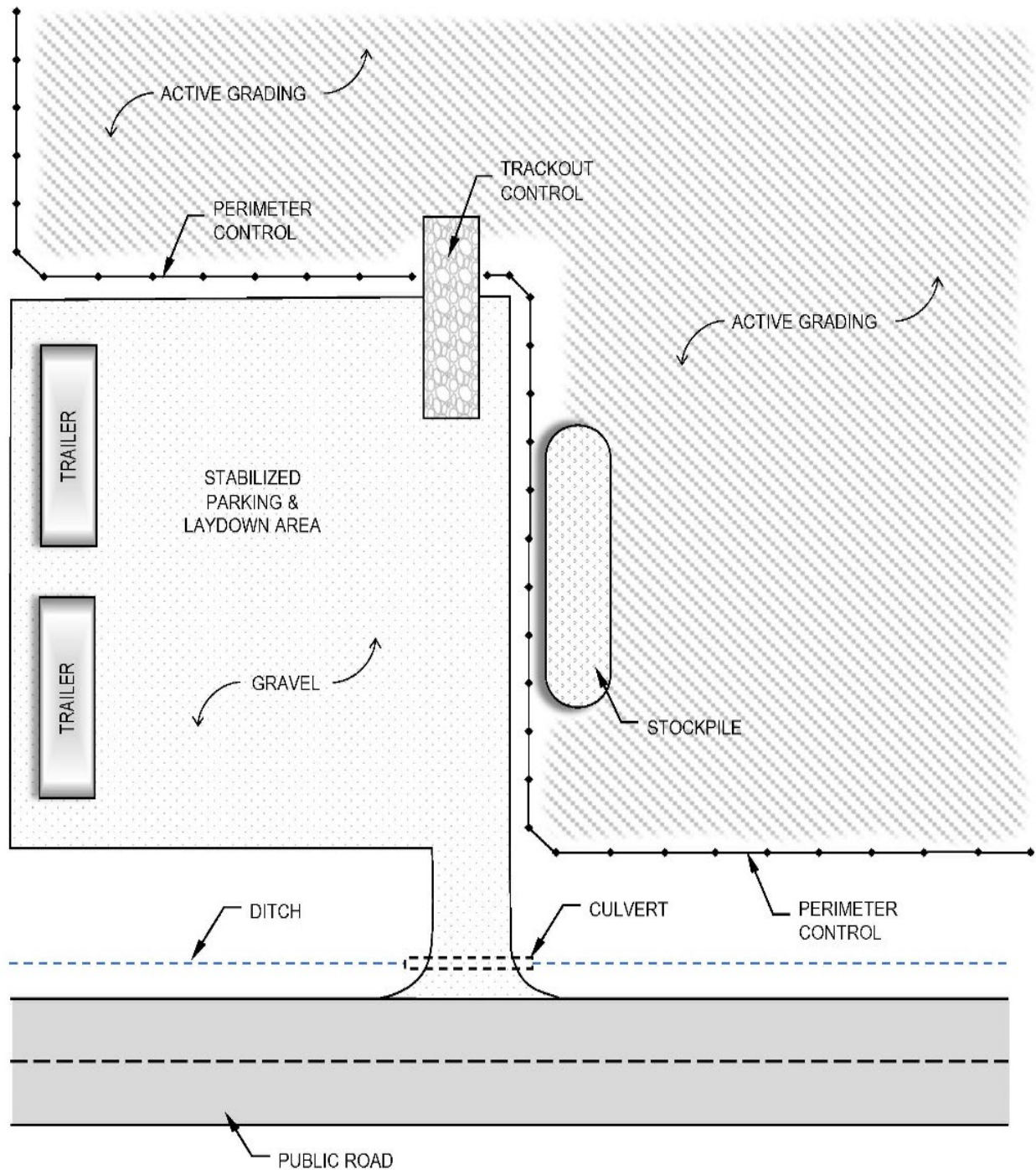
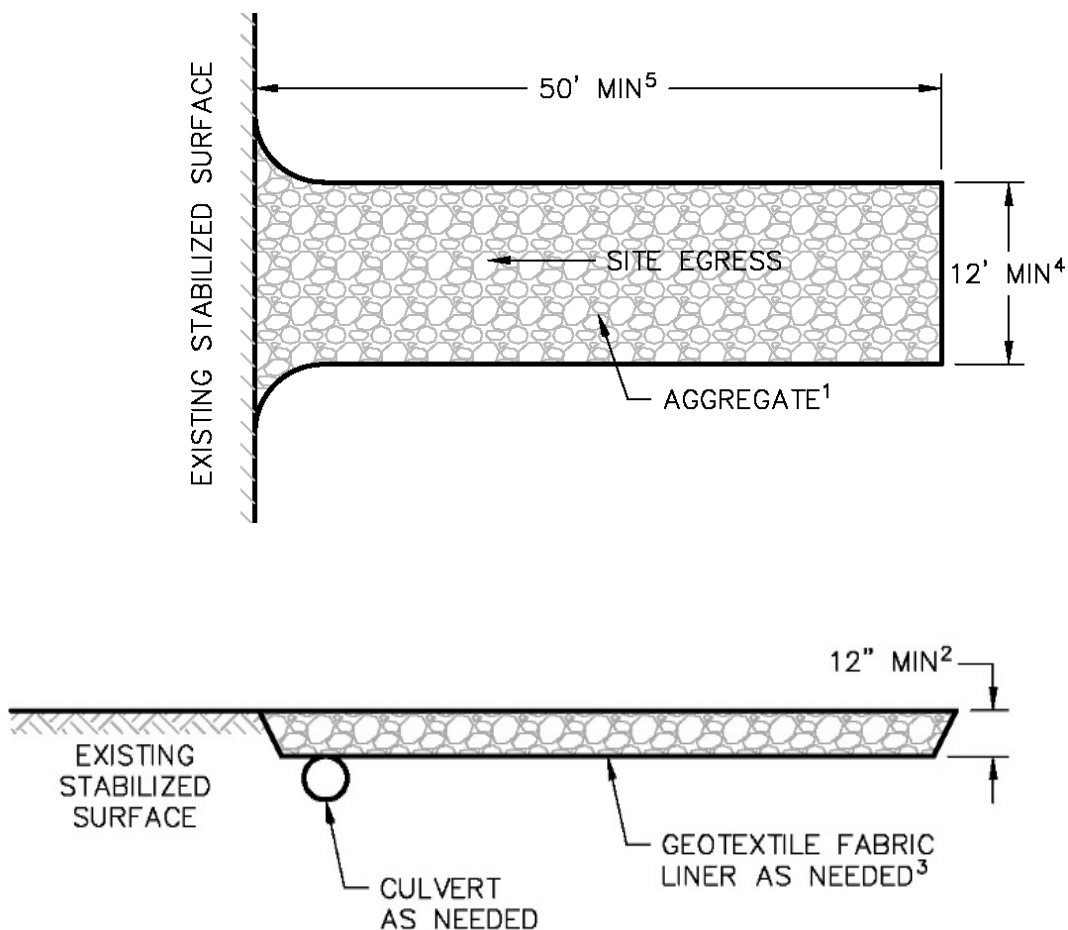


Figure 2:
Stone tracking pad detail



Note 1 Use hard, durable, angular stone or recycled concrete meeting the gradation in Table 1. Where this gradation is not available, meet the gradation in Wisconsin Department of Transportation (DOT) 2018 Standard Specification, Section 312, Select Crushed Material.

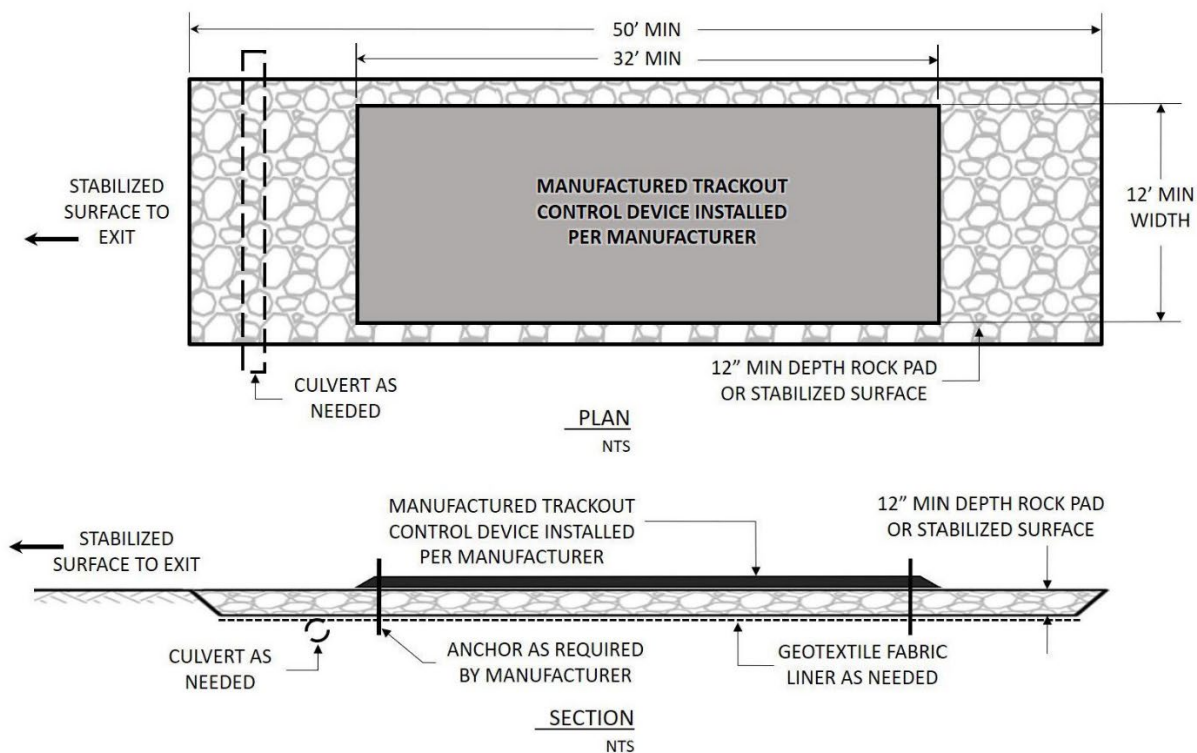
Note 2 Slope the stone tracking pad in a manner to direct runoff to an approved treatment practice.

Note 3 Select fabric type based on soil conditions and vehicles loading.

Note 4 Install tracking pad across full width of the access point, or restrict existing traffic to a dedicated egress lane at least 12 feet wide across the top of the pad.

Note 5 If a 50' pad length is not possible due to site geometry, install the maximum length practicable and supplement with additional practices as needed.

Figure 3:
Example manufactured trackout control device detail.



Note 1 This detail is provided as an example. Comply with manufacturer's specifications while also meeting the minimum manufactured tracking pad length and width described in this technical standard.

Note 2 Install such that runoff flows to an approved treatment practice.

Note 4 A thinner stone layer or other stable surface may be acceptable such that rutting is minimized as vehicles mount or dismount from the manufactured trackout control device.

Note 5 Select fabric type based on soil conditions and vehicles loading.

Note 6 Direct all exiting vehicles over manufactured trackout control device. Stone tracking pad installation across remaining access width is recommended. A 12' minimum can be used when exiting traffic is restricted to a dedicated egress lane.

Note 7 If minimum installation length is not possible due to site geometry, install the maximum length practicable and supplement with additional practices as needed.

Note 7 Accommodate exiting vehicles in excess of manufactured trackout control device weight capacity with other treatment practices.

Mulching For Construction Sites (1058)

Wisconsin Department of Natural Resources
Technical Standard

I. Definition

Mulching is the application of organic material to the soil surface to protect it from raindrop impact and overland flow. Mulch covers the soil and absorbs the erosive impact of rainfall and reduces the flow velocity of runoff.

II. Purpose

This practice may be used to:

- Reduce soil erosion
- Aid in seed germination and establishment of plant cover
- Conserve soil moisture

III. Conditions Where Practice Applies

This practice may be applied on exposed soils as a temporary control where soil grading or landscaping has taken place or in conjunction with temporary or permanent seeding. Mulching is generally not appropriate in areas of concentrated flow.

IV. Federal, State, and Local Laws

Users of this standard shall comply with applicable federal, state and local laws, rules, regulations or permit requirements governing mulching. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Site Preparation:

Soil surface shall be prepared prior to the application of mulch in order to achieve the desired purpose and to ensure optimum contact between soil and mulch. All areas to be mulched shall be reasonably free of rills and gullies.

B. Materials:

Mulch shall consist of natural biodegradable material such as plant residue (including but not limited to straw, hay, wood chips, bark and wood cellulose fiber), or other equivalent materials of sufficient dimension (depth or thickness) and durability to achieve the intended effect for the required time period.

Mulch shall be environmentally harmless to wildlife and plants. Materials such as gravel, plastic, fabric, sawdust, municipal solid waste, *solid waste byproducts*¹, shredded paper, and non-biodegradable products shall not be used.

Mulch shall be free of diseased plant residue (i.e. oak wilt), *noxious weed* seeds, harmful chemical residues, heavy metals, hydrocarbons and other known environmental toxicants.

Marsh hay shall not be used as mulch in lowland areas but may be used on upland sites to prevent the spread of invasive, non-native species (i.e. reed canary grass) commonly found in marsh hay.

Straw and hay mulch that will be crimped shall have a minimum fiber length of 6 inches.

¹ Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

Wood chips or wood bark shall only be used for sites that are not seeded.

C. Application Rate:

1. Mulch shall cover a minimum of 80% of the soil surface for unseeded areas. For seeded areas, mulch shall be placed loose and open enough to allow some sunlight to penetrate and air to circulate but still cover a minimum of 70% of the soil surface.
2. Mulch shall be applied at a uniform rate of 1½ to 2 tons per acre for sites that are seeded, and 2 to 3 tons per acre for sites that are not seeded. This application results in a layer of ½ to 1½ inches thick for seeded sites, and 1½ to 3 inches thick for sites not seeded.
3. Wood chips or wood bark shall be applied at a rate of 6 to 9 tons per acre to achieve a minimum of 80% ground cover. This application should result in a layer of wood chips or wood bark ½ to 1½ inches thick.

D. Mulch Anchoring Methods

Anchoring of mulch shall be based on the type of mulch applied, site conditions, and accomplished by one of the following techniques:

1. Crimping

Immediately after spreading, the mulch shall be anchored by a mulch crimper or equivalent device consisting of a series of dull flat discs with notched edges spaced approximately 8 inches apart. The mulch shall be impressed in the soil to a depth of 1 to 3 inches.

2. Polypropylene Plastic, or Biodegradable Netting

Apply plastic netting over mulch application and staple according to manufacturer's recommendations.

3. Tackifier

Tackifier shall be sprayed in conjunction with mulch or immediately

after the mulch has been placed. Tackifiers must be selected from those that meet the WisDOT Erosion Control Product Acceptability List (PAL). Asphalt based products shall not be applied.

The tackifiers shall be applied at the following minimum application rates per acre:

- a. Latex-Base: mix 15 gallons of adhesive (or the manufacturer's recommended rate which ever is greater) and a minimum of 250 pounds of recycled newsprint (pulp) as a tracer with 375 gallons of water.
- b. Guar Gum: mix 50 pounds of dry adhesive (or the manufacturer's recommended rate which ever is greater) and a minimum of 250 pounds of recycled newsprint (pulp) as tracer with 1,300 gallons of water.
- c. Other Tackifiers: (Hydrophilic Polymers) mix 100 pounds of dry adhesive (or the manufacturer's recommended rate which ever is greater) and a minimum of 250 pounds of recycled newsprint (pulp) as a tracer with 1,300 gallons of water.

VI. Considerations

- A. Wood products typically absorb available soil nitrogen as they degrade, thus making it unavailable for seed.
- B. The use of mulch behind curb and gutter may not be desirable unless anchored by netting, because air turbulence from nearby traffic can displace the mulch. Consider the use of erosion mat or sod as an alternative.
- C. In areas where lawn type turf will be established, the use of tackifiers is the preferred anchoring method. Crimping will tend to leave an uneven surface and plastic netting can become displaced and entangled in mowing equipment.

- D. A heavier application of mulch may be desired to prevent seedlings from being damaged by frost.
- E. It may be beneficial to apply polyacrylimide in addition to mulch. Refer to WDNR Technical Standard (1050) Erosion Control Land Application of Anionic Polyacrylamide for information about the advantages and proper use of polymers.
- F. Concentrated flows above the site where mulch is applied should be diverted.
- G. Mulch should be placed within 24 hours of seeding.
- H. Mulching operations should not be performed during periods of excessively high winds that would preclude the proper placement of mulch.
- I. Materials such as gravel may be effective for erosion control but are not considered mulches.

VII. Plans and Specifications

- A. Plans and specifications for mulching shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:
 - 1. Type of mulch used
 - 2. Application rate
 - 3. Timing of application
 - 4. Method of anchoring
- B. All plans, standard detail drawings, or specifications shall include schedules for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

Mulch shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.

Mulch that is displaced shall be reapplied and properly anchored. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

WisDOT's Erosion Control Product Acceptability List (PAL) can be found on the WisDOT web site:

<https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrcs/tools/pal/default.aspx>

Printed copies are no longer being distributed.

X. Definitions

Noxious weed (V.B): Any weed a governing body declares to be noxious within its respective boundaries. The State of Wisconsin list of noxious weeds can be found in Statute 66.0407.

Solid Waste Byproducts (V.B): Includes industrial, commercial, residential, and agricultural wastes that have been processed, incinerated, or composted and still contain inorganic wastes such as glass and metals and organic wastes including plastics, textiles, rubber, leather, and other miscellaneous organic wastes which may be toxic or hazardous in nature.

Seeding For Construction Site Erosion Control

(1059)

Wisconsin Department of Natural Resources
Technical Standard

I. Definition

Planting seed to establish temporary or permanent vegetation for erosion control.

II. Purpose

The purpose of *temporary seeding*¹ is to reduce runoff and erosion until permanent vegetation or other erosion control practices can be established. The purpose of *permanent seeding* is to permanently stabilize areas of exposed soil.

III. Conditions Where Practice Applies

This practice applies to areas of exposed soil where the establishment of vegetation is desired. Temporary seeding applies to disturbed areas that will not be brought to final grade or on which land-disturbing activities will not be performed for a period greater than 30 days, and requires vegetative cover for less than one year. Permanent seeding applies to areas where perennial vegetative cover is needed.

IV. Federal, State and Local Laws

Users of this standard shall be aware of all applicable federal, state and local laws, rules, regulations or permit requirements governing seeding. This standard does not contain the text of federal, state or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Site and Seedbed Preparation

Site preparation activities shall include:

1. Temporary Seeding

- a. Temporary seeding requires a seedbed of loose soil to a minimum depth of 2 inches.
- b. Fertilizer application is not generally required for temporary seeding. However, any application of fertilizer or lime shall be based on soil testing results.
- c. The soil shall have a pH range of 5.5 to 8.0.

2. Permanent Seeding

- a. *Topsoil* installation shall be completed prior to permanent seeding.
- b. Permanent seeding requires a seedbed of loose topsoil to a minimum depth of 4 inches with the ability to support a *dense* vegetative cover.
- c. Application rates of fertilizer or lime shall be based on soil testing results.
- d. Prepare a tilled, fine, but firm seedbed. Remove rocks, twigs foreign material and clods over two inches that cannot be broken down.
- e. The soil shall have a pH range of 5.5 to 8.0.

¹ Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

B. Seeding

1. Seed Selection

- a. Seed mixtures that will produce dense vegetation shall be selected based on soil and site conditions and intended final use. Section IX References, lists sources containing suggested seed mixtures.
- b. All seed shall conform to the requirements of the Wisconsin Statutes and of the Administrative Code Chapter ATCP 20.01 regarding noxious weed seed content and labeling.
- c. Seed mixtures that contain potentially invasive species or species that may be harmful to native plant communities shall be avoided.
- d. Seed shall not be used later than one year after the test date that appears on the label.
- e. Seed shall be tested for purity, germination and noxious weed seed content and shall meet the minimum purity and germination requirements as prescribed in the current edition of Rules for Testing Seed, published by the Association of Official Seed Analysts.

2. Seed Rates

a. Temporary Seeding (Cover Crop)

Areas needing protection during periods when permanent seeding is not applied shall be seeded with annual species for temporary protection. See Table 1 for seeding rates of commonly used species. The residue from this crop may either be incorporated into the soil during seedbed preparation at the next permanent seeding period or left on the soil surface and the planting made as a no-till seeding.

Table 1 Temporary Seeding Species and Rates

Species	Lbs/Acre	Percent Purity
Oats	131 ¹	98
Cereal Rye	131 ²	97
Winter wheat	131 ²	95
Annual Ryegrass	80 ²	97

¹ Spring and summer seeding

² Fall seeding

b. Permanent Seeding

Rates shall be based on pounds or ounces of Pure Live Seed (PLS) per acre. Section IX contains some possible reference documents that provide seeding rates. Permanent seeding rates may be increased above the minimum rates shown in the reference documents to address land use and environmental conditions.

If a nurse crop is used in conjunction with permanent seeding, the nurse crop shall not hinder establishment of the permanent vegetation.

A nurse crop shall be applied at 50% its temporary seeding rate when applied with permanent seed.

3. Inoculation

Legume seed shall be inoculated in accordance with the manufacturer's recommendations. Inoculants shall not be mixed with liquid fertilizer.

4. Sowing

Seed grasses and legumes no more than ¼ inch deep. Distribute seed uniformly. Mixtures with low seeding rates require special care in sowing to achieve proper seed distribution.

Seed may be broadcast, drilled, or hydroseeded as appropriate for the site.

Seed when soil temperatures remain consistently above 53° F. *Dormant seed* when the soil temperature is consistently below 53° F (typically

Nov. 1st until snow cover). Seed shall not be applied on top of snow.

VI. Considerations

- A. Consider seeding at a lower rate and making two passes to ensure adequate coverage.
- B. Compacted soil areas may need special site preparation prior to seeding to mitigate compaction. This may be accomplished by chisel plowing to a depth of 12 inches along the contour after heavy equipment has left the site.
- C. Sod may be considered where adequate watering is available.
- D. When working in riparian areas refer to the NRCS Engineering Field Handbook, Chapter 16, Streambank and Shoreline Protection and Chapter 18, *Soil Bioengineering* for Upland Slope Protection and Erosion Reduction.
- E. A site assessment should be conducted to evaluate soil characteristics, topography, exposure to sunlight, proximity to natural plant communities, proximity to nuisance, noxious and/or invasive species, site history, moisture regime, climatic patterns, soil fertility, and previous herbicide applications.
- F. Use *introduced species* only in places where they will not spread into existing natural areas.
- G. Lightly roll or compact the area using suitable equipment when the seedbed is judged to be too loose, or if the seedbed contains clods that might reduce seed germination.
- H. See Section IX. References for suggested seed mixes (NRCS, WisDOT, UWEX) or use their equivalent.
- I. Turf seedlings should not be mowed until the stand is at least 6 inches tall. Do not mow closer than 3 inches during the first year of establishment.
- J. Seeding should not be done when the soil is too wet.

- K. Consider watering to help establish the seed. Water application rates shall be controlled to prevent runoff and erosion.
- L. Prairie plants may not effectively provide erosion control during their establishment period without a nurse crop.
- M. Topsoil originating from agricultural fields may contain residual chemicals. The seedbed should be free of residual herbicide or other contaminants that will prevent establishment and maintenance of vegetation. Testing for soil contaminants may be appropriate if there is doubt concerning the soil's quality.
- N. Consider using mulch or a nurse crop if selected species are not intended for quick germination. When mulching refer to WDNR Technical Standard Mulching for Construction Sites (1058).

VII. Plans and Specifications

Plans and specifications for seeding shall be in keeping with this standard and shall describe the requirements for applying this practice.

All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

- A. During construction areas that have been seeded shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period. Inspect weekly during the growing season until vegetation is densely established or permit expires. Repair and reseed areas that have erosion damage as necessary.
- B. Limit vehicle traffic and other forms of compaction in areas that are seeded.
- C. A fertilizer program should begin with a soil test. Soil tests provide specific fertilizer recommendations for the site and can help to avoid over-application of fertilizers.

IX. References

A. Seed Selection References

United States Department of Agriculture – Natural Resources Conservation Service Field Office Technical Guide Section IV, Standard 342, Critical Area Planting.

UWEX Publication A3434 Lawn and Establishment & Renovation.

WisDOT, 2003. State of Wisconsin Standard Specifications For Highway and Structure Construction. Section 630, Seeding.

B. General References

Association of Official Seed Analysts, 2003. Rules for Testing Seed. <http://www.aosaseed.com>.

Metropolitan Council, 2003. Urban Small Sites Best Management Practice Manual, Chapter 3, Vegetative Methods 3-85 – 3-91. Minneapolis.

The State of Wisconsin list of noxious weeds can be found in Statute 66.0407.

United States Department of Agriculture – Natural Resources Conservation Service. Engineering Field Handbook, Chapters 16 and 18.

UWEX Publication GWQ002 Lawn & Garden Fertilizers.

Nurse Crop (V.B.2.b): Also known as a companion crop; is the application of temporary (annual) seed with permanent seed.

Permanent seeding (II) Seeding designed to minimize erosion for an indefinite period after land disturbing construction activities have ceased on the site.

Soil Bioengineering (VI.D) Practice of combining mechanical, biological and ecological concepts to arrest and prevent shallow slope failures and erosion.

Temporary Seeding (II) Seeding designed to control erosion for a time period of one year or less that is generally removed in order to perform further construction activities or to permanently stabilize a construction site.

Topsoil (V.A.2.a) Consists of loam, sandy loam, silt loam, silty clay or clay loam humus-bearing soils adapted to sustain plant life with a pH range of 5.5 – 8.0. Manufactured topsoil shall through the addition of sand or organic humus material, peat, manure or compost meet the above criteria.

X. Definitions

Dense (V.A.2.b) A stand of 3-inch high grassy vegetation that uniformly covers at least 70% of a representative 1 square yard plot.

Dormant seed (V.B.4): Seed is applied after climatic conditions prevent germination until the following spring.

Introduced Species (VI.F) Plant species that historically would not have been found in North America until they were brought here by travelers from other parts of the world. This would include smooth brome grass and alfalfa. Some of these species may have a wide distribution such as Kentucky bluegrass.

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
TECHNICAL STANDARD
STORM DRAIN INLET PROTECTION FOR CONSTRUCTION SITES
1060

DEFINITION

A temporary device installed in or around a storm drain inlet, drop inlet, or curb inlet.

PURPOSE

This practice is intended to minimize sediment from entering storm drainage systems in areas where the contributing drainage area is temporarily disturbed or receives traffic from temporarily disturbed areas nearby.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where runoff from construction sites enters conveyance system inlets, such as drain inlets, drop inlets, and curb inlets. Inlet protection devices are for drainage areas of one acre or less. Runoff from areas larger than one acre shall be routed through a properly designed sediment trapping or settling practice upstream of the inlet.

CRITERIA

General Criteria

Be aware of applicable federal, state and local laws, rules, regulations, or permit requirements governing the use and placement of storm drain inlet protection. This standard does not contain the text of federal, state, or local laws.

Install the appropriate type of inlet protection prior to drain, drop, or curb inlet receiving runoff.

Keep the inlet protection in place and maintain until the disturbed contributing area is stabilized. Use Table 1 to select inlet protection type.

Table 1 Inlet Device Selection			
Inlet Type	Project Phase	Inlet Protection	Notes
Yard Drain or Field Inlet	Major grading through final stabilization	Type A	Allow ponding around drain if conditions allow
Paved Area Drain	Pre-Paving	Type A	After castings are in place, use Type D Series when needed for safety, or use Type B if insufficient depth is available
	Post-Paving	Type D, D-M, D- HR, or D-RF	Use Type B if inlet is not deep enough for Type D Series
Curb Inlet	Pre-Paving	Type A	After castings are in place, use Type D Series when needed for safety, or use Type C if insufficient depth is available
	Post-Paving/Curbing	Type D, D-M, D- HR, or D-RF	Use Type C if inlet is not deep enough for Type D Series

To provide additional sediment settling, allow ponding below inlet rim where it will not interfere with traffic, create a safety hazard, impede site access, or cause property damage.

Leave no gaps in the material that would allow the flow of water to bypass the inlet protection device, except for overflow holes or “emergency spillways” needed to limit ponding to avoid interfering with the flow of traffic, creating a safety hazard, impeding site access, or causing property damage.

Use fabrics that meet Wisconsin Department of Transportation (WisDOT) specifications for the specified fabric.

Use *FF fabric*¹ as specified in the WisDOT Erosion Control Product Acceptability List (PAL), for Type A, B, C or D inlet protection.

Use *R*, *DF*, and *HR fabrics* as specified in the WisDOT Standard Specifications for Highway and Structure Construction.

Criteria for Type A Devices

Install frame and trench-in FF fabric around entire perimeter of device. (See Type A detail in Figure 1.)

Criteria for Type B Devices

Use Type B inlet protection only where there is no curb inlet and there is insufficient depth to install Type D Series inlet protection.

For Type B inlet protection, use FF fabric.

Leave at least 6 inches of geotextile fabric ‘flap’ around the perimeter of the grate. Stand on or hold the flap while removing grate for maintenance to prevent discharge of accumulated sediment into inlet. (See Type B detail in Figure 1.)

Criteria for Type C Devices

Use Type C inlet protection only where there is a curb inlet and there is insufficient depth to install Type D Series inlet protection.

For Type C inlet protection, use FF fabric.

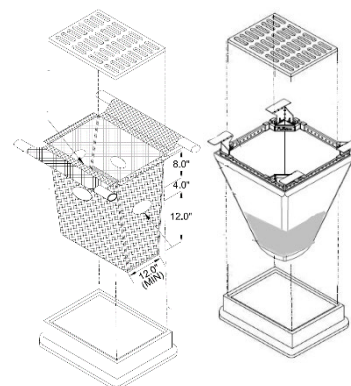
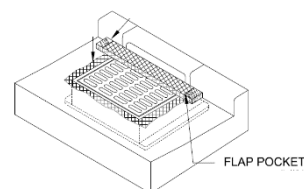
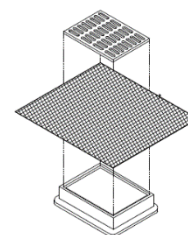
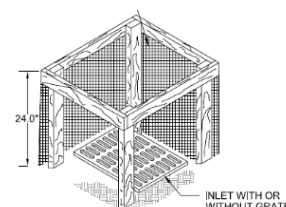
Wrap a 2-inch by 4-inch (nominal) piece of wood, secure it in the fabric and place in front of the curb head, as shown in Figure 1. Do not block the entire opening of the curb box with wood. Secure wood to the grate with wire or plastic ties. Water ponding more than 2 inches around the inlet should be able to overflow into the curb box. Leave at least 6 inches of geotextile fabric ‘flap’ around the perimeter of the grate. Stand on or hold the flap while removing grate for maintenance to prevent discharge of accumulated sediment into inlet. (See Type C detail in Figure 1.)

Criteria for Type D Series Devices

For Type D Series inlet protection devices, keep three inches of clearance between the bag and the sides of the inlet to prevent the filter bag from blocking overflow water. Cinch device bags when used in inlets less than 30 inches in depth to provide the required 3-inch clearance for overflow.

In general, device bags should not extend below the lowest outlet for inlets with sumps.

Refer to Table 2 for filter fabric type and exposed soil texture and particle diameter where a Type D Series device is appropriate.



¹ Words in the standard that are shown in italics are described in the Glossary section. The words are italicized the first time they are used in the text.

Table 2 Fabric Selection			
Exposed Soil Texture	Exposed Soil Average Particle Diameter (mm)	Filtering Fabric	Inlet Protection Type
Coarse (Sand)	≥ 0.0625	FF*	D, D-M, D-RF
Medium (Silt Loam)	0.0624 – 0.005	DF**	D-M, D-RF
Fine (Clay)	≤ 0.004	R	D-M, D-RF
		HR	D-HR, D-RF

Notes: * DF, R or HR fabrics may be used where FF is the required minimum standard.

** R or HR fabrics may be used where DF is the required minimum standard.

For **Type D** inlet protection, use FF fabric. (See Type D detail in Figure 2.)

For **Type D-M** inlet protection, use FF fabric for both the upper section and the outer lower sections of the device. Select the replaceable interior filter fabric type according to the particle size trapped. (See Type D-M detail in Figure 3.)

For **Type D-HR** inlet protection, use FF fabric for the upper half of the device and use HR fabric in the lower half of the device. (See Type D-HR detail in Figure 4.)

For **Type D-RF** inlet protection, include a rigid frame and a removable geosynthetic bag fixed to the frame with adequate strength to support the weight of the sediment bag when completely full. Use FF fabric for the upper section of the bag and a nonwoven liner based according to the particle size trapped. Bags can be a dual fabric bag sewn together, or a nonwoven liner sewn inside of an FF bag. Bypass overflows, within the frame or the sediment bag, shall be sized so that the flow through the overflows shall equal or exceed the design flow of the inlet required at a specific drainage location. (See Type D-RF detail in Figure 5.)

Criteria for Other Inlet Protection Methods

Rock bags, straw bales, stone weepers, and other ditch check devices can be used to settle sediment or divert flow. These devices are not applicable to areas adjacent to traffic and are not approved for inlet protection use on WisDOT projects.

- Manufactured rock bags shall conform to the WisDOT specification for rock bag material, including fill material.
- Ditch check device installation shall conform to the criteria outlined in the WDNR Technical Standard 1062 Ditch Check.
- Stone weeper installation shall conform to the criteria in WDNR Technical Standard 1063 Sediment Trap.

CONSIDERATIONS

- (1) Inlet protection is only one element in an erosion control plan and can be the last line of defense before runoff leaves a site. Use other practices, including temporary stabilization and area clean up, upstream of the inlet. Good construction site housekeeping measures, such as maintaining clean gutters and street sweeping, are also important.
- (2) Temporarily close or seal inlets completely to prevent entrance of runoff and sediment when site conditions allow.

- (3) Stabilize and restore disturbed areas as quickly as possible. Timely stabilization is the most effective method to control sediment entering the storm sewer.
- (4) Inlet protection should be considered for use along haul routes to supplement trackout control measures in WDNR Technical Standard 1057 Trackout Control Practices.
- (5) Inlet protection is only as effective as the filter or device used around the inlet. In general, inlet protection provides relatively good removal of coarse and medium-sized soil particles from runoff; however, to effectively trap fine soil particles, other practices such as the use of polyacrylamides, may be required (see WDNR Technical Standard 1050 Land Application of Additives for Erosion Control.)
- (6) Inlet protection requires routine inspection and maintenance. Effectiveness decreases rapidly if the inlet protection is not properly maintained. Field inspections have shown where inlet protection causes excessive ponding that the device is removed, punctured, or bypassed. In such situations, upstream erosion control effectiveness should be evaluated and replacement with a device including an overflow mechanism is appropriate, instead of simply removing the inlet protection device.
- (7) The effectiveness of inlet protection devices in unpaved areas can be enhanced by additional excavation to increase the storage capacity around the inlet.
- (8) The use of fabric intended for a finer soil type on a construction site with coarser soil may increase the required maintenance frequency due to faster clogging.
- (9) Consider using Type D-M, D-HR, and D-RF inlet protection rather than Type B, C, or D in areas with fine soils where more effective filtering is desired.
- (10) Inlet protection devices listed in the WisDOT PAL are accepted for use in accordance with this standard.
- (11) Stabilize contributing drainage area prior to winter season. Once contributing area is stabilized, remove inlet protection to prevent flooded conditions. Replace inlet protection prior to site disturbance in spring. Where this is not feasible, Type D-RF is recommended for inlets on snow plow routes.
- (12) Where vegetated buffers are present around yard drains or field inlets, Type B inlet protection may be sufficient.
- (13) Permanent inlet filters for stormwater management should not be installed until after construction is complete and the site has been stabilized as they may clog prematurely.

PLANS AND SPECIFICATIONS

Develop all plans and specifications in accordance with this standard, and to describe the requirements for applying the practice to achieve its intended purpose. In the plans and specifications address the following:

- (1) Locations and types of inlet protection. If the type of inlet protection will change as construction progresses, note this in the plans.
- (2) Material specification conforming to this standard.
- (3) In all construction documents, identify the responsible party and include a schedule for installation, inspection, and maintenance requirements.
- (4) Include a copy of the applicable inlet protection details in the construction plans.

OPERATIONS AND MAINTENANCE

Remove inlet protection devices once the contributing drainage area is stabilized with appropriate vegetation or impervious surface.

At a minimum, inspect inlet protection weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period. Use a flashlight to improve visibility when necessary.

When maintaining and removing inlet protection devices, exercise care to minimize sediment falling into the inlet. Immediately remove all material that has fallen into inlets. Deposit sediment removed from the device in a suitable area and stabilize.

Replace inlet protection if flaps become too damaged to allow cleaning without material falling into the inlet.

Operations and Maintenance (O&M) for Type A, B or C Inlet Protection

Remove sediment deposits when sediment has accumulated between $\frac{1}{3}$ to $\frac{1}{2}$ of the design height or the device is no longer functioning as designed.

Inspect the device routinely, and as necessary repair and restore to original condition.

Ponding may indicate that the device's fabric needs maintenance and sediment removal. Unless extraordinary circumstance arise, fabric should not be cut to bypass the fabric. If filter fabric is cut, replace inlet protection as soon as water levels recede enough to do so.

O&M for Type D, D-M, and D-HR Inlet Protection

Remove sediment when it accumulates to within 6 inches of the bottom of the overflow holes.

If standing water remains within 6 inches of the bottom of the overflow holes 24 hours after a runoff event, remove accumulated sediment to restore the fabric's filtering capacity.

Holes in the FF fabric less than 2 inches in length may be repaired by stitching. The bag must be replaced if holes greater than 2 inches are observed in the FF fabric.

Replace insert filters and HR fabrics if any holes are observed.

The filter must be replaced if the flap pockets sustain damage that compromises the integrity of the filter or the ability to perform maintenance. If in good condition, bags can be cleaned and reused on subsequent project sites.

O&M for Type D-RF Inlet Protection

Remove sediment deposits when sediment has accumulated between $\frac{1}{3}$ to $\frac{1}{2}$ of the design storage depth or the device is no longer functioning as designed.

Holes in the FF fabric less than 2 inches in length may be repaired by stitching. The bag must be replaced if holes greater than 2 inches are observed in the FF fabric.

Replace the bag if any holes are observed in the nonwoven liner fabric. If in good condition, bags can be cleaned and reused on subsequent project sites.

REFERENCES

Wisconsin Department of Transportation, Erosion Control Product Acceptability List, <https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrcs/tools/pal/default.aspx>

Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, <https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrcs/rdwy/stdnspec.aspx>.

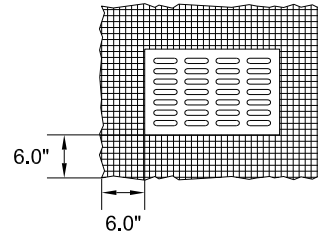
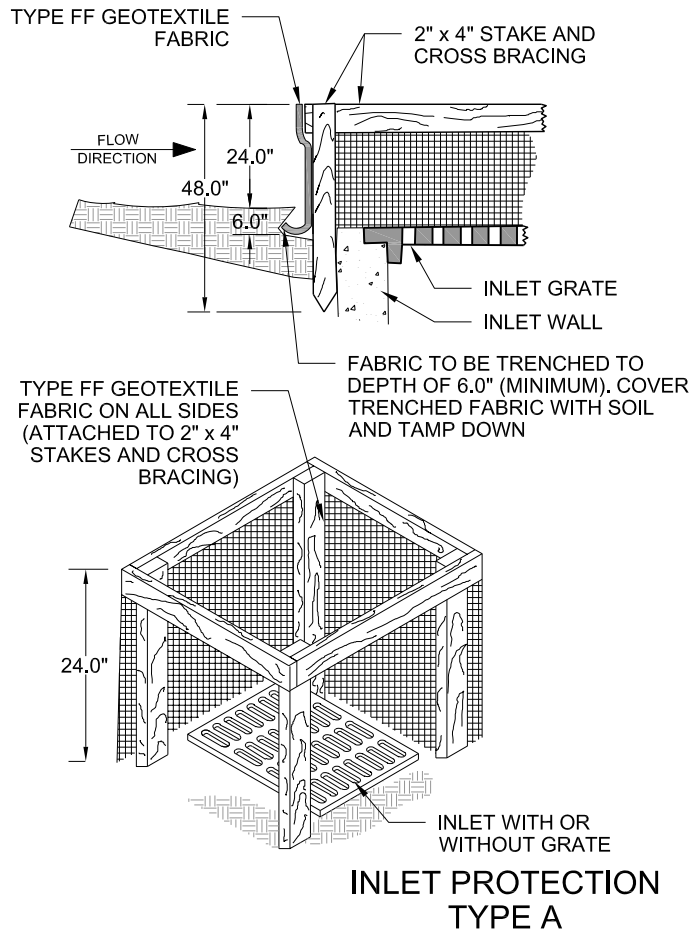
ASTM International. *D8057-17 Standard Specification for Inlet Filters with a Rigid Frame*. West Conshohocken, PA, 2017.

GLOSSARY

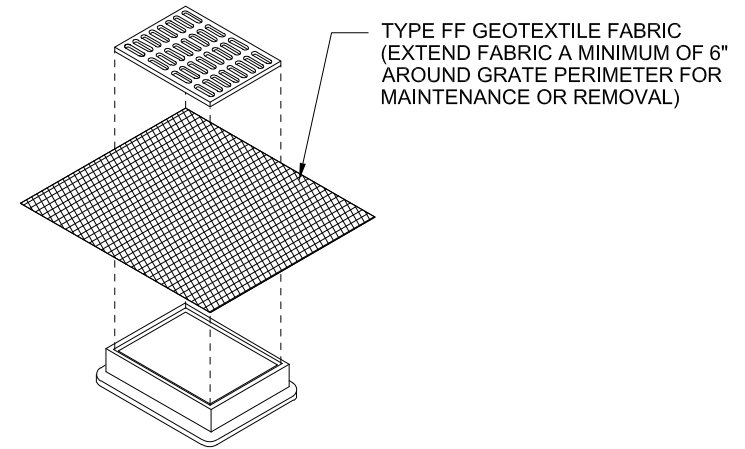
FF Fabric is a woven polypropylene monofilament geotextile and is resistant to biological degradation and commonly-encountered soil chemicals.

R, DF and HR Fabrics are nonwoven geotextiles composed of bonded polypropylene fibers and are resistant to biological degradation and commonly-encountered soil chemicals.

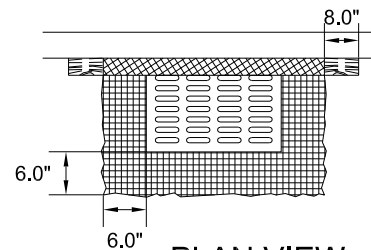
FIGURE 1. INLET PROTECTION TYPES A, B AND C



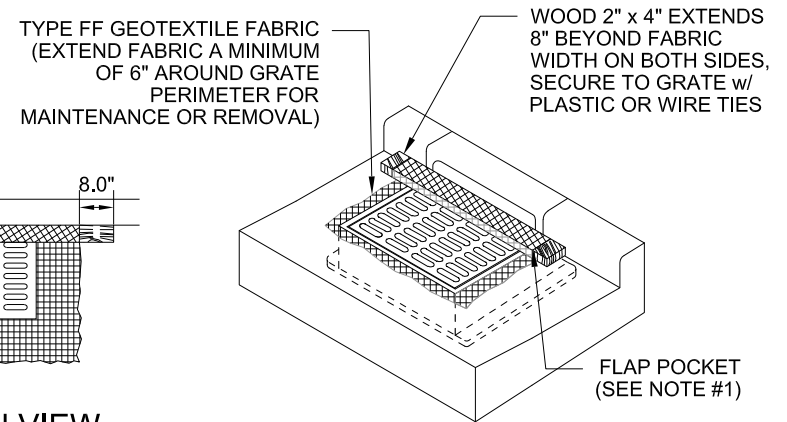
PLAN VIEW TYPE B
WITHOUT CURB BOX



INLET PROTECTION TYPE B
WITHOUT CURB BOX



PLAN VIEW TYPE C
WITH CURB BOX



INLET PROTECTION TYPE C
WITH CURB BOX

NOTES:

1. FLAP POCKETS SHALL BE LARGE ENOUGH TO ACCEPT WOOD 2" x 4". THE REBAR, STEEL PIPE, OR WOOD SHALL BE INSTALLED IN THE REAR FLAP AND SHALL NOT BLOCK THE TOP HALF OF THE CURB FACE OPENING.

MAINTENANCE NOTES:

1. WHEN REMOVING OR MAINTAINING INLET PROTECTION, CARE SHALL BE TAKEN SO THAT THE SEDIMENT TRAPPED IN THE FABRIC DOES NOT FALL INTO THE STRUCTURE. MATERIAL THAT HAS FALLEN INTO THE INLET SHALL BE IMMEDIATELY REMOVED.

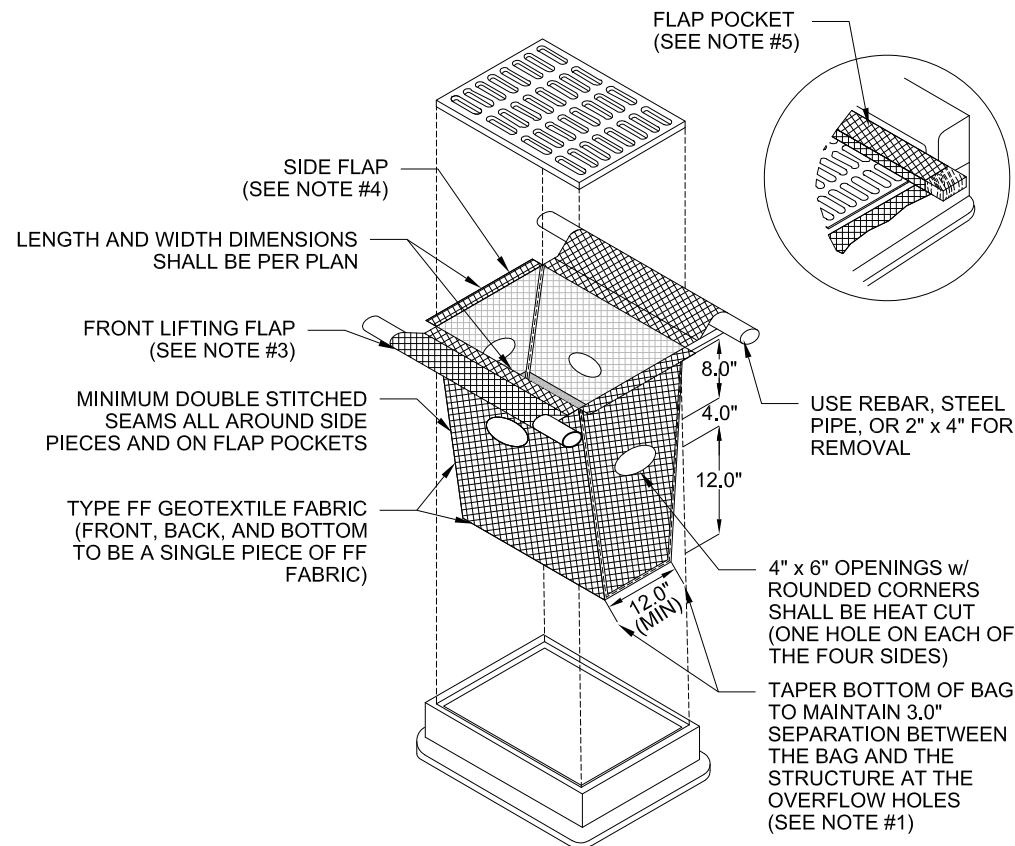


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NOT TO SCALE

FIGURE 2. INLET PROTECTION TYPE D



INLET PROTECTION TYPE D

CAN BE INSTALLED IN INLETS
WITH OR WITHOUT CURB BOXES

NOTES:

1. TAPER BOTTOM OF BAG TO MAINTAIN 3" OF CLEARANCE BETWEEN THE BAG AND THE STRUCTURE, MEASURED FROM THE BOTTOM OF THE OVERFLOW OPENINGS TO THE STRUCTURE WALL.
2. GEOTEXTILE FABRIC TYPE FF FOR FLAPS, TOP AND BOTTOM OF OUTSIDE OF FILTER BAG. FRONT, BACK, AND BOTTOM OF FILTER BAG BEING ONE PIECE.
3. FRONT LIFTING FLAP IS TO BE USED WHEN REMOVING AND MAINTAINING FILTER BAG.
4. SIDE FLAPS SHALL BE A MAXIMUM OF 2" LONG. FOLD THE FABRIC OVER AND REINFORCE WITH MULTIPLE STITCHES.
5. FLAP POCKETS SHALL BE LARGE ENOUGH TO ACCEPT WOOD 2" x 4". THE REBAR, STEEL PIPE, OR WOOD SHALL BE INSTALLED IN THE REAR FLAP AND SHALL NOT BLOCK THE TOP HALF OF THE CURB FACE OPENING.

MAINTENANCE NOTES:

1. WHEN REMOVING OR MAINTAINING INLET PROTECTION, CARE SHALL BE TAKEN SO THAT THE SEDIMENT TRAPPED IN THE FABRIC DOES NOT FALL INTO THE STRUCTURE. MATERIAL THAT HAS FALLEN INTO THE INLET SHALL BE IMMEDIATELY REMOVED.



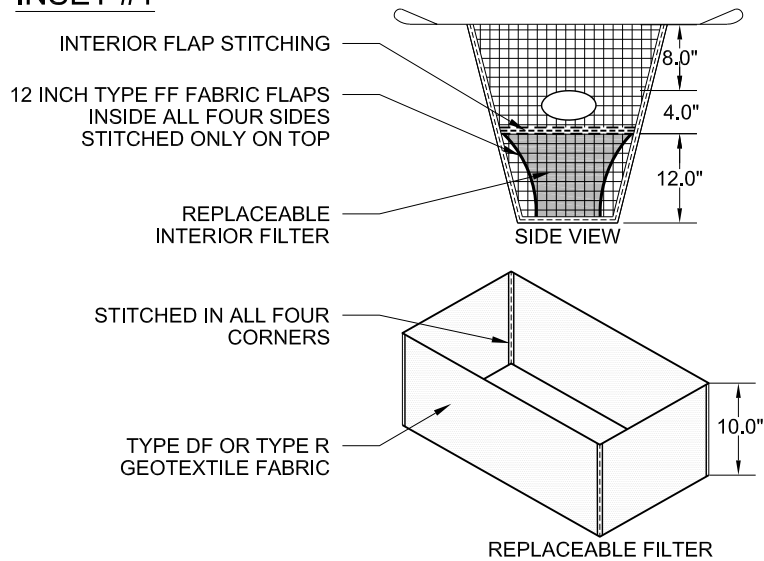
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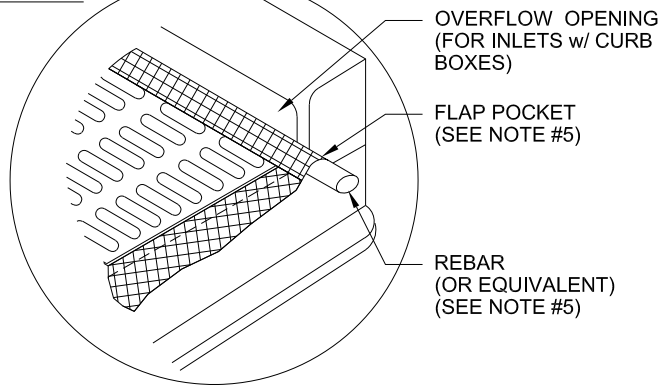
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FIGURE 3. INLET PROTECTION TYPE D-M

INSET #1



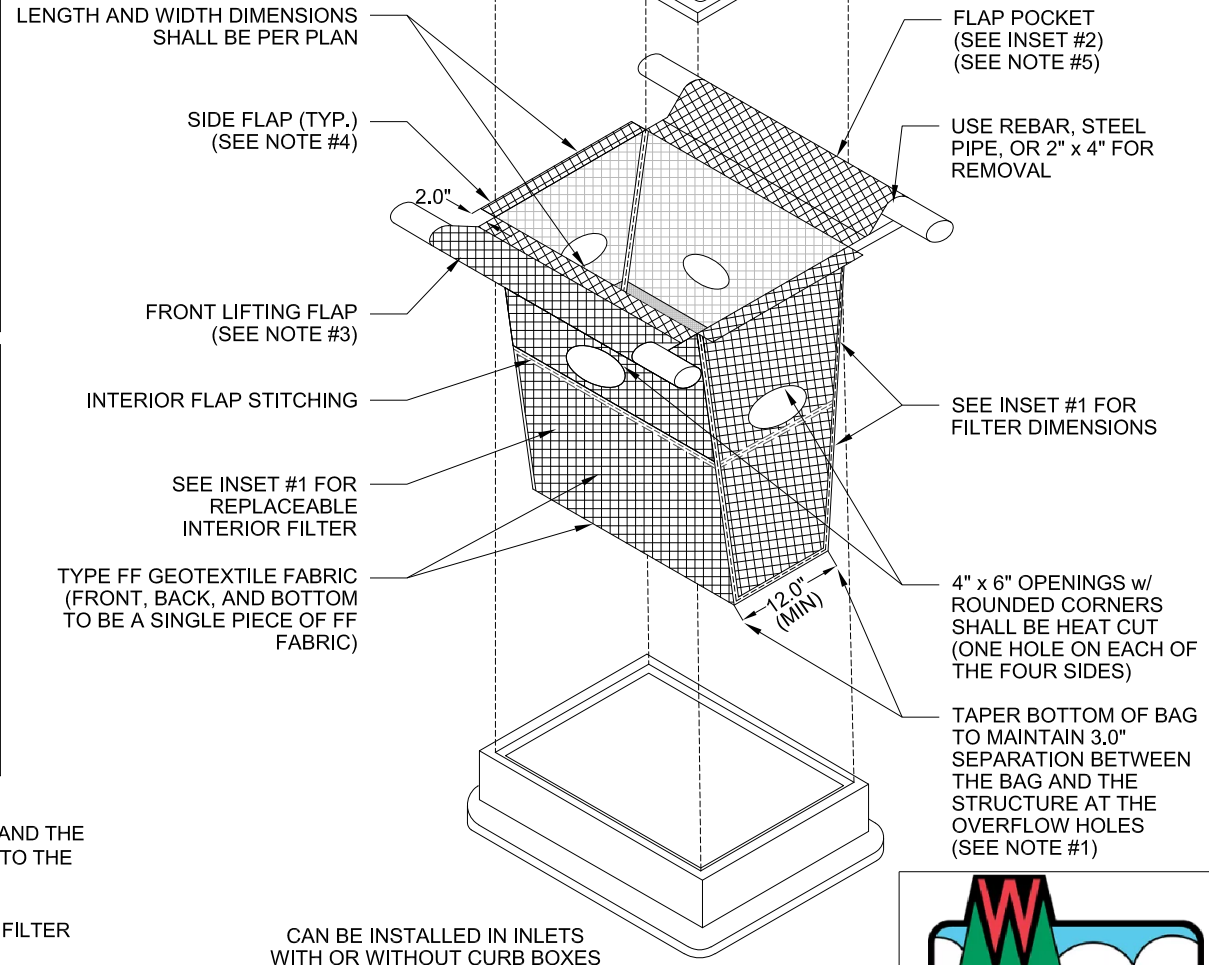
INSET #2



NOTES:

1. TAPER BOTTOM OF BAG TO MAINTAIN 3" OF CLEARANCE BETWEEN THE BAG AND THE STRUCTURE, MEASURED FROM THE BOTTOM OF THE OVERFLOW OPENINGS TO THE STRUCTURE WALL.
2. GEOTEXTILE FABRIC TYPE FF FOR FLAPS, TOP AND BOTTOM OF OUTSIDE OF FILTER BAG. FRONT, BACK, AND BOTTOM OF FILTER BAG BEING ONE PIECE.
3. FRONT LIFTING FLAP IS TO BE USED WHEN REMOVING AND MAINTAINING FILTER BAG.
4. SIDE FLAPS SHALL BE A MAXIMUM OF 2" LONG. FOLD THE FABRIC OVER AND REINFORCE WITH MULTIPLE STITCHES.
5. FLAP POCKETS SHALL BE LARGE ENOUGH TO ACCEPT WOOD 2" x 4". THE REBAR, STEEL PIPE, OR WOOD SHALL BE INSTALLED IN THE REAR FLAP AND SHALL NOT BLOCK THE TOP HALF OF THE CURB FACE OPENING.

LENGTH AND WIDTH DIMENSIONS SHALL BE PER PLAN



MAINTENANCE NOTES:

1. WHEN REMOVING OR MAINTAINING INLET PROTECTION, CARE SHALL BE TAKEN SO THAT THE SEDIMENT TRAPPED IN THE FABRIC DOES NOT FALL INTO THE STRUCTURE. MATERIAL THAT HAS FALLEN INTO THE STRUCTURE SHALL BE IMMEDIATELY REMOVED.



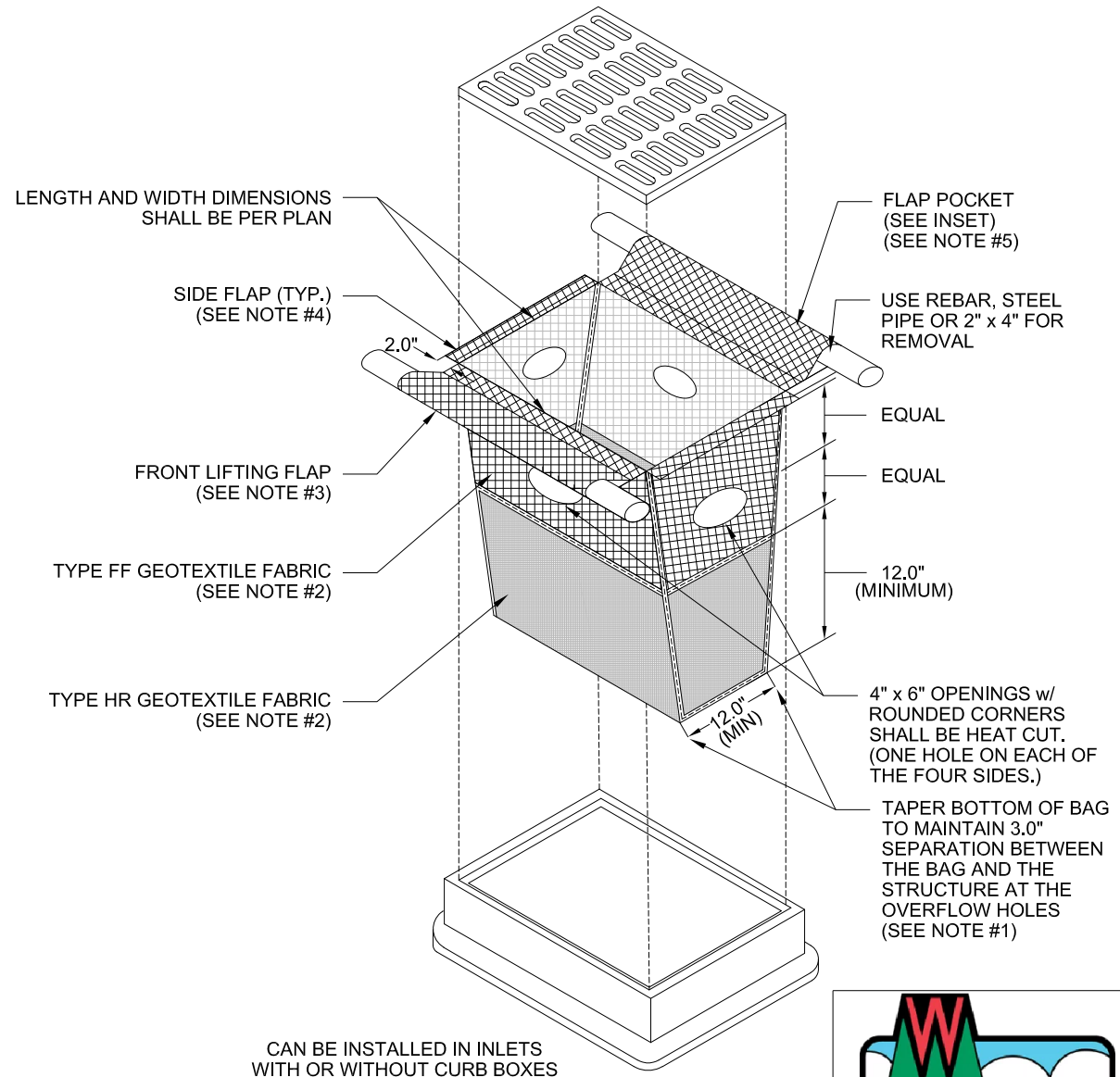
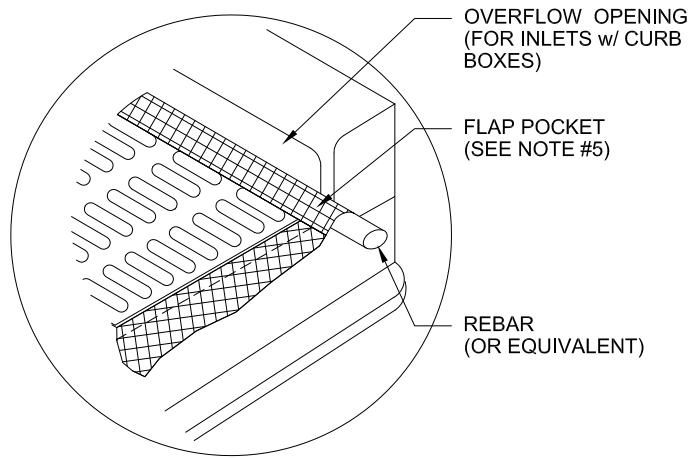
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FIGURE 4. INLET PROTECTION TYPE D-HR

INSET



NOTES:

1. TAPER BOTTOM OF BAG TO MAINTAIN 3" OF CLEARANCE BETWEEN THE BAG AND THE STRUCTURE, MEASURED FROM THE BOTTOM OF THE OVERFLOW OPENINGS TO THE STRUCTURE WALL.
2. GEOTEXTILE FABRIC, TYPE FF FOR FLAPS AND TOP HALF OF FILTER BAG. GEOTEXTILE FABRIC, TYPE HR FOR BOTTOM HALF OF FILTER BAG WITH FRONT, BACK, AND BOTTOM BEING ONE PIECE. DUAL FABRIC BAGS SHALL BE STITCHED TOGETHER
3. FRONT LIFTING FLAP IS TO BE USED WHEN REMOVING AND MAINTAINING FILTER BAG.
4. SIDE FLAPS SHALL BE A MAXIMUM OF 2" LONG. FOLD THE FABRIC OVER AND REINFORCE WITH MULTIPLE STITCHES.
5. FLAP POCKETS SHALL BE LARGE ENOUGH TO ACCEPT WOOD 2" x 4". THE REBAR, STEEL PIPE, OR WOOD SHALL BE INSTALLED IN THE REAR FLAP AND SHALL NOT BLOCK THE TOP HALF OF THE CURB FACE OPENING.

MAINTENANCE NOTES:

1. WHEN REMOVING OR MAINTAINING INLET PROTECTION, CARE SHALL BE TAKEN SO THAT THE SEDIMENT TRAPPED IN THE FABRIC DOES NOT FALL INTO THE STRUCTURE. MATERIAL THAT HAS FALLEN INTO THE STRUCTURE SHALL BE IMMEDIATELY REMOVED.



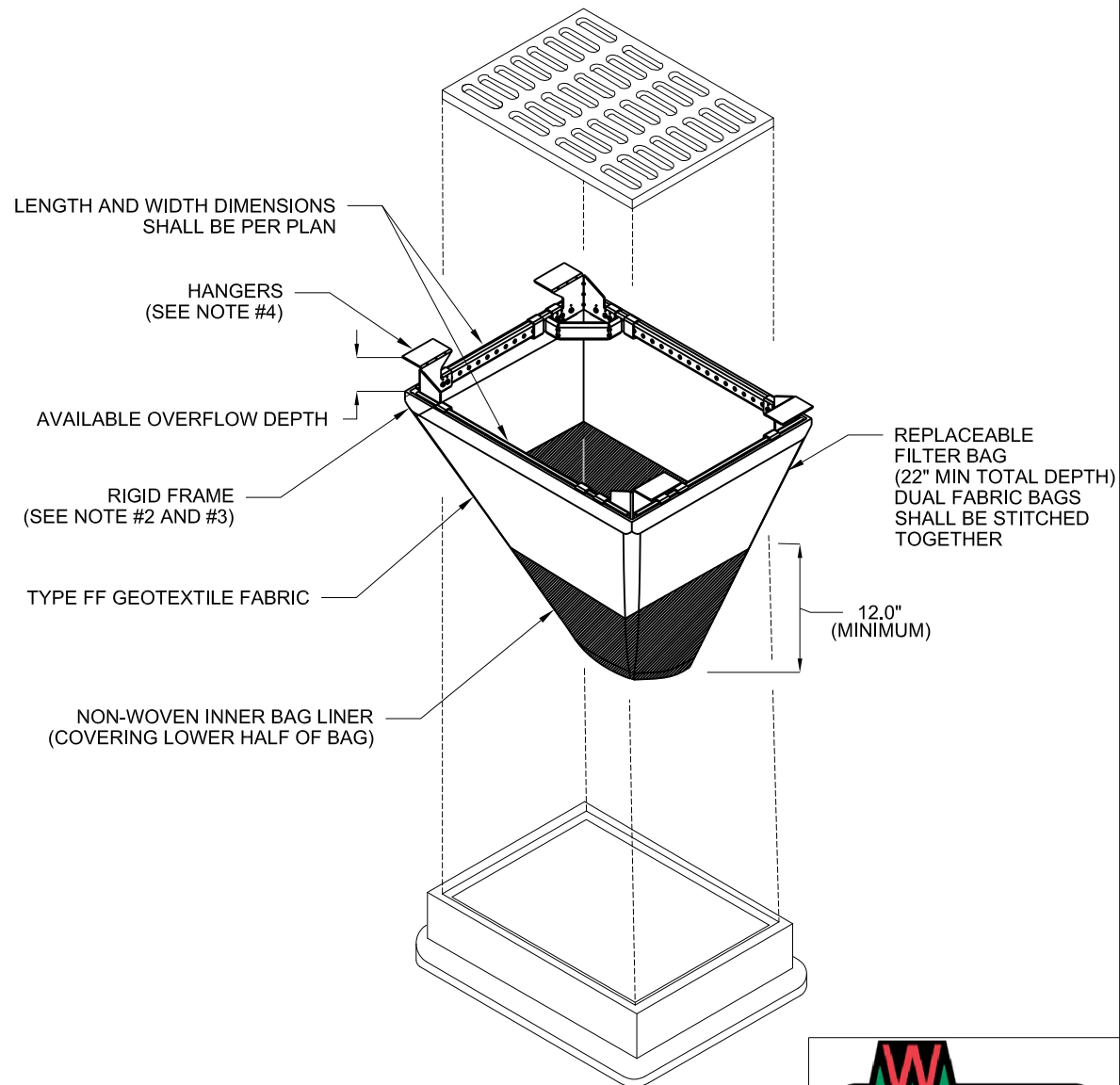
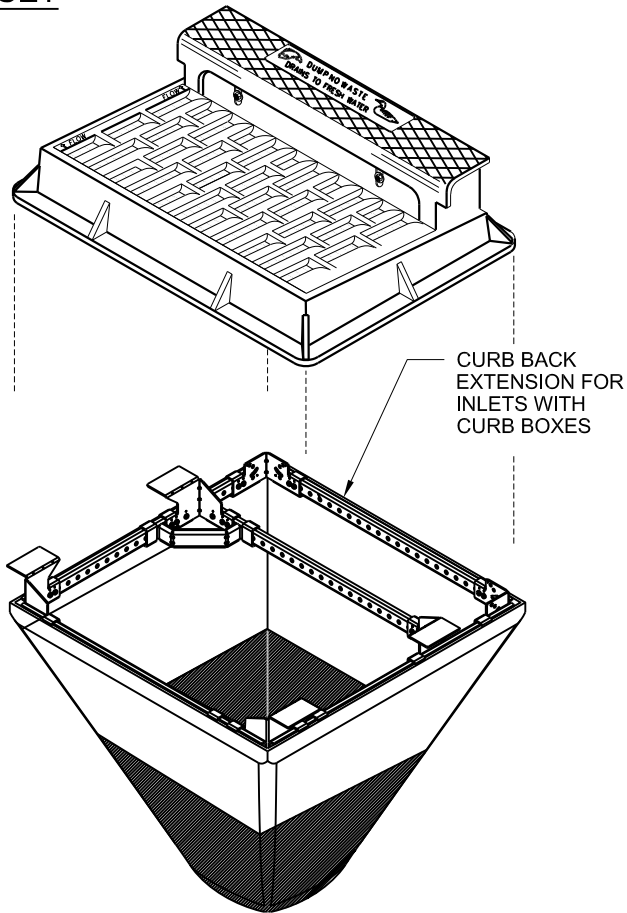
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FIGURE 5. INLET PROTECTION TYPE D-RF

INSET



NOTES:

1. TAPER BOTTOM OF BAG TO MAINTAIN 3" OF CLEARANCE BETWEEN THE BAG AND THE STRUCTURE, MEASURED FROM THE BOTTOM OF THE OVERFLOW OPENINGS TO THE STRUCTURE WALL.
2. THE RIGID FRAME SHALL BE CONSTRUCTED OF GALVANIZED STEEL AND HAVE ADEQUATE STRENGTH TO SUPPORT THE WEIGHT OF THE SEDIMENT BAG WHEN COMPLETELY FULL.
3. THE RIGID FRAME SHALL NOT INTERFERE WITH OR ELEVATE THE GRATE MORE THAN 1/8".
4. DROP THE INLET FILTER THROUGH THE CLEAR OPENING SUCH THAT THE HANGERS REST FIRMLY ON THE LIP OF THE STRUCTURE.

CAN BE INSTALLED IN INLETS
WITH OR WITHOUT CURB BOXES

MAINTENANCE NOTES:

1. WHEN REMOVING OR MAINTAINING INLET PROTECTION, CARE SHALL BE TAKEN SO THAT THE SEDIMENT TRAPPED IN THE FABRIC DOES NOT FALL INTO THE STRUCTURE. MATERIAL THAT HAS FALLEN INTO THE STRUCTURE SHALL BE IMMEDIATELY REMOVED.



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DEWATERING

Code No.
(1061)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A compartmented container, settling basin, filter, or other appropriate best management practice through which sediment-laden water is conveyed to trap and retain the sediment.

II. Purposes

The purpose of this standard is to determine appropriate methods and means to remove sediment from water generated during dewatering activities prior to discharging off-site or to waters of the state. Practices identified in this standard shall be deemed to meet the de-watering performance standard to prevent the discharge of sediment to the maximum extent practicable (MEP) as defined in NR 151.11(6)(c).

III. Conditions where Practice Applies

This practice applies where sediment laden water needs to be removed for construction or maintenance activities. Dewatering practices shall be in keeping with the effective operating and applicability criteria listed on Figure 2, Dewatering Practice Selection Matrix.

This practice does not apply to:

- Water being discharged directly to groundwater or *karst features*¹. Refer to NR140.
- Well dewatering systems. Refer to NR 812.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of this practice. This may include activities performed under NR 216 and Chapter 30 permits, for water bodies with *targeted performance standards* per NR 151.004, 303d waterbodies or others. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum allowable limits for design parameters, installation and performance requirements.

Dewatering practices shall be selected based on the predominant soil texture encountered at the dewatering site with consideration given to pumping or flow rates, volumes and device effectiveness. Refer to Figure 1 USDA Soil textural triangle to assist with soil classifications at the site. Figure 2, Dewatering Practice Selection Matrix illustrates acceptable dewatering options and their effective ranges. Practices selected that are not on the matrix must provide an equivalent level of control, with justification provided to the reviewing authority.

A. Site Assessment - A site assessment shall be conducted and documented to determine the physical site characteristics that will affect the placement, design, construction and maintenance of dewatering activities. The site assessment shall identify characteristics such as ground slopes, soil types, soil conditions, bedrock, sinkholes, drainage patterns, runoff constituents, proximity to regulated structures, natural resources, and specific land uses. The site assessment shall include the following:

- Sanitary and storm sewer locations
- Potential contamination - Odor or discoloration other than sediment, or an oily sheen on the surface of the sediment laden water. If contamination is present, notify DNR Spills Reporting
- Soil textural class for areas where dewatering will occur. Soil investigation shall extend below grading and trenching activities
- Depth to the seasonally highest water table.
- Discharge outfall locations
- Distance and conveyance method to receiving waters

¹ Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

B. General Criteria applicable to all dewatering activities

1. Contact the WDNR when the discharge from a dewatering practice will enter a WDNR listed *Exceptional Resource Water (ERW)*, *Outstanding Resource Water (ORW)*, or a wetland in an area of special natural resource interest as identified in NR 103.
2. Contact the owner or operator of the municipal separate stormwater system if the discharge is to a municipal storm water conveyance system. The allowable discharge rate shall be limited by the capacity of the system or requirements of the system owner.
3. When practical, dewatering effluent shall be collected in a pump truck for transport to a *treatment facility* or discharged directly to a treatment facility.
4. For surface dewatering, utilize a floating suction hose, or other method, to minimize sediment being sucked off the bottom.
5. For discharges that will be directed to locations on-site verify that the anticipated volume of water can be fully contained.
6. The topography and condition of the ground cover between the pump discharge point and potential receiving waters shall be evaluated for potential erosion. Appropriate stabilization measures shall be incorporated to prevent erosion.
7. When discharge to a karst feature or other direct groundwater connection can not be avoided, the dewatering system must be designed and operated to maintain compliance with the groundwater quality standards contained in applicable regulations, including ch. NR 140 Wis. Adm. Code.
8. If the discharge directly or indirectly enters a stream, the discharge flow rate shall not exceed 50 percent of the peak flow rate of the 2-year 24-hour storm event.

C. Geotextile Bags

1. Geotextile bags shall meet the criteria listed in Table 1.

Table 1: Properties for Geotextile Bags

Property	Test Method	Type I Value	Type II Value
Maximum Apparent Opening Sizes	ASTM D-4751	0.212 mm	0.212 mm
Grab Tensile Strength	ASTM D-4632	200 lbs.	300 lbs.
Mullen Burst	ASTM D-3786	350 psi	580 psi
Permeability	ASTM D-4491	0.28 cm/sec	0.2 cm/sec
Fabric	Nominal Representative Weight	8 oz	12 oz

2. Geotextile bags shall be sized according to the particle size being trapped, expected flow or pumping rate (gallons per minute) per square foot of fabric and a 50% clogging factor. The footprint of the bag shall be no smaller than 100 square feet.
3. Geotextile bags shall be securely attached to the discharge pipe.
4. Polymers can be used to enhance the efficiency of geotextile bags. If polymer is used, the polymer shall be approved by the WDNR and meet the criteria stipulated in WDNR Conservation Practice Standard 1051, Sediment Control Water Application of Polymers. The polymer supplier or applicator shall provide certifications showing that products have met the performance requirements of Standard 1051. If the manufacturer has not completed the required testing, the project may be used to gain that certification provided it meets the site requirements of Standard 1051. Any such testing will be monitored by DNR or WisDOT, with testing done by a qualified third party.

D. Gravity Based Settling Systems

Gravity based systems rely on settling of particles as the primary means of treatment. To effectively accomplish this, quiescent conditions should exist with sufficient detention time. Practices include portable sediment tanks, sediment traps, sediment basins and wet detention basins.

If polymer is used to enhance settling, the polymer shall be approved by the WDNR and meet the criteria stipulated in WDNR Conservation Practice Standard 1051, Sediment Control Water Application of Polymers. The polymer supplier or applicator shall provide certifications showing that products have met the performance requirements of Standard 1051. If the manufacturer has not completed the required testing, the project may be used to gain that certification provided it meets the site requirements of Standard 1051. Any such testing will be monitored by DNR or WisDOT, with testing done by a qualified third party.

1. Portable Sediment Tank: These tanks are intended to settle only sands, loamy sands, and sandy loams. If polymer is added, these tanks will also be appropriate for settling loams, silt loams and silts. Portable sediment tanks shall have a minimum of two baffled compartments, and be a minimum of three feet deep. The inlet and outlet pipe shall be a minimum diameter of three inches. Use one of the following methods to size a tank:

- a. Settling: Account for settling of the suspended sediments with the following equation:

$$S_a = 1.83 * Q;$$

where

S_a = Tank surface area (sq ft)

Q = Pumping rate (gallons per minute)

Note: 1.83 is a factor that includes the conversion from gpm to cfs (1 gpm = 0.0022 cfs) and the particle settling velocity for Soil Class 1 (0.0012 ft/sec) from WDNR Conservation Practice Standard 1064 Sediment Basin.

- b. Filtration: Build the first chamber as large as possible to aid in settling. Flow capacity shall be determined by the end area of the filter media (fabric) and the flow rate (gallons per minute) per square foot of the finest filter media and a 50% clogging factor.
2. Sediment Trap or Sediment Basin: This device is a temporary sediment control device. The design, installation, and operation of the sediment trap or basin shall

meet the requirements stipulated in WDNR Conservation Practice Standard 1063 Sediment Trap or Standard 1064 Sediment Basin

3. Wet Detention Basin: This device is generally a permanent structure designed to address post-construction pollutant reduction requirements. The design, installation, and operation of the wet detention basin shall meet the requirements stipulated in WDNR Conservation Practice Standard 1001 Wet Detention Basin.

E. Passive Filtration Systems

Passive filtration systems rely on filtration as the primary method of removing particles. Sediment removal efficiency will be related to the particle size distribution in the stormwater. Practices include manufactured filters, filter tanks, filter basins, vegetative filters, grass swales, and filtration fabric.

Filter fabric sediment removal efficiency shall be based on the properties specified in Table 1.

1. Manufactured Filters: Filters shall be sequenced from the largest to the smallest pore opening. Sand media filters are available with automatic backwashing features that can filter to 50 µm particle size. Screen or bag filters can filter down to 5 µm. Fiber wound filters can remove particles down to 0.5 µm.
2. Filter Tank (portable): Install, operate and maintain according to manufacturer recommendations.
3. Filter Basin: Install, operate and maintain according to Wisconsin Department of Transportation technical guidance.
4. Vegetative Filter: Refer to WDNR Conservation Practice Standard 1054 Vegetated Buffer for Construction Sites.

F. Pressurize Filtration Systems

Pressurized filtration systems differ from passive systems in that the water flowing through the media is pressurized and the filter media is designed to handle higher flow rates. Practices include portable sand filters, wound cartridge units, membranes and micro-filtration units.

Pressurized filters typically have automatic backwash systems that are triggered by a pre-set pressure drop across the filter. If the backwash water volume is small or substantially more turbid than the stormwater stored in the holding pond or tank, returning backwash water to the pond or tank may be appropriate. However, land application or another means of treatment and disposal may be necessary.

Screen, bag, and fiber filters must be cleaned and/or replaced when they become clogged.

1. Portable Sand Filter: Install, operate and maintain according to manufacturer recommendations.
2. Wound Cartridge Units: Secondary filtration of sediments using high efficiency filter cartridges may be necessary to remove fine particles such as clays. Install, operate and maintain according to manufacturer recommendations.
3. Membranes and Micro-filtration: Install, operate and maintain according to manufacturer recommendations.
4. If polymer is used to enhance settling, the polymer shall be approved by the WDNR and meet the criteria stipulated in WDNR Conservation Practice Standard 1051, Sediment Control Water Application of Polymers. The polymer supplier or applicator shall provide certifications showing that products have met the performance requirements of Standard 1051. If the manufacturer has not completed the required testing, the project may be used to gain that certification provided it meets the site requirements of Standard 1051. Any such testing will be monitored by DNR or WisDOT, with testing done by a qualified third party.

VI. Considerations

- A. It may be necessary to clean the municipal storm drainage system prior to and after discharging to the system to prevent scouring solids from the drainage system.
- B. Geotextile bags are generally not appropriate when discharging to ORW, ERW, waterbodies supporting cold water communities, trout

streams, or to *highly susceptible* and *less susceptible wetlands*.

- C. Pressurized filtration systems are the most efficient for removing fine sediments.
- D. Portable sediment tanks may be appropriate when other sediment trapping practices cannot be installed due to lack of space or other reasons.
- E. Filtration is not an efficient treatment of water with heavy sediment loads. Use a settling tank or sand filter as pretreatment when possible.
- F. It may be necessary to use a combination of dewatering practices to achieve the intended results.

VII. Plans and Specifications

All plans, standard detail drawings, or specifications shall include the schedule for installation, inspection, and maintenance and shall be kept on-site with the erosion control plan.

VIII. Operation and Maintenance

- A. Sediment shall be removed from devices to maintain effectiveness. All sediment collected in dewatering devices shall be properly disposed of to prevent discharge to waters of the state.
- B. The following monitoring shall be conducted. Test results shall be recorded on a daily log kept on site:
 1. Discharge duration and specified pumping rate
 2. Observed water table at time of dewatering.
 3. If used, type and amount of chemical used for pH adjustment
 4. If used, type and amount of polymer used for treatment
 5. Maintenance activities

IX. References

The American Association of State Highway Officials (AASHTO) Soil Classification System

X. Definitions

Exceptional Resource Waters (ERW) (V.B.1): are waters listed in s. NR 102.11.

Highly susceptible wetland (VI.B): include the following types: fens, sedge meadows, bogs, low prairies, conifer swamps, shrub swamps, other forested wetlands, fresh wet meadows, shallow marshes, deep marshes and seasonally flooded basins.

Karst feature (III): are an area or geologic feature subject to bedrock dissolution so that it is likely to provide a conduit to groundwater, and may include caves, enlarged fractures, mine features, exposed bedrock surfaces, sinkholes, springs, seeps or swallets.

Less susceptible wetland (VI.B): include degraded wetlands dominated by invasive species such as reed canary grass.

Outstanding Resource Waters (ORW) (V.B.1): are waters listed in s. NR 102.10

Targeted performance standard (IV): means a performance standard that will apply in a specific area, where additional practices beyond those contained in NR 151 are necessary to meet water quality standards.

Treatment facility (V.B.3): includes wastewater treatment plants or wet detention basins constructed in accordance with WDNR Conservation Practice Standard 1001 Wet Detention Basin or other approved land application sites.

Figure 1: USDA Soil Textural Triangle

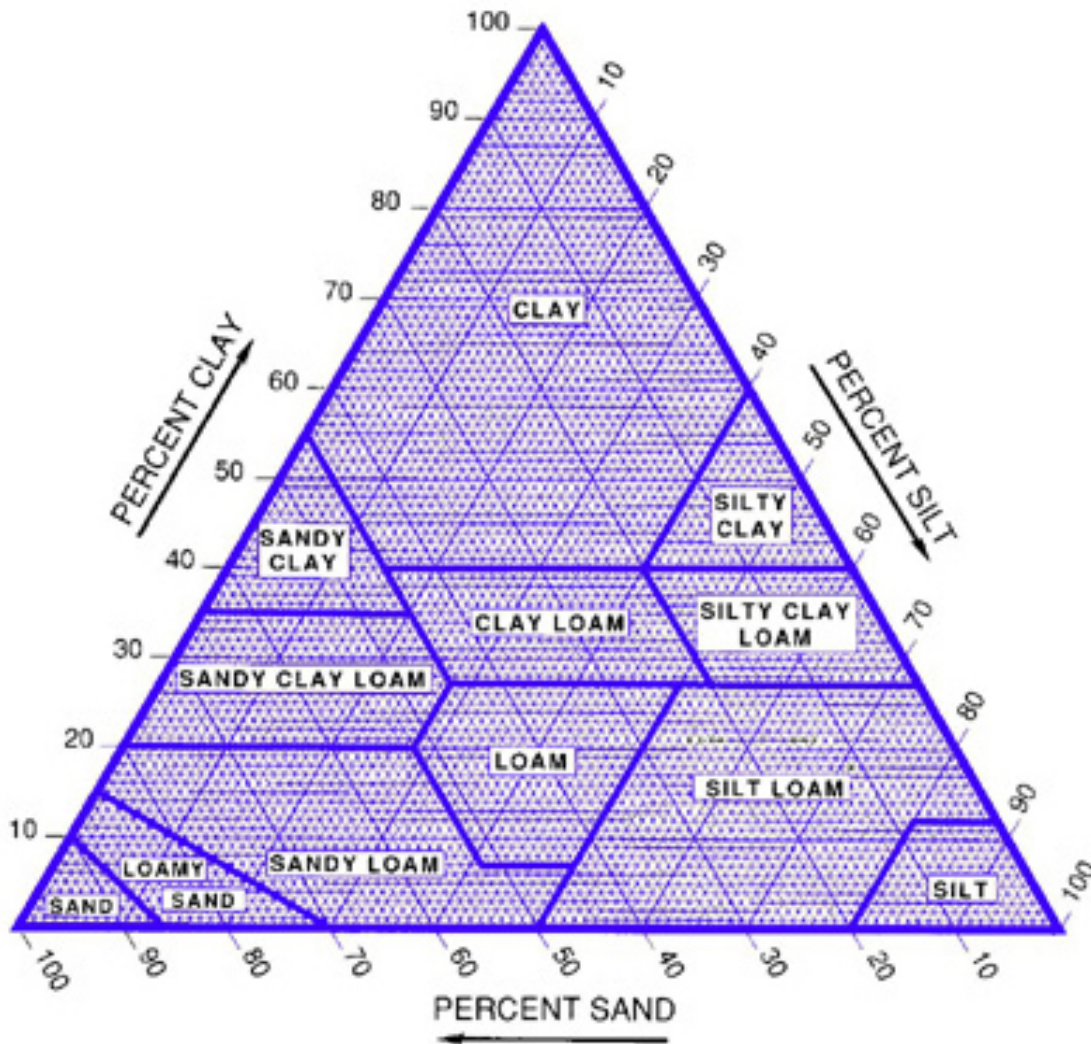







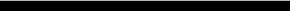










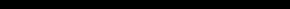
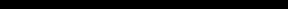
























Figure 2: Dewatering Practice Selection Matrix

Type of Dewatering Practice	Soil and Particle Size Classification			Notes
	Coarse to Medium Particles	Medium to Fine Particles	Fine to Very Fine Particles	
	Sand, Loamy Sands, and Sandy Loams	Loams, Silt Loams, and Silts	Clay Loams, Silty Clays and Clay	
Geotextile Bags				
Type I				
Type II				
Gravity Based Settling				
Sediment Tank (Portable)				
Sediment Trap (Temporary)				Use Standard 1063 Sediment Trap
Sediment Basin (Temporary)				Use Standard 1064 Sediment Basin
Wet Detention Basin (Perm)				Use Standard 1001 Wet Detention Basin
Passive Filtration				
Filter Tank (Portable)				Use according to manufacturer's recommendations
Filter Basin				See WisDOT Standard Specifications
Vegetative Filter	 	 	 	Effectiveness depends upon the width of the filter and the runoff rate of flow. See Standard 1054 for design guidelines.
Pressurized Filtration				
Portable Sand Filter				The contractor shall provide a certification sheet from the manufacturer specifying performance of the device based on soil type and pumping rate.
Wound Cartridge Units				
Membranes & Micro-filtration				Very effective but high maintenance requirements
Other Practices				
Sanitary Sewer Discharge				
Pump Truck				Transported to treatment facility
Alternative Method				Discuss with regulatory authority

Key:

Effective range of device:

Device applicable but may not be cost effective:

Effective range with addition of polymer: ● ● ● ● ● ● ● ●

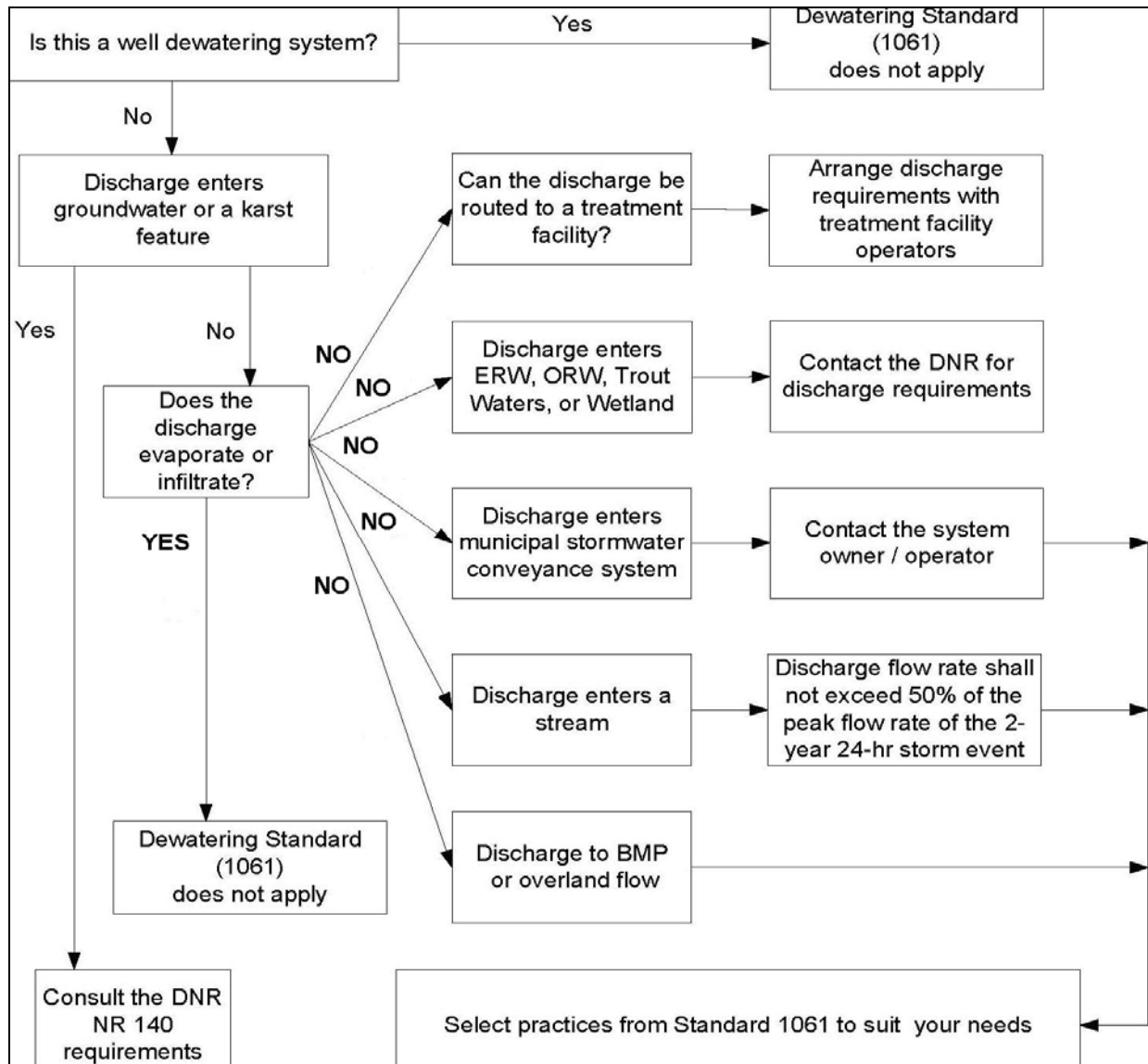
Notes:

(1) The effectiveness of many practices can be enhanced through the use of polymer mixture.

(2) Soil classification shall be done in accordance to an accepted method (i.e. USDA, AASHTO)

¹ Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

**Figure 3: Factors Influencing
The Selection of Dewatering Practices**



If the dewatering effluent is discolored, has an odor, an oily sheen,
or other toxins are present notify the DNR immediately
24 Hours Spills Reporting Hotline 1-800-943-0003

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
TECHNICAL STANDARD
DITCH CHECK
1062

DEFINITION

A ditch check is a temporary dam constructed across a swale, drainage ditch, channel, or other area of concentrated flow to reduce the velocity of water. Ditch checks are constructed using stone, straw bales or manufactured products identified on the Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL).

PURPOSE

The purpose of this practice is to reduce flow velocity and to pond water, thereby reducing active channel erosion and promoting settling of suspended solids behind the ditch check.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies where grading activity occurs in areas of channelized flows and a temporary measure is needed to control erosion and sediment transport until permanent stabilization practices can be applied. For contributing drainage areas less than one acre, ditch checks can be used as construction site sediment control practices. For drainage areas of one acre or more, a sediment trap or basin may be installed for construction site sediment control in accordance with WDNR Technical Standard 1063 Sediment Trap or 1064 Sediment Basin.

Do not place ditch checks in an intermittent or perennial stream under any circumstances without permission from WDNR. Do not use ditch checks as a substitute for major construction site sediment control practices such as sediment basins.

Materials and installation for ditch checks used on WisDOT projects are subject to the requirements of the WisDOT Standard Specifications and the WisDOT Erosion Control PAL/User Guide.

CRITERIA

This section establishes the minimum standards for design, installation and performance requirements.

General Criteria

Laws and Regulations. Be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of ditch checks. This standard does not contain the text of federal, state, or local laws.

Design Parameters.

Design and install all ditch checks to have a minimum height of 10 inches after installation.

Place ditch checks such that the resultant ponding will not adversely impact or damage adjacent areas.

Design and install ditch checks to be capable of withstanding the anticipated flow, volume and velocity.

Use ditch checks during rough grading and remove ditch checks once final grading and stabilization is applied, unless intended as permanent storm water management features.

Do not use either silt fence or single rows of straw bales as ditch checks.

Do not use steel posts or rods to stake ditch checks as they are potential safety hazards for ATVs, snowmobiles and bicycles.

Channel Applications

Use the following equation to calculate the spacing of ditch checks in channels:

$$L = H / S$$

Where:

L = distance between ditch checks, in feet

H = height of the ditch check measured from ditch check overflow invert to channel bottom on the downslope side of ditch check, in feet

S = longitudinal slope of the channel in decimal form (e.g., 2% = 2'/100' = 0.02)

Place ditch checks perpendicular to the flow line of the ditch and extend up the slope such that the bottoms of the ends are at least 6 inches higher in elevation than the top of the lowest middle section to assure that runoff will flow through or over the check, or both. If this is not done, flows are forced to the edge of the ditch check causing scour around the sides of the ditch check.

Design ditch checks to fit the channel cross-section to allow for proper installation and prevent washout from occurring. If the ditch check cannot be designed to fit the cross-section of the channel, use a different control measure.

Ditch Check Sediment Traps

It is acceptable to use a ditch check as a construction site sediment control practice when the contributing drainage area to the check is less than one acre.

It is acceptable to use ditch checks at low points in a silt fence line in cases where low points are unavoidable (see Figure 1).

Stone Ditch Checks (See Figure 2)

Design and install stone ditch checks to have a minimum top width of 2 feet measured in the direction of flow with a maximum slope of 2:1 (2 horizontal to 1 vertical) on the upslope and downslope sides.

It is acceptable to use any of the following stone specifications:

- (1) Well-graded angular stone with a D_{50}^1 of 3 inches or greater with no more than 5% passing the #4 sieve.
- (2) 1-foot layer of 1-inch (#2) washed stone over 3 to 6-inch clear stone.
- (3) Angular stone meeting the gradation for WisDOT specification 312 select crush or local equivalent.

It is acceptable to construct stone ditch checks using bags or socks filled with stone.

Straw Bale Ditch Checks (See Figure 3)

Install straw bale ditch checks using two rows of bales per check with bales on their sides so the twine wrapped around the bale is off the ground. Stagger the joints between adjacent rows of bales.

Anchor each straw bale using two wooden stakes. Stake the bales tightly against one another. Drive the stakes flush with the top of the bale when soil conditions permit.

Embed or entrench each straw bale 4 inches deep.

¹ The particle size for which 50% of the material by weight is smaller than that size.

Design and install straw bales such that the bottom elevation of the end straw bales are a minimum of 6 inches higher than the top of the lowest middle straw bale.

When installed on bare soils, place channel erosion mat or other non-erodible materials on the downstream side of a straw bale ditch check, and extended a minimum of 6 feet to prevent scour and washing out the toe of the ditch check. WDNR Technical Standard 1053 Channel Erosion Mat contains criteria for the placement of erosion mat in this location.

Manufactured Ditch Checks

For manufactured ditch check products, use those identified on the WisDOT PAL.

Manufactured ditch check materials shall be installed in accordance with the manufacturer-supplied methods used in prequalification testing for listing on the WisDOT PAL.

CONSIDERATIONS

- (1) To enhance sediment control, consider using temporary sumps located on the upstream side of a ditch check.
- (2) For added stability, key the base of a stone or rock ditch check into the soil to a depth of 6 inches.
- (3) It is acceptable to underlay stone ditch checks with a nonwoven geotextile fabric to ease ditch check installation and removal.
- (4) Ditch checks installed in grass-lined channels may kill the vegetation if water is ponded for extended periods or excessive siltation occurs. Proper maintenance is required to keep areas above and below the ditch check stabilized.
- (5) The best way to prevent sediment from entering the storm sewer system is to stabilize the disturbed area of the site as quickly as possible, preventing erosion and stopping sediment transport at its source.
- (6) When placing ditch checks in swales adjacent to roadways consider designating a 'clear zone' free of obstacles posing a threat to out of control vehicles.
- (7) Mowing operations may throw stones from ditch checks causing a potential safety hazard.
- (8) Failure of straw bale ditch checks due to improper installation is commonly reported. Consider alternatives to straw bale ditch checks in locations where proper installation will be difficult.
- (9) The various types of ditch checks function in different ways. Some ditch checks act as virtually impermeable dams and others allow flow to pass through. How a ditch check will function should be considered when selecting a type of ditch check that is appropriate for site specific conditions.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use.

OPERATION AND MAINTENANCE

Inspect ditch checks at a minimum weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.

Unless incorporated into a permanent storm water management system, remove ditch checks once the final grading and channel stabilization is applied.

Remove sediment deposits when deposits reach half the height of the ditch check. Removal of sediment may require replacement of stone. Complete maintenance as soon as possible with consideration to site conditions.

REFERENCES

WisDOT, Erosion Control Product Acceptability List, <https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrcs/tools/pal/default.aspx>

Figure 1:
Silt Fence Relief

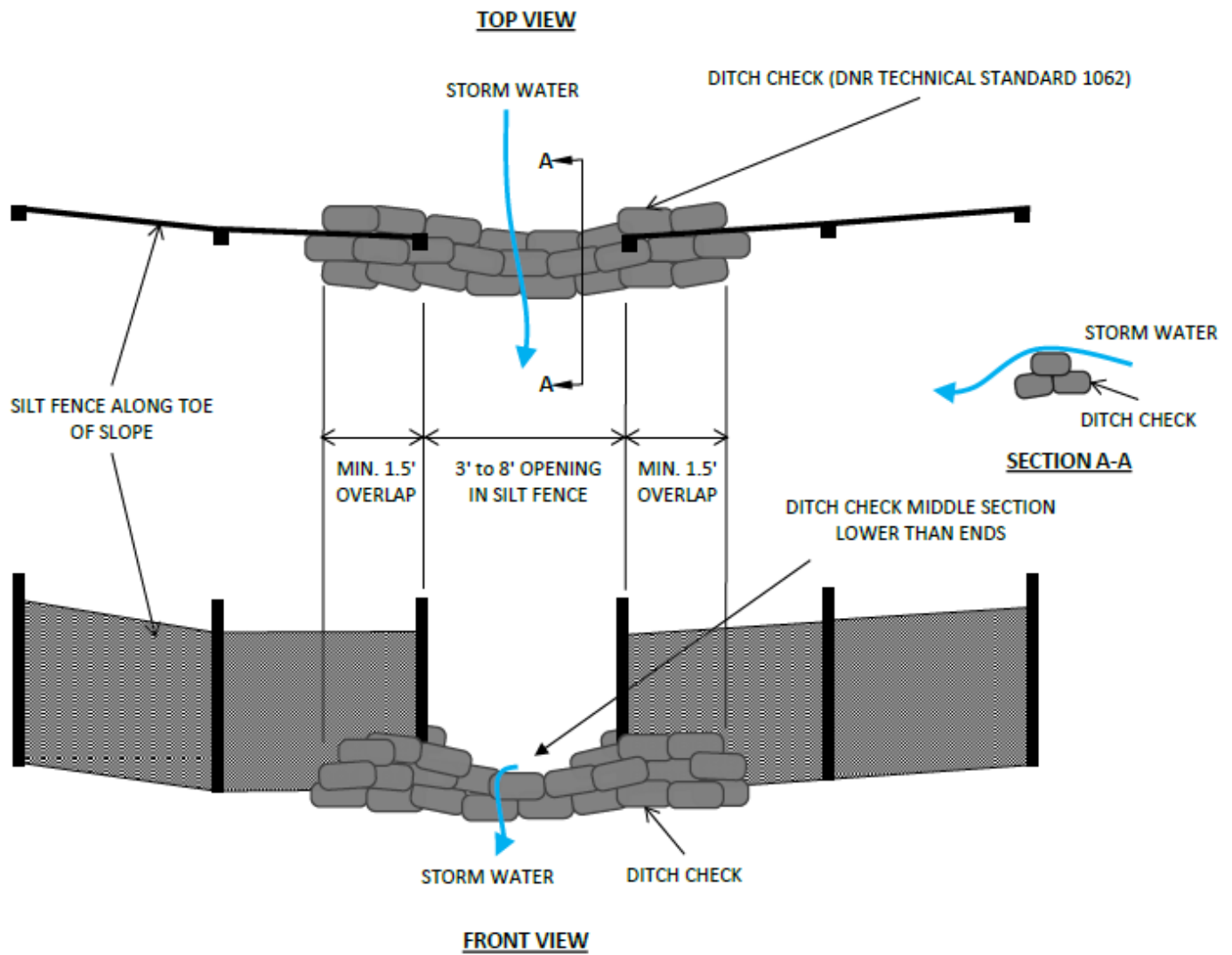
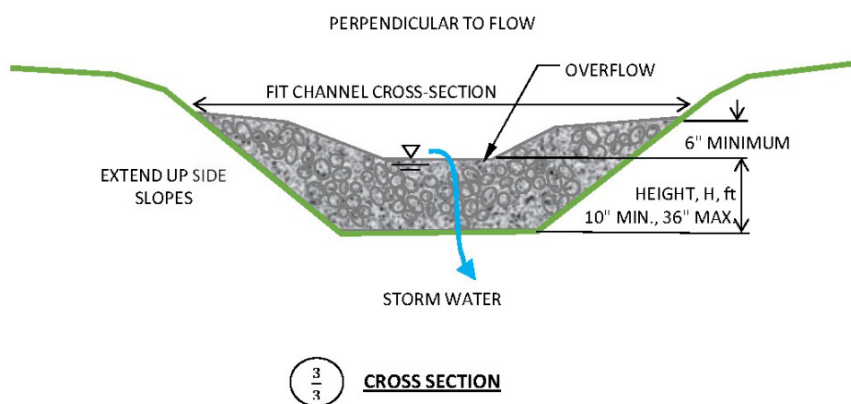
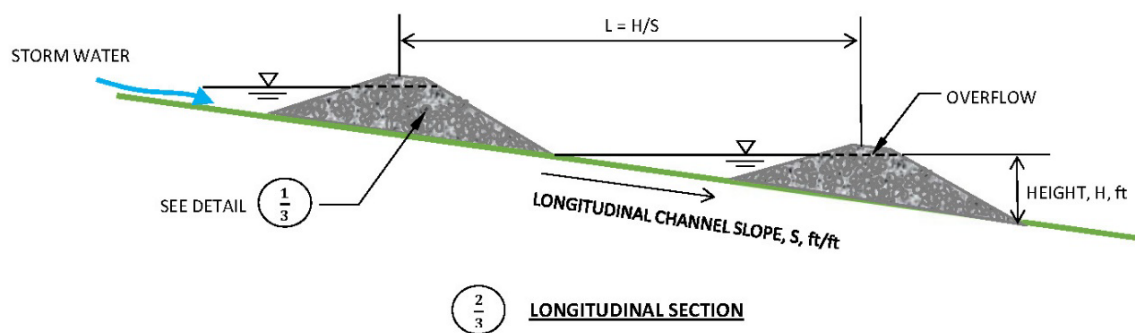
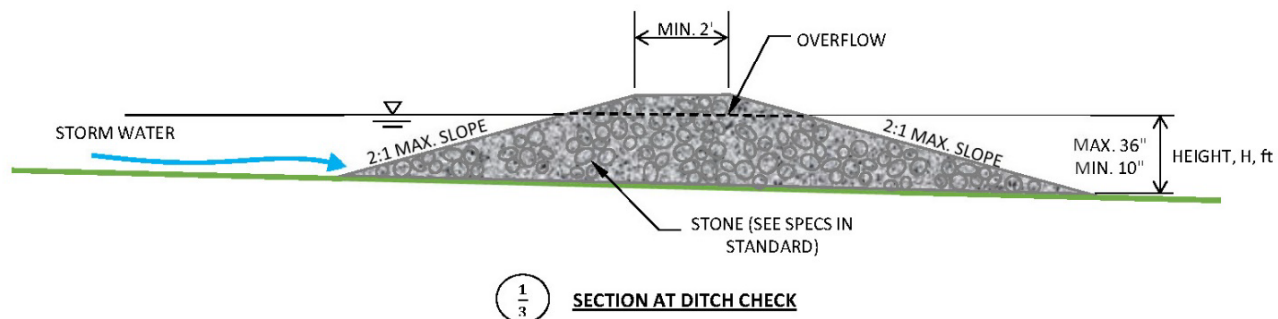
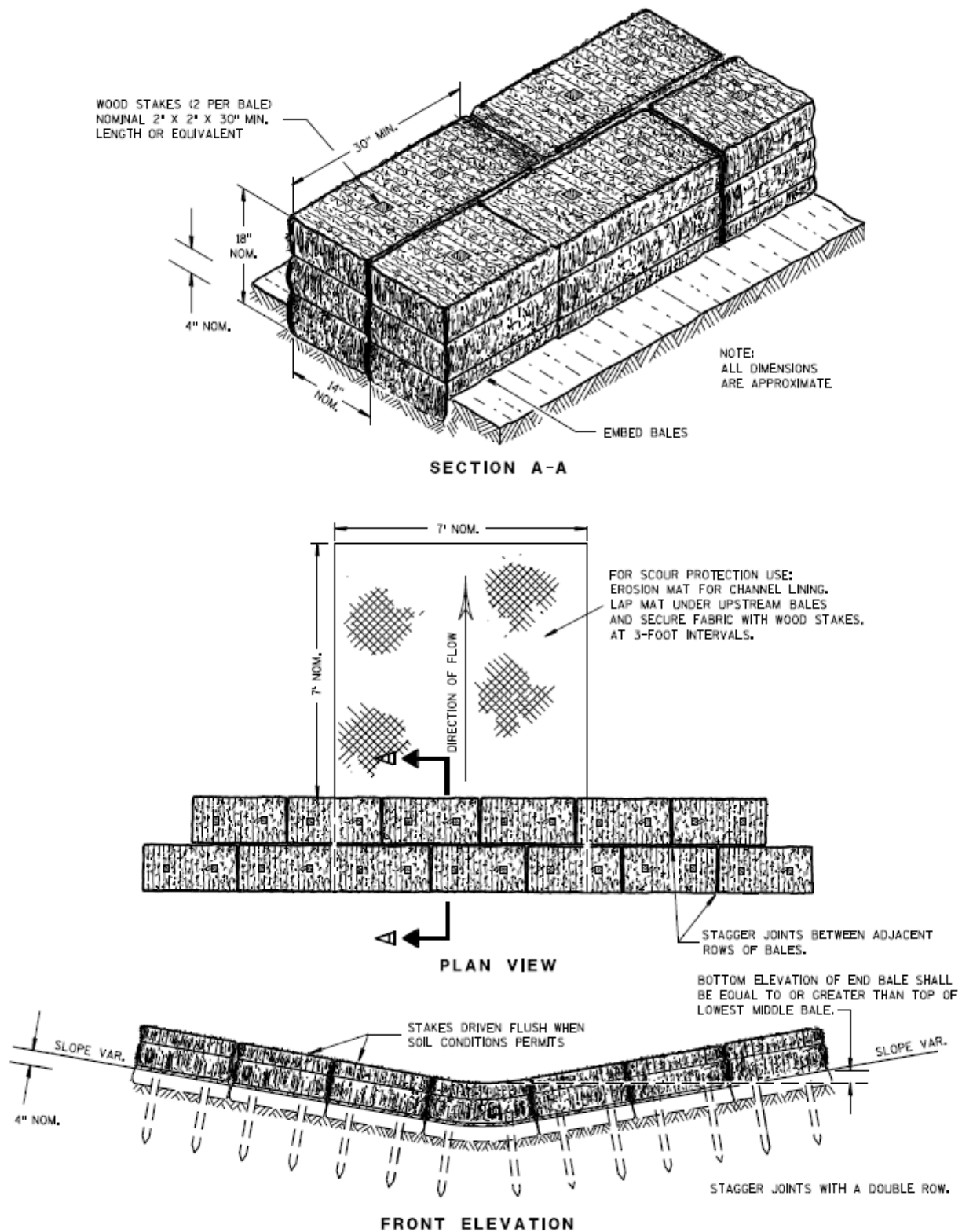


Figure 2:
Stone Ditch Checks



WDNR
2019

Figure 3:
Straw Bale Ditch Check



Sediment Trap

(1063)

Wisconsin Department of Natural Resources
Technical Standard

I. Definition

A *temporary*¹ sediment control device formed by excavation and/or embankment to intercept sediment-laden runoff and to retain the sediment.

II. Purposes

To detain sediment-laden runoff from disturbed areas for sufficient time to allow the majority of the sediment to settle out.

III. Conditions Where Practice Applies

Sediment traps are utilized in areas of concentrated flow or points of discharge during construction activities. Sediment traps shall be constructed at locations accessible for clean out. Sediment traps are designed to be in place until the contributory drainage area has been *stabilized*.

The contributory drainage area shall be a maximum of five acres. For concentrated flow areas smaller than one acre, ditch checks may be installed; refer to WDNR Technical Standard Ditch Check (1062).

For larger drainage areas and/or for sediment basins requiring an engineered outlet structure refer to WDNR Technical Standard Sediment Basin (1064) or Wet Detention Basin (1001).

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of sediment traps. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. **Timing** – Sediment traps shall be constructed prior to disturbance of up-slope areas and placed so they function during all phases of construction. Sediment traps shall be placed in locations where runoff from disturbed areas can be diverted into the traps.

B. **Sizing Criteria** – Properly sized sediment traps are relatively effective at trapping medium and coarse-grained particles. To effectively trap fine-grained particles, the sediment trap must employ a large surface area or polymers.

The specific trapping efficiency of a sediment trap varies based on the surface area, depth of dead storage, and the particle size distribution and concentration of sediment entering the device.

1. **Surface Area** – The minimum surface area of a sediment trap shall be based on the dominant textural class of the soil entering the device. The surface area calculated below represents the surface for the permanent pool area (if wet) or the surface area for the dead storage. This surface area is measured at the invert of the stone outlet (see Figure 1).

a. For coarse textured soils (loamy sand, sandy loam, and sand):

$$A_{s \text{ (coarse)}} = 625 * A_{dr}$$

¹ Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

- b. For medium textured soils (loams, silt loams, and silt):

$$A_{s(\text{medium})} = 1560 * A_{dr}$$

- c. For fine textured soils (sandy clay, silty clay, silty clay loam, clay loam, and clay):

$$A_{s(\text{fine})} = 5300 * A_{dr}$$

For the equations above:

A_s = surface area of storage volume in square feet

A_{dr} = contributory drainage area in acres

Note: The equations above were derived using a representative particle distribution for detached sediment for each textural class. Sediment traps designed based on this standard will achieve 80% reduction of suspended solids for the drainage area.

- d. The surface area of sediment traps used in areas with fine to medium sized soils can be reduced when used in conjunction with water applied polymers. When employing polymers, size the surface area for controlling fine particles using the criteria for medium soils (V.B.1.b.) and when controlling medium sized particles use the sizing equation contained in (V.B.1.a.) for coarse soils. See WDNR Technical Standard Sediment Control Water Application of Polymers (1051) for criteria governing the proper use and selection of polymers.
2. Depth – The depth of the sediment trap measured from the sediment trap bottom to the invert of the stone outlet, shall be at least three feet to minimize re-suspension and provide storage for sediment.
3. Shape – The sediment trap shall have a length to width ratio of at least 2:1. The position of the outlet to the inlet shall be as such to minimize short-circuiting of the water flow path.

4. Side Slopes – Side slopes shall be no steeper than 2:1.

Note: A sediment trap sized with the surface area equations above, a three-foot depth, and 2:1 side slopes will generally result in an 80% sediment reduction. Slopes flatter than 2:1 will require larger surface areas to provide adequate storage.

- C. **Embankment** – Embankments of temporary sediment traps shall not exceed five feet in height measured from the downstream toe of the embankment to the top of the embankment. Construct embankments with a minimum top width of four feet, and side slopes of 2:1 or flatter. Earthen embankments shall be compacted.

Where sediment traps are employed as a perimeter control, the embankments shall have stabilization practices place prior to receiving runoff.

- D. **Outlet** – Sediment traps shall be constructed with both a principal and emergency spillway. The stone outlet of a sediment trap shall consist of a stone section of embankment (stone outlet) located at the discharge point. The stone outlet section provides a means of dewatering the basin back to the top of the permanent storage between storm events, and also serves as a non-erosive emergency spillway for larger flow events.

1. Outlet Size – The size of the outlet shall depend on the contributory drainage area and desired outflow. The length of the stone outlet / weir outlet can be calculated based on the size of the drainage area found in Table 1. Refer to section IX References for the equation used to calculate flow through a stone outlet or gabion.

Table 1 Weir Length

Drainage Area (acres)	Weir Length (feet)
1	4.0
2	6.0
3	8.0
4	10.0
5	12.0

The emergency spillway (top of the weir) shall be sized to adequately pass the 10-year 24-hour storm without overtopping the sediment trap. The crest of the spillway shall be at least one foot below the top of the embankment. The minimum weir lengths provided in Table 1 are adequate to pass the 10 year event.

Note: The weir length has little effect on overall treatment efficiency provided the sizing criteria in Section V.B. is adhered to.

The stone outlet shall have a minimum top width of 2 feet and a maximum side-slope of 2:1.

Discharge from the sediment basin shall be safely conveyed to a stormwater facility, drainage way, or waterbody. The discharge velocity shall be below the velocity to initiate scour unless appropriate stabilization methods are employed.

2. Stone Size – Stone shall consist of angular well graded 3 to 6 inch clear washed stone.
 3. Keyway Trench – The stone outlet shall be protected from undercutting by excavating a keyway trench across the stone foundation and up the sides to the height of the outlet. See Figure 1. Underlying with geotextile fabric is optional.
- E. Provide access for cleanout and disposal of trapped sediment.

VI Considerations

- A. Sediment traps generally require excessive surface areas to settle clay particles and fine silts. If these conditions exist on the site consider using a sediment basin (WDNR Technical Standard Sediment Basin 1064) or adding polymer to the sediment trap. See WDNR Technical Standard Sediment Control Water Application of Polymers (1051) for criteria governing the use of polymers

- B. To improve trapping efficiency, filter fabric can be placed on the up-slope side of the stone outlet / gabion and anchored with stone. When fabric is utilized to enhance filtering, more frequent maintenance is required to prevent clogging. When using fabric, a monofilament type fabric shall be used (such as WisDOT Type FF). The apparent opening size of the fabric, not the stone size, will dictate the flow rate through the outlet therefore outlet lengths need to be calculated since values in Table 1 are based on stone. When calculating the size of the outlet a clogging factor of 50% should be used for the fabric.
- C. Consider possible interference with construction activities when locating sediment traps.
- D. Provisions should be made for protecting the embankment from failure caused by storms exceeding the 10-year design requirement. Consider a stabilized and non-erosive emergency spillway bypass.
- E. In general, groundwater impacts from temporary sediment traps that have storage areas in contact with groundwater are not a major concern. However, sediment trap contact with groundwater should be avoided in areas with karst features, fractured bedrock, or areas of significant groundwater recharge.
- F. Sediment trapping is achieved primarily by settling within the pool formed by the trap. Sediment trapping efficiency is a function of surface area, depth of pool, and detention time. If site conditions permit, a length to width ratio greater than 2:1 will increase efficiency.
- G. If site conditions prevent the sediment trap from having a three-foot depth, then an equivalent storage volume must be created through increasing the surface area.
- H. For sediment traps in place longer than 6 months, consider outlets constructed of two types of stone. A combination of coarse aggregate and riprap (WisDOT light riprap classification) should be used to provide stability. A one-foot layer of one inch washed stone then should be placed on the up-slope face to reduce drainage flow rate.

VII Plans and Specifications

- A. Plans and specifications for installing sediment traps shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:
 - 1. Location and spacing of sediment traps
 - 2. Schedules and sequence of installation and removal
 - 3. Standard drawings and installation details
 - 4. Rock gradation
- B. All plans, standard detail drawings, or specifications shall include a schedule for installation, inspection, maintenance, and identify the responsible party.

VIII Operation and Maintenance

Sediment Traps shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period. Sediment may need to be removed more frequently.

- A. Deposits of sediment shall be removed when they reach a depth of one foot.
- B. If the outlet becomes clogged it shall be cleaned to restore flow capacity.
- C. Recommend provisions for proper disposal of the sediment removed from the trap.
- D. Maintenance shall be completed as soon as possible with consideration given to site conditions.
- E. Sediment traps shall be removed and the location stabilized after the disturbed area draining to the sediment trap is stabilized and no longer susceptible to erosion.

IX References

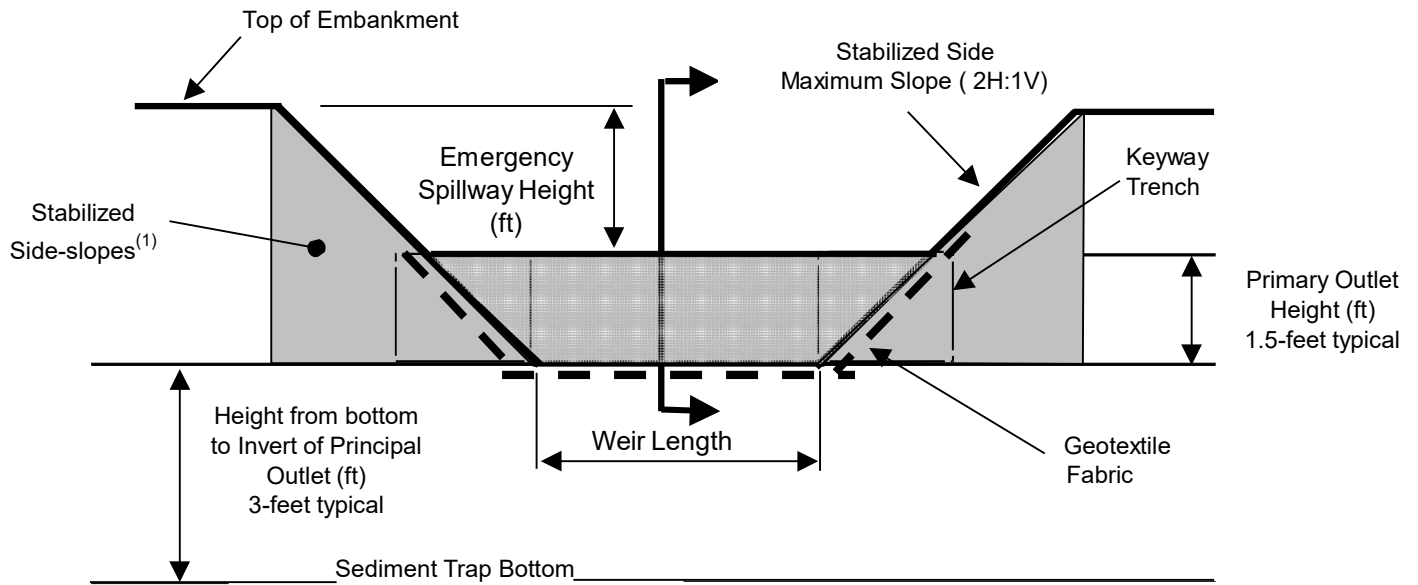
C. McIntyre, G. Aron, J. Willenbrock, and M. Deimler. Report No. 10: Analysis of flow through porous media as applied to gabion dams regarding the storage and release of storm water runoff. NAHB/NRC Designated Housing Research Center at Penn State, Department of Civil Engineering; August 1992.

X Definitions

Stabilized (III): Means that all land disturbing construction activities at the construction site have been completed and that a uniform perennial vegetative cover has been established with a density of at least 70% of the cover for the unpaved areas and areas not covered by permanent structures or that employ equivalent stabilization measures.

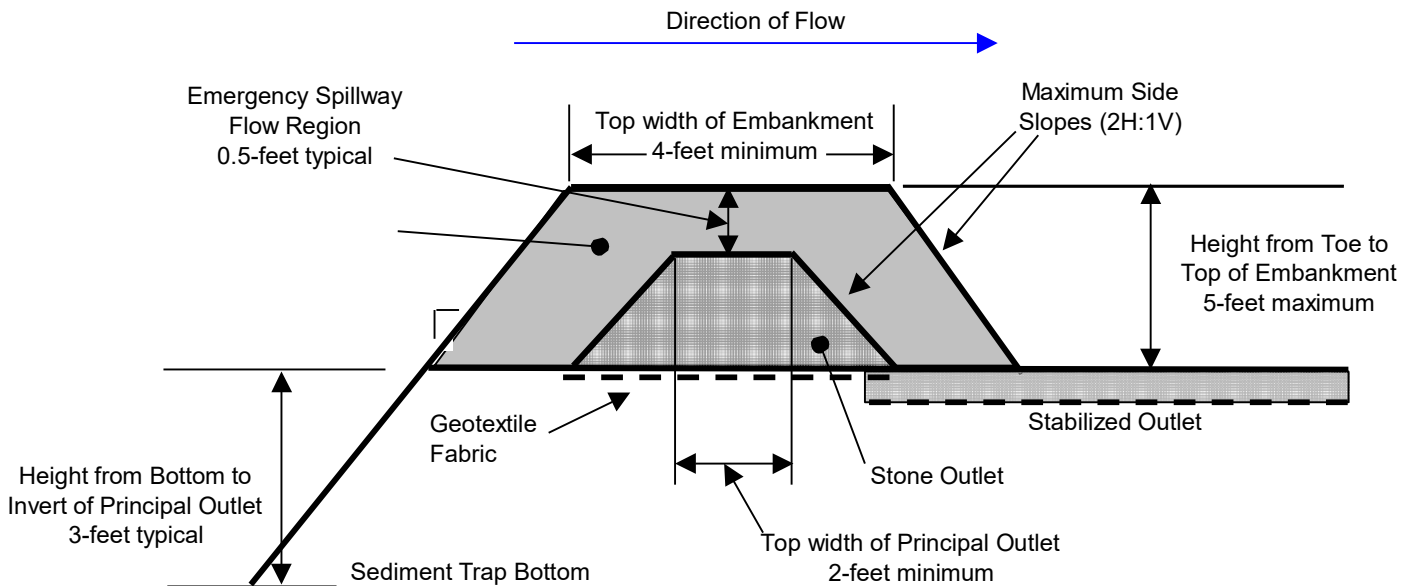
Temporary (I): An erosion control measure that is in place for the duration of construction or until the site is stabilized.

Figure 1: Sediment Trap Outlet Detail



Cross-section View of Principal Outlet

Notes: (1) Side-slopes and faces of earthen embankment around outlet shall be armored with riprap or stabilized with erosion mat sufficient to handle flows from the 10-year storm.



View A - A of Principal Outlet

Sediment Basin

(1064)

Wisconsin Department of Natural Resources
Technical Standard

I. Definition

A sediment control device constructed with an engineered outlet, formed by excavation or embankment to intercept sediment-laden runoff and retain the sediment.

II. Purposes

Detain sediment-laden runoff from disturbed areas for sufficient time to allow the majority of the sediment to settle out.

III. Conditions Where Practice Applies

Sediment basins are utilized in areas of concentrated flow or points of discharge during construction activities. Sediment basins shall be constructed at locations accessible for clean out. Site conditions must allow for runoff to be directed into the basin.

Sediment basins are designed to be in place until the contributory drainage area has been *stabilized*¹. Sediment basins are temporary and serve drainage areas up to 100 acres however other conservation practices are often more economical for smaller drainage areas. For drainage areas smaller than 5 acres sediment traps or ditch checks may be applicable; for design criteria refer to WDNR Technical Standard Sediment Trap (1063) or Ditch Check (1062).

Design to WDNR Technical Standard Wet Detention Basin (1001) when a permanent stormwater basin is required.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of sediment basins. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements. Sediment basins meeting these design criteria are deemed 80% effective by design in trapping sediment.

A. **Timing** – Sediment basins shall be constructed prior to disturbance of up-slope areas and placed so they function during all phases of construction. Sediment basins shall be placed in locations where runoff from disturbed areas can be diverted into the basin.

B. **Sizing Criteria** – Properly sized sediment basins are more effective at trapping fine-grained particles than sediment traps. Specific trapping efficiency varies based on the surface area and the particle size distribution of the sediment entering the device. See Figure 1 for clarification of terms. Attachment 1 includes a sample design problem.

1. **Treatment Surface Area** – The surface area of the sediment basin measured at the invert of the lowest outlet. The treatment surface area shall be sized based on the texture of the soil entering the device and the peak outflow during the 1-year, 24-hour design storm using Equation 1:

$$S_a = 1.2 * (q_{out} / v_s)$$

Where:

S_a = Treatment surface area measured at the invert of the lowest outlet of sediment basin (square feet)

q_{out} = Peak outflow (cubic feet / second) during the 1-year, 24-hour design storm for the principal outlet

v_s = Particle settling velocity (feet/second)

1.2 = EPA recommended safety factor.

¹ Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

Particle settling velocities (V_s) shall be based on representative soil class as follows:

- a. Soil Class 1: $v_s = 1.2 \times 10^{-3}$ ft/sec
- b. Soil Class 2: $v_s = 7.3 \times 10^{-5}$ ft/sec
- c. Soil Class 3: $v_s = 1.2 \times 10^{-5}$ ft/sec

Note: Particle settling velocities calculated assuming a specific gravity of 2.65 and a water temperature of 68 degrees Fahrenheit.

Soil Class 1 includes particles greater than 20 microns generally corresponding to sand, loamy sand, and sandy loam.

Soil Class 2 includes particles between 5 and 20 microns generally corresponding to loam, silt, and silt loam aggregates as transported in runoff.

Soil Class 3 includes particles between 2 and 5 microns generally corresponding to clay loam, silty clay, and clay aggregates as transported in runoff.

The representative soil class shall be selected based on the dominant textural class of the soil entering the device.

The treatment surface area of sediment basins can be reduced when used in conjunction with water applied polymers. When employing polymers, size the treatment surface area for controlling fine soils (Class 3) using the settling velocity for medium soils (Class 2). When designing for medium sized soils (Class 2) use the settling velocity for coarse soils (Class 1). See WDNR Technical Standard Sediment Control Water Application of Polymers (1051) for criteria governing the proper use and selection of polymers.

- 2. **Depth below Treatment Surface Area** – The depth below the treatment surface area as measured from the invert of the lowest outlet of the sediment basin shall be a minimum of 5 feet deep (2 feet for sediment storage plus 3 feet to protect

against scour/ resuspension) and a maximum of 10 feet deep to limit the potential for thermal stratification.

Due to side slope requirements and safety shelf considerations it may be difficult to maintain 5 feet of depth for the entire treatment surface area.

Therefore, 50% of the total treatment surface area shall be a minimum of 5 feet deep. For basins less than 5,000 square feet, maximize the area of 5 feet depth.

Interior side slopes below the lowest invert shall be 2:1 (horizontal: vertical) or flatter to maintain soil stability.

While a permanent pool of water below the lowest invert may form, it is not required to be maintained through irrigation or installation of a liner system.

- 3. **Active Storage Volume** – The volume above the treatment surface area shall be calculated using one of the following methods:

- a. The method outlined in TR-55 for determining the storage volume for detention basins. This can be accomplished by using Figure 2 where:

q_o = Peak outflow (cubic feet / second) during the 1-year, 24-hour design storm for the principal outlet calculated using Equation 1 (see section V.B.1).

q_i = Calculated peak inflow or runoff rate (cubic feet / second) during the 1-year, 24-hour design storm.

V_r = Calculated volume of runoff from the 1-year 24-hour design storm for the entire contributory area with the maximum area of disturbance characterized as bare soil.

V_s = Is the required active storage volume determined using Figure 2.

- b. The active storage volume may be calculated based on routing the 1-year, 24-hour storm provided the principal outlet requirements stipulated in section V.D.2 are maintained. This method will require the use of a model.

Note: Both these methods require iterative calculations.

4. Shape – The length to width ratio of the flow path shall be maximized with a goal of 3:1 or greater. The flow path is considered the general direction of water flow within the basin including the treatment surface area and any forebay.

C. **Embankments** – Earthen embankments shall be designed to address potential risk and structural integrity issues such as seepage and saturation. All constructed earthen embankments shall meet the following criteria.

1. The base of the embankment shall be stripped of all vegetation, stumps, topsoil and other organic matter.
2. Side slopes shall be 3:1 or flatter. The minimum embankment top width shall be adequate to provide structural stability. Where applicable the top width shall be wide enough to provide maintenance access.
3. There shall be a core trench or key-way along the embankment.
4. Any pipes extending through the embankment shall be bedded and backfilled with equivalent soils used to construct the embankment. The bedding and backfill shall be compacted in lifts and to the same standard as the original embankment. Excavation through a completed embankment shall have a minimum side slope of 1:1 or flatter.
5. Measures shall be taken to minimize seepage along any conduit buried in the embankment.

D. **Outlet** – Sediment basins shall have both a principal outlet and an overflow spillway.

1. Timing – Outlets must be constructed in conjunction with the remainder of the basin and must be constructed prior to the basin receiving runoff. Sediment basins are ineffective until the outlet is constructed.
2. Principal Water Quality Outlet – The principal water quality outlet shall be designed to pass the 1-year 24-hour storm without use of the overflow spillway or other outlet structures. The maximum outflow (q_o) from the principal water quality outlet shall be less than or equal to the q_o used in Equation 1 (V.B.1). If the sediment basin is to serve as a permanent stormwater basin, the principal outlet structure can be modified (i.e. removable plates) to meet flow requirements encountered during and after construction; separate outlet structures do not need to be constructed.

Note: Local ordinances may require control of larger storm events such as the 2-year 24 hour storms. In these cases, additional or compound outlets may be required.

3. Overflow (Emergency) Spillway – An overflow spillway shall be provided consisting of an open channel constructed adjacent to the embankment and built over a stabilized area. The spillway shall be designed to carry the peak rate of runoff expected from a 10-year, 24-hour design storm or one commensurate with the degree of hazard, less any reduction due to flow in the principal outlet. The top of the embankment shall be at least one foot above the design high water level and a minimum of 1 foot above the invert of the overflow spillway. The overflow spillway shall be protected from erosion. Flow from the overflow spillway shall be directed away from the embankment.
4. Outlet Protection – All outlet designs shall incorporate preventive measures for ice damage, trash accumulation, and erosion at the outfall. For orifices less

than 8-inches in diameter, or equivalent, additional measures to prevent clogging are required.

- E. **Inlet Protection** – Inlets shall be designed to prevent scour and reduce velocities during peak flows. Possible design options include flow diffusion, plunge pools, directional berms, baffles, or other energy dissipation structures.
- F. **Location** – Temporary sediment basins should be located to provide access for cleanout and disposal of trapped sediment.
- G. **Removal** – Temporary sediment basins shall be removed after the contributing drainage area has been stabilized. Complete final grading and restoration according to the site plans. If standing water needs to be removed it shall be done in accordance with WDNR Technical Standard Dewatering (1061).

VI. Considerations

- A. When constructing a sediment basin that will also serve as the long-term stormwater detention pond, build the sediment basin to the larger of the two sizes required either for stormwater control or erosion control. In addition, when sizing the outlet structure first design the outlet for the long-term stormwater management requirements then check to satisfy the flow requirements for sediment control during construction. If additional flow restriction is needed consider use of a temporary restriction plates or other measures to avoid having to construct separate outlet structures for the sediment basin and stormwater basin.
- B. Over-excavation beyond the required depth in the sediment storage area of the sediment basin may allow for less frequent maintenance. Addition of other measures in the contributing drainage area may reduce sediment accumulation and associated maintenance requirements.
- C. The use of a sediment forebay can extend the useful life of the main sediment storage area by trapping the majority of sediment in the forebay area. Separation of the forebay from the rest of the basin requires construction of a submerged shelf (if wet) or

a stone or stabilized earthen embankment. The forebay should have a surface area equal to at least 12% of the total basin area.

- D. In addition to soil stability issues, interior slopes of sediment basins should be selected based on safety issues commensurate with the degree of hazard.

VII. Plans and Specifications

- A. Plans and specifications for installing sediment basins shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.
 - 1. Location of sediment basin
 - 2. Schedules and sequence of installation and removal
 - 3. Standard drawings and installation details
 - 4. Control structure detail and layout
 - 5. Sizing of sediment storage area
 - 6. Maintenance requirements
- B. All plans, standard detail drawings, or specifications shall include sequence for installation, inspection, and maintenance requirements. The responsible party shall be identified.

VIII. Operation and Maintenance

Sediment basins shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.

- A. Sediment shall be removed to maintain the three foot depth of the treatment surface area as measured from the invert of the principal outlet. Sediment may need to be removed more frequently.
- B. If the outlet becomes clogged it shall be cleaned to restore flow capacity.
- C. Provisions for proper disposal of the sediment removed shall be made.

- D. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

Chapter NR 333, Dam and Design Construction.

Hann, Barfield, and Hayes. Design Hydrology and Sedimentology for Small Catchments. Academic Press Inc., 1994.

Robert E. Pitt, Small Storm Hydrology.

US Bureau of Reclamation, Design of Small Dams.

http://www.usbr.gov/pmts/hydraulics_lab/pubs/index.cfm.

USDA, Natural Resources Conservation Service, Ponds – Planning, Design, Construction. Agriculture Handbook No. 590, Revised September 1997.

WDNR Technical Standard 1001
Wet Detention Basin.

X. Definitions

Active Storage Volume (V.B.3) – Is measured from the invert of the lowest outlet to the invert of the emergency spillway.

Stabilized (III) – Means protecting exposed soil from erosion.

Treatment Surface Area (V.B.1) – Is the surface area of the sediment basin measured at the invert of the lowest outlet.

Figure 1:

Clarification of Sediment Basin Terminology

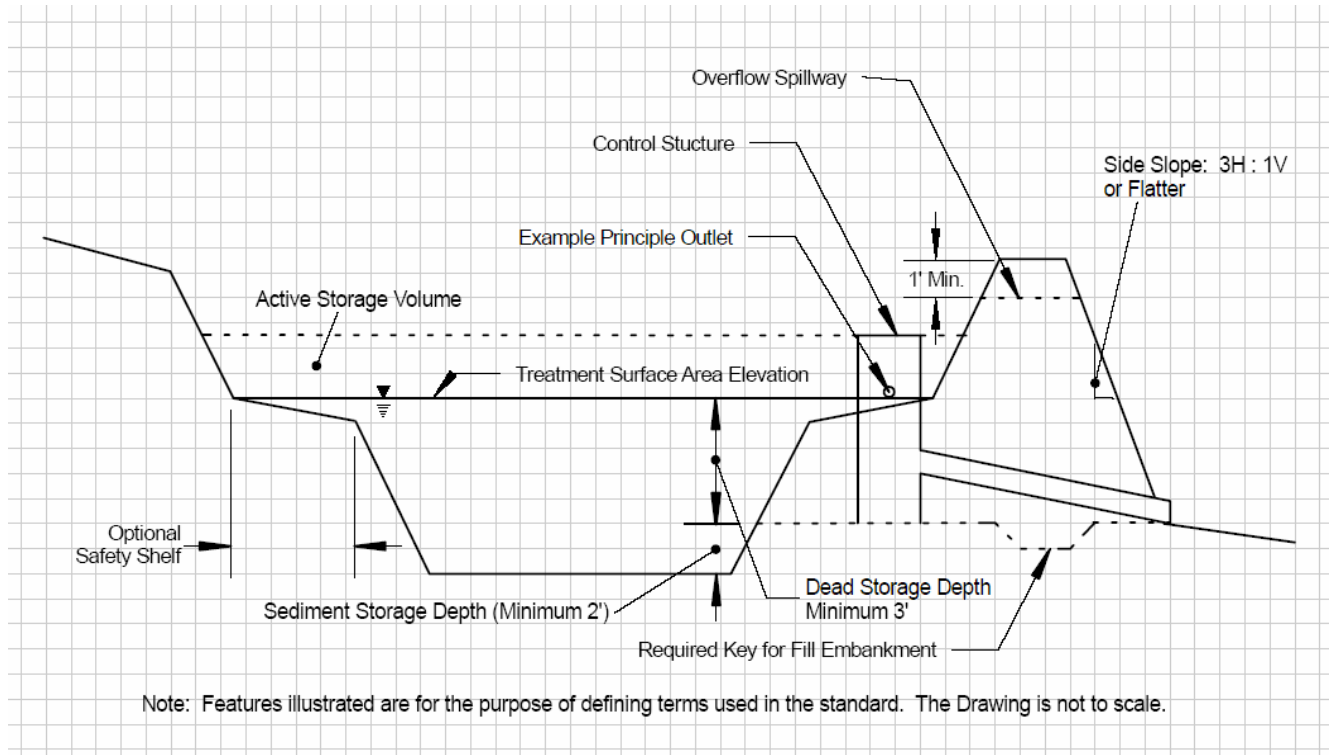
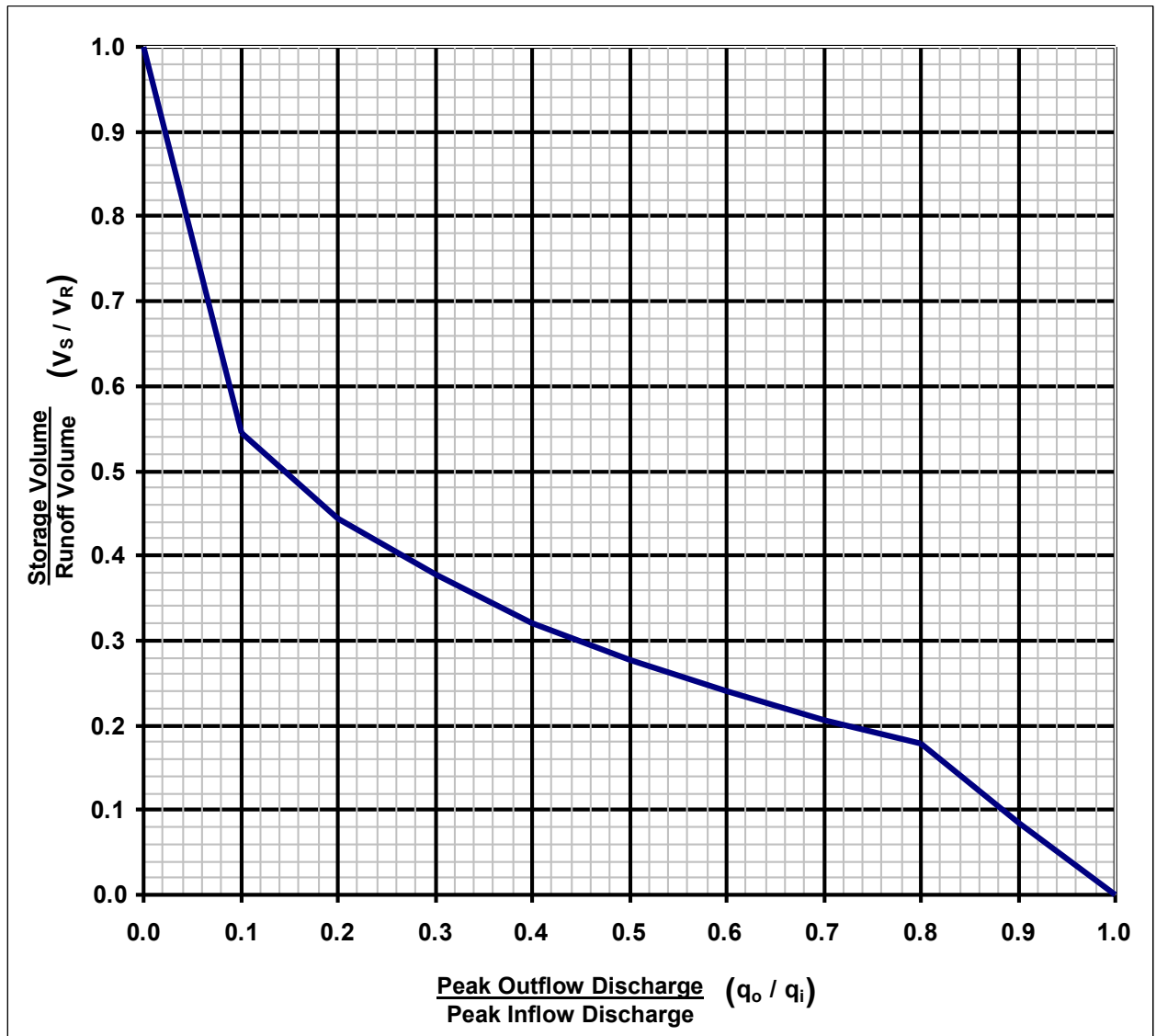


Figure 2:

Approximate Detention Basin Routing for Type II Storms



Source: Technical Release 55, United States Department of Agriculture, Natural Resources Conservation Service. Washington D.C. 1988.

Rainfall Quantities:

Table 1 provides a summary of the 1-year, 24-hour rainfall totals using NRCS mandated TP-40 which has not been updated since 1961. Table 2 provides a summary of more current data from the Rainfall Frequency Atlas of the Midwest published in 1992. Local requirements may dictate the use of one dataset over the other.

Table 1 - Rainfall for Wisconsin Counties for a 1 - year, 24 - hour Rainfall¹	
Inches of Rainfall	County
2.1 in.	Door, Florence, Forest, Kewaunee, Marinette, Oconto, Vilas
2.2 in.	Ashland, Bayfield, Brown, Calumet, Douglas, Iron, Langlade, Lincoln, Manitowoc, Menominee, Oneida, Outagamie, Price, Shawano, Sheboygan
2.3 in.	Barron, Burnett, Dodge, Fond du Lac, Green Lake, Marathon, Milwaukee, Ozaukee, Portage, Racine, Rusk, Sawyer, Taylor, Washburn, Washington, Waukesha, Waupaca, Waushara, Winnebago, Wood
2.4 in.	Adams, Chippewa, Clark, Columbia, Dane, Dunn, Eau Claire, Jackson, Jefferson, Juneau, Kenosha, Marquette, Pepin, Pierce, Polk, Rock, St. Croix, Walworth
2.5 in.	Buffalo, Green, Iowa, La Crosse, Monroe, Richland, Sauk, Trempealeau, Vernon
2.6 in.	Crawford, Grant, Lafayette
¹ TP - 40 - Rainfall Frequency Atlas of the United States, U.S. Department of Commerce Weather Bureau.	

Table 2 - Rainfall for Wisconsin Counties for a 1 - year, 24 - hour Rainfall²		
Zone	Inches of Rainfall	County
1	2.22	Douglas, Bayfield, Burnett, Washburn, Sawyer, Polk, Barron, Rusk, Chippewa, Eau Claire
2	2.21	Ashland, Iron, Vilas, Price, Oneida, Taylor, Lincoln, Clark, Marathon
3	1.90	Florence, Forest, Marinette, Langlade, Menominee, Oconto, Door, Shawano
4	2.23	St. Croix, Dunn, Pierce, Pepin, Buffalo, Trempealeau, Jackson, La Crosse, Monroe
5	2.15	Wood, Portage, Waupaca, Juneau, Adams, Waushara, Marquette, Green Lake
6	1.96	Outagamie, Brown, Kewaunee, Winnebago, Calumet, Manitowac, Fond Du Lac, Sheboygan
7	2.25	Vernon, Crawford, Richland, Sauk, Grant, Iowa, Lafayette
8	2.25	Columbia, Dodge, Dane, Jefferson, Green, Rock
9	2.18	Ozaukee, Washington, Waukesha, Milwaukee, Walworth, Racine, Kenosha
² Bulletin 71: Rainfall Frequency Atlas of the Midwest, Midwest Climate Center and Illinois State Water Survey, 1992.		

Attachment 1: Sample Sediment Basin Design Problem

The proper sizing and design of a sediment basin will often require iterative calculations. The technical standard for sizing sediment basins was written to give the designer as much flexibility as possible in designing the basin while meeting water quality requirements. The governing equation relates the surface area of the sediment basin to the outflow and critical particle settling velocity. The larger the sediment basin outflow, the larger the surface area required to settle the particle. As the outflow is reduced, a smaller surface area is required however the required storage volume dictates how small a surface area can become through the storage depth or hydraulic head acting on the outlet.

The particle settling velocities are listed in the standard requiring the designer to either start with a desired outflow based on an outlet size or an estimated starting surface area. The sample equation below starts with an estimated surface area.

Sample Problem:

A 10 acre site is being developed into condos. Eight acres of the site are being disturbed while 2 acres of forest are remaining undisturbed. The dominate soils on the site are silt loam. The 1-year, 24-hour design storm is 2.25 inches.

Step 1: Calculate runoff volume and peak using TR-55 or approved method.

From TR-55 the curve number (CN) for the disturbed area is 86 and the CN for the forested area is 55 resulting in a composite CN of 80. Using TR-55, the runoff volume calculated for the 1-year 24-hour design storm is 0.7 inches (0.6 acre-feet for the entire 10-acre site). The time of concentration was calculated as 0.4 hours resulting in a peak flow of 6 cfs.

Step 2: Begin sizing sediment basin using Equation 1. The technical standard lists silt loam under particle class 2 with a settling velocity of 7.3×10^{-5} ft/sec. We are also going to assume a starting surface area of 0.25 acres (10,890 ft²). An alternative approach is to assume an outflow velocity.

$$SA = 1.2 * (q_{out} / v_s)$$

$$\text{Solve for } q_{out}: 10,980 \text{ ft}^2 = 1.2 * (q_{out} / 7.3 \times 10^{-5} \text{ ft/sec})$$

$$q_{out} = 0.67 \text{ cfs}$$

Step 3: Using Figure 2: Approximate Detention Basin Routing for Type II Storms determines the volume of storage (V_S) needed.

$$q_{out} = 0.67 \text{ cfs (calculated in Step 2)}$$

$$q_{in} = 6.0 \text{ cfs (peak flow calculated using TR-55 in Step 1)}$$

$$V_R = 0.6 \text{ acre-feet (volume of runoff calculated using TR-55 in Step 1)}$$

$$q_{out} / q_{in} = 0.67 \text{ cfs} / 6.0 \text{ cfs} = 0.11. \text{ Using Figure 2 with a } q_{out} / q_{in} = 0.11, \text{ the } V_S / V_R \text{ is determined to be } 0.54. \text{ Therefore the } V_S = 0.54 * 0.6 \text{ acre-feet} = 0.324 \text{ acre-feet (14,113 ft}^3\text{)}$$

Step 4: Check configuration: Calculate maximum head on outlet using surface area and volume.

$$SA = 10,890 \text{ ft}^2 \text{ and a } V_S = 14,113 \text{ ft}^3 \text{ we get a depth (H) of } 1.29 \text{ feet} = 14,113 \text{ ft}^3 / 10,890 \text{ ft}^2$$

Step 5: Size Outlet: Assuming an orifice type outlet calculate the size needed to meet the q_{out} calculated in Step 1 and the H calculated in Step 4.

Using the orifice equation: $q_{out} = C \cdot A \cdot (2gH)^{1/2}$ with $C=0.6$ (coefficient), $A = \text{Area} = \text{ft}^2$, $g = 32.2$, and $H = \text{hydraulic head expressed in feet}$.

$$q_{out} = 0.6 \cdot A \cdot (2 \cdot 32.2 \cdot H)^{1/2} \quad \text{so} \quad 0.66 = 0.6 \cdot A \cdot (2 \cdot 32.2 \cdot 1.29)^{1/2} \quad \text{therefore} \quad A = .12 \text{ ft}^2$$

An area of 0.12 ft^2 corresponds to an orifice outlet of 4.7 inches in diameter.

Step 6: Iteration: While the above solution works, the sediment basin has not been optimally sized and we have an orifice diameter that is not a standard pipe size. An iterative approach can be used to reduce the surface area of the sediment basin and obtain a more common orifice diameter. We can assume a 4-inch orifice since it is close to diameter calculated in Step 5 and we can start with the depth we calculated in Step 4. The iterations below each represent Steps 2 through 5.

Iteration 1:

$q_{out} = 0.43 (H)^{1/2} = 0.43 (1.29)^{1/2} = 0.48 \text{ cfs}$ which is less than the 0.66 cfs calculated in Step 1. Therefore, we can go back to Step 1 and repeat the sizing procedure and downsize the sediment basin.

$$SA = 1.2 \cdot (q_{out} / v_s) = 1.2 \cdot (0.48 \text{ cfs} / 7.3 \cdot 10^{-5} \text{ ft/sec}) = 7,890 \text{ ft}^2$$

Using Figure 2:

$$q_{out} = 0.48 \text{ cfs}$$

$$q_{in} = 6.0 \text{ cfs (peak flow calculated using TR-55 in Step 1)}$$

$$V_R = 0.6 \text{ acre-feet (volume of runoff calculated using TR-55 in Step 1)}$$

$q_{out} / q_{in} = 0.48 \text{ cfs} / 6.0 \text{ cfs} = 0.08$. Using Figure 2 with a $q_{out} / q_{in} = 0.08$, the V_S / V_R is determined to be 0.62. Therefore the $V_S = 0.62 \cdot 0.6 \text{ acre-feet} = 0.372 \text{ acre-feet} (16,204 \text{ ft}^3)$

$$SA = 7,890 \text{ ft}^2 \text{ and a } V_S = 16,204 \text{ ft}^3 \text{ we get a depth (H) of } 2.05 \text{ feet} = 16,204 \text{ ft}^3 / 7,890 \text{ ft}^2$$

$$q_{out} = 0.43 (H)^{1/2} = 0.43 (2.05)^{1/2} = 0.61 \text{ cfs}$$
 which is more than the 0.48 cfs we used so iterate.

Iteration 2:

$$SA = 1.2 \cdot (q_{out} / v_s) = 1.2 \cdot (0.61 \text{ cfs} / 7.3 \cdot 10^{-5} \text{ ft/sec}) = 10,027 \text{ ft}^2$$

Using Figure 2:

$$q_{out} = 0.61 \text{ cfs}$$

$$q_{in} = 6.0 \text{ cfs (peak flow calculated using TR-55 in Step 1)}$$

$$V_R = 0.6 \text{ acre-feet (volume of runoff calculated using TR-55 in Step 1)}$$

$q_{out} / q_{in} = 0.61 \text{ cfs} / 6.0 \text{ cfs} = 0.10$. Using Figure 2 with a $q_{out} / q_{in} = 0.10$, the V_S / V_R is determined to be 0.54. Therefore the $V_S = 0.54 \cdot 0.6 \text{ acre-feet} = 0.324 \text{ acre-feet} (14,113 \text{ ft}^3)$

$$SA = 10,027 \text{ ft}^2 \text{ and a } V_S = 14,113 \text{ ft}^3 \text{ we get a depth (H) of } 1.41 \text{ feet} = 14,113 \text{ ft}^3 / 10,027 \text{ ft}^2$$

$q_{out} = 0.43 (H)^{1/2} = 0.43 (1.41)^{1/2} = 0.51 \text{ cfs}$ which is less than the 0.61 cfs we used so we are OK or we can iterate again until we have q_{out} that are almost identical.

After Iteration 2, we have a sediment basin with a $SA = 10,027 \text{ ft}^2$ and a $V_S = 14,113 \text{ ft}^3$. We have a principal water quality outlet consisting of a 4-inch orifice. This design meets the water quality requirements of the technical standard.

Construction Site Diversion (1066)

Wisconsin Department of Natural Resources
Technical Standard

I. Definition

A *temporary*¹ berm or channel constructed across a slope to collect and divert runoff.

II. Purpose

To intercept, divert, and safely convey runoff at construction sites in order to divert clean water away from disturbed areas, or redirect sediment laden waters to an appropriate sediment control facility.

III. Conditions Where Practice Applies

- A. This practice is applicable to construction sites where temporary surface water runoff control or management is needed. Locations and conditions include:
 - 1. Above disturbed areas, to limit runoff onto the site.
 - 2. Across slopes to reduce slope length.
 - 3. Below slopes to divert excess runoff to stabilized outlets.
 - 4. To divert sediment-laden water to sediment control facilities.
 - 5. At or near the perimeter of the construction area to keep sediment from leaving the site.
- B. This standard does not pertain to permanent diversions. Refer to appropriate design criteria and local regulations when designing permanent diversions.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of this practice. This standard does not contain the text of federal, state, or local laws.

V. Criteria

- A. The diversion shall have stable side slopes and shall not be overtopped during a 2-year frequency, 24-hour duration storm. The minimum berm cross section shall be as follows:
 - 1. Side slopes of 2:1 (horizontal:vertical) or flatter.
 - 2. Top width of two feet.
 - 3. Berm height of 1.5 feet.
- B. Sediment-laden runoff from disturbed areas shall be diverted into a sediment control practice. For typical sediment control practices see WDNR Technical Standards Sediment Trap (1063) or Sediment Basin (1065) for design criteria.
- C. When diverting clean water the diversion channel and its outfall shall be immediately *stabilized* for the 2-year frequency, 24-hour duration storm. Build and stabilize clean water diversions before initiating down slope land-disturbing activities.
- D. Diversions shall be protected from damage by construction activities. At all points where diversion berms or channels will be crossed by construction equipment, the diversion shall be stabilized or shaped appropriately. Temporary culverts of adequate capacity may be used.
- E. For diversions that are to serve longer than 30 days, the side slopes including the ridge, and down slope side the diversion shall be stabilized as soon as they are constructed. The diversion channel should be stabilized (i.e. erosion mat) or a larger sediment control practice shall be needed. For diversions serving less than 30 days, the

¹ Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used in the text. Definitions apply to concepts found in this document and may not apply in other situations.

down slope side of the diversion shall be stabilized as soon as constructed.

diversion berm. Properly dispose of any sediment removed from the diversion.

VI. Considerations

- A. The channel cross section may be parabolic, v-shaped or trapezoidal. The use of "V" channels is generally discouraged due to potential erosion problems.
- B. Ditch checks may be used to enhance sediment removal. Ditch checks shall be designed in accordance with WDNR Technical Standard Ditch Check (1062).
- C. For diversion berms consider designing an emergency overflow section or bypass area to limit damage from storms that exceed the 2-year frequency 24-hour duration storm. The overflow section may be designed as a stabilized weir with riprap protection.

- D. Diversions shall be removed and the area stabilized according to construction plans.

IX. Definitions

Temporary (I): an erosion control measure that is utilized during construction and grading operations prior to final stabilization.

Stabilized (V.C): means protecting exposed soil from erosion.

VII. Plans and Specifications

- A. Plans and specifications for installing diversions shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:
 - 1. Diversion location.
 - 2. Channel grade or elevations.
 - 3. Typical cross section.
 - 4. Channel stabilization if required.
- B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

- A. Diversions shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24-hour period.
- B. Maintenance shall be completed as soon as possible with consideration to site conditions.
- C. Accumulated sediment shall be removed when it reaches one half the height of the

Temporary Grading Practices For Erosion Control

(Surface Roughening and Temporary Ditch Sumps)

(1067)

Wisconsin Department of Natural Resources
Technical Standard

I. Definition

*Temporary*¹ grading practices used to minimize construction site erosion. These practices include, but are not limited to surface roughening (directional tracking and tillage) and temporary ditch sumps.

II. Purpose

The purpose of these practices are to minimize erosion and sediment transport during grading operations on construction sites.

III. Conditions Where Practice Applies

These practices apply where land disturbing activities occur on construction sites. These practices shall be used in conjunction with other erosion control practices.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing these practices. This standard does not contain the text of federal, state, or local laws.

V. Criteria

These interim practices may be employed in addition to the approved grading plan to reduce erosion and sediment transport.

- A. Surface Roughening - Surface roughening is abrading the soil surface with horizontal ridges and depressions across the slope to reduce runoff velocities.
 1. Directional Tracking - The process of creating ridges with tracked vehicles on unvegetated slopes. This method is used for short durations on sites actively being graded and shall be used in

conjunction with other practices. This practice shall be in place at the end of each workday.

Directional tracking involves driving a tracked vehicle up and down a slope. The tracks create horizontal grooves and ridges. The rough surface slows sheet runoff and helps to prevent rills from forming. (Conversely, if the tracked vehicle is driven along the contour the tracks create vertical grooves and ridges for the water to follow, increasing erosion.)

2. Tillage - Utilizing conventional tillage equipment to create a series of ridges and furrows on the contour no more than 15 inches apart.

- B. Temporary Ditch Sump - Temporary ditch sumps are ½ to 5 cubic yard excavations made in a drainageway during earthmoving operations. Their purpose is to slow and pond runoff during the time that drainageways are being graded. Sumps shall be in place prior to anticipated rain events.

Construction involves excavating sumps (holes) in the rough ditch grade, and using the excavated material to form a dike on the downstream side of the sump.

Temporary ditch sumps are not effective perimeter controls. Other sediment control practices shall be utilized prior to channels discharging into public waterways.

VI. Considerations

- A. Directional tracking may compact the soil, therefore additional seedbed preparation may be required. Refer to WDNR Technical Standard Seeding for

¹ Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

Construction Site Erosion Control (1059) for seedbed preparation and seeding criteria.

- B. When constructing a temporary ditch sump, compacting the dike provides additional stability.
- C. Consider at a minimum excavating ½ cubic yard per 1% gradient, for every 500 feet of channel when constructing temporary ditch sumps

VII. Plans and Specifications

Due to the interim nature of these practices, and the fact that location determinations are made in the field, they need only be referenced in the erosion control plan narration or general notes.

VIII. Operation and Maintenance

These practices shall be inspected and repaired or reinstalled after every runoff event.

IX. References

Virginia Department of Conservation and Recreation. 1992. Virginia Erosion and Sediment Control Handbook, Third Edition. Chapter 3 – 3.29 Surface Roughening.

Dane County. 2002. Dane County Erosion Control and Stormwater Manual, First Edition. Appendix Surface Roughening S-16.1.

X. Definitions

Temporary (I): An erosion control measure that is utilized during construction site grading activities.

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
TECHNICAL STANDARD
DUST CONTROL ON CONSTRUCTION SITES
1068

DEFINITION

Dust control includes practices used to reduce or prevent the surface and air transport of dust during construction.

Dust control measures for construction activities include minimization of soil disturbance, applying mulch and establishing vegetation, water spraying, surface roughening, applying additives (polymers), spray-on tackifiers, chlorides, and barriers.

PURPOSE

This practice may be used to:

- (1) Reduce wind erosion and dust.
- (2) Minimize deposition of dust and wind transported soils into water bodies through runoff or wind action.
- (3) Reduce respiratory problems.
- (4) Minimize low visibility conditions caused by airborne dust.

CONDITIONS WHERE PRACTICE APPLIES

Dust control measures may be applied at any construction site, but is particularly important for sites with dry exposed soils which may be exposed to wind or vehicular traffic.

CRITERIA

Comply with applicable federal, state and local laws, rules, regulations or permit requirements governing this practice. This standard does not contain the text of federal, state, or local laws.

This section establishes the minimum standards for design, installation and performance requirements.

Limit the area exposed for dust generation prior to implementing dust control practices.

Asphalt and petroleum based products cannot be used for dust control.

Mulch and Vegetation. Mulch or seed and mulch may be applied to protect exposed soil from both wind and water erosion. Refer to WDNR Technical Standards Mulching for Construction Sites (1058) and Seeding for Construction Site Erosion Control (1059) for criteria.

Water. Water until the surface is wet and repeat as needed. Water at rates so that runoff does not occur. Provide a stone tracking pad or tire washing station at treated soil surfaces that receive vehicle traffic. Refer to WDNR Technical Standard Stone Tracking Pad and Tire Washing (1057) for criteria.

Tillage. Tillage can be used as a control measure performed with chisel type plows on exposed soils. Begin tillage on the windward side of the site. Tillage is only applicable to flat areas.

Additives. Additives can be an effective practice for areas that do not receive vehicle traffic. Initially apply water to additives for activation to be effective for dust control. Refer to WDNR Technical Standard 1050 - Land Applied Additives for Erosion Control for application criteria.

Technical Standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your local WDNR office or the Standards Oversight Council office in Madison, WI at (608) 441-2677.

WDNR
November 2017

Tackifiers and Soil Stabilizers Type A. Select products and install at rates conforming to the WisDOT Erosion Control Product Acceptability List (PAL). Examples include vegetable based products such as natural Latex or Guar Gum.

Chlorides. Apply chlorides according to the most recent version of the WisDOT Standard Specifications for Highway and Bridge Construction.

Barriers. Place barriers at right angles to prevailing wind currents at intervals of about 15 times the barrier height. Solid board fences, snow fences, burlap fences, crate walls, bales of hay and similar material can be used to control air currents and blown soil.

CONSIDERATIONS

Some sites may require an approach that utilizes a combination of measures for dust control.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for dust control practices in keeping with this standard and to describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

Inspect daily areas that have dust control practices.

REFERENCES

WisDOT's Erosion Control Product Acceptability List (PAL) can be found on the WisDOT web site:

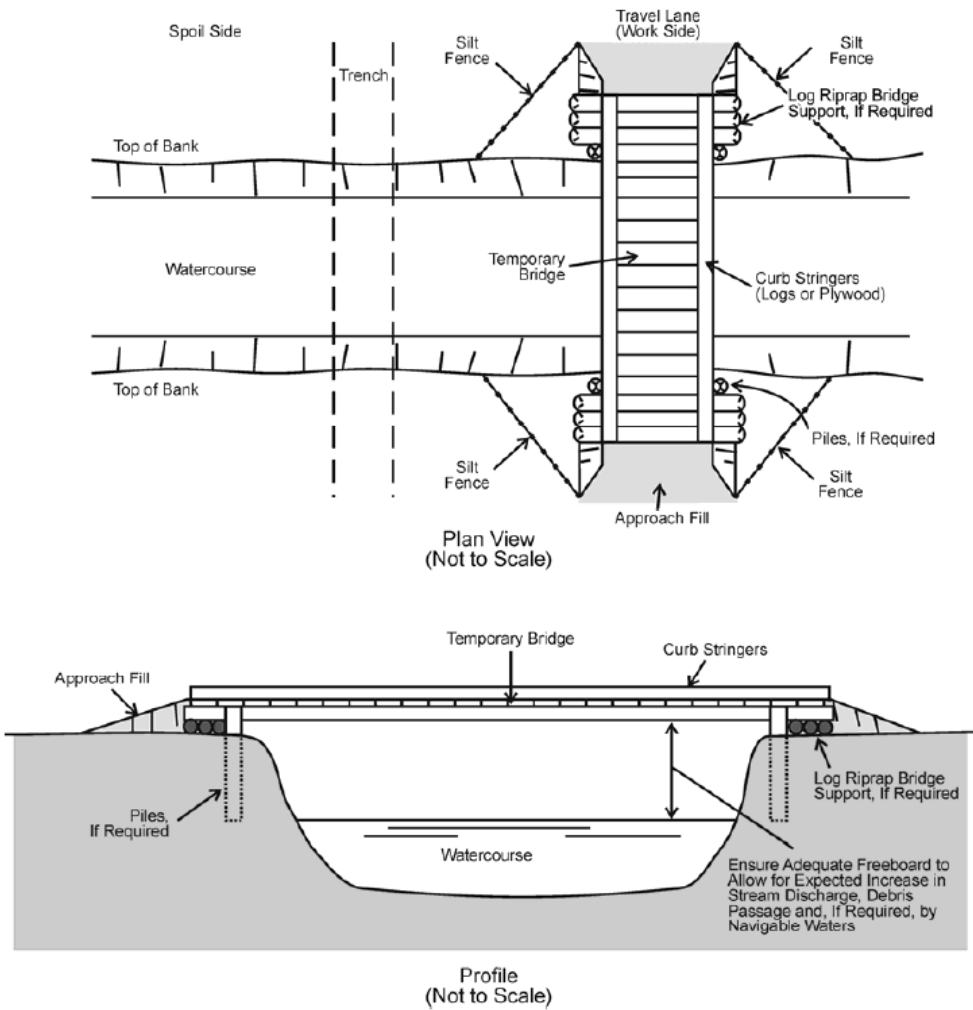
<http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrcs/tools/pal/default.aspx>

Printed copies are no longer being distributed.

Appendix G

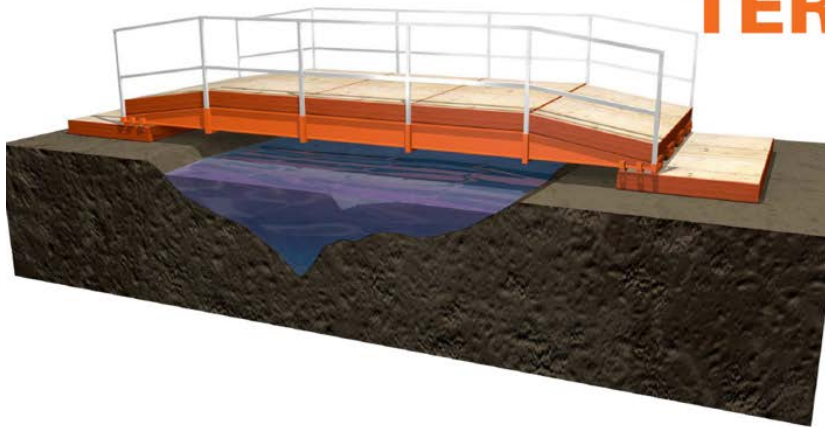
Bridge Types

Bridge Crossing Typical



Vehicle Crossing - Engineered Bridge

Type B = 20' to 60'



TERRACROSS

Fully Engineered
Bridging Solution
for Utility &
Construction
Access

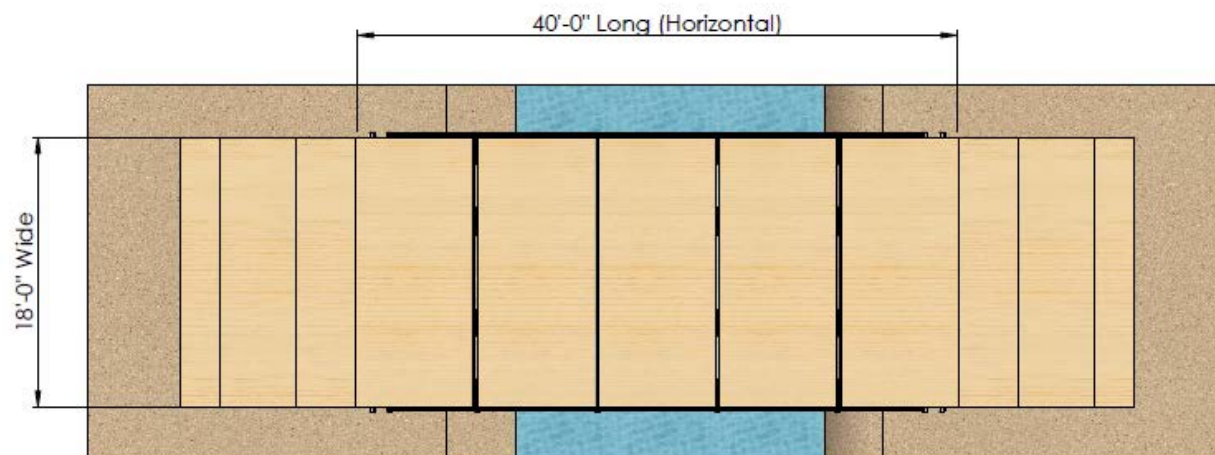
ENGINEERED BRIDGING SYSTEM

TerraCross will support vehicles up to 100 tons and span gaps up to 35' with a total system length of 40'

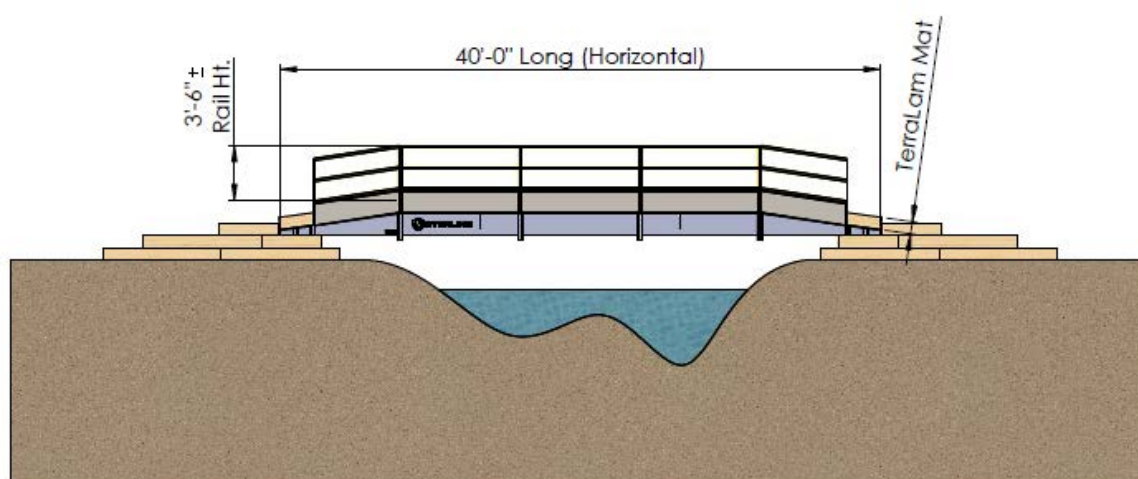
LIGHTWEIGHT & FAST SETUP

System allows for single truck delivery and rapid deployment with equipment you already have on site





General Plan

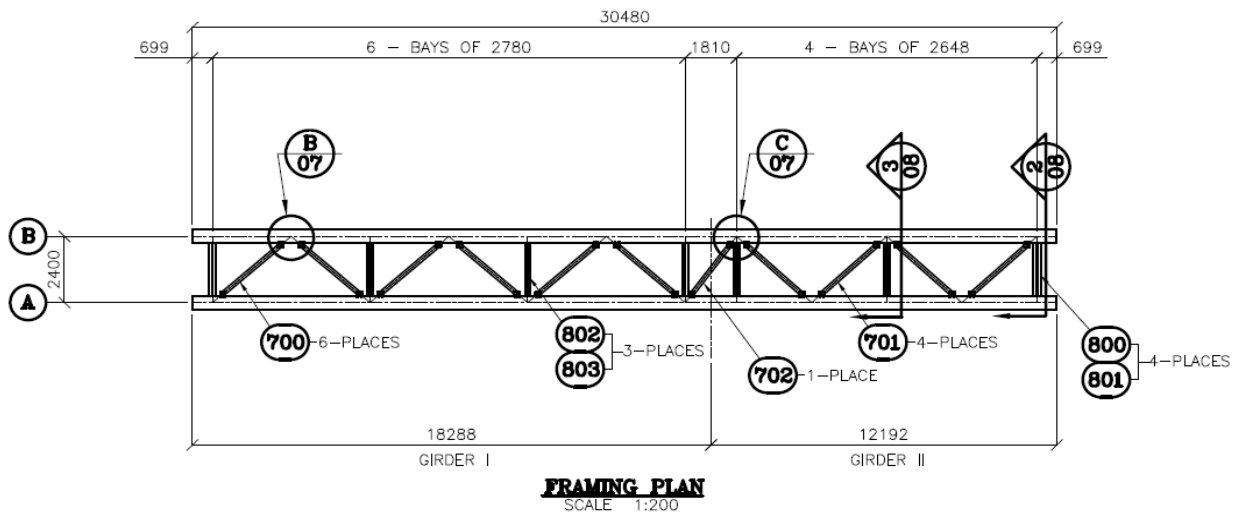
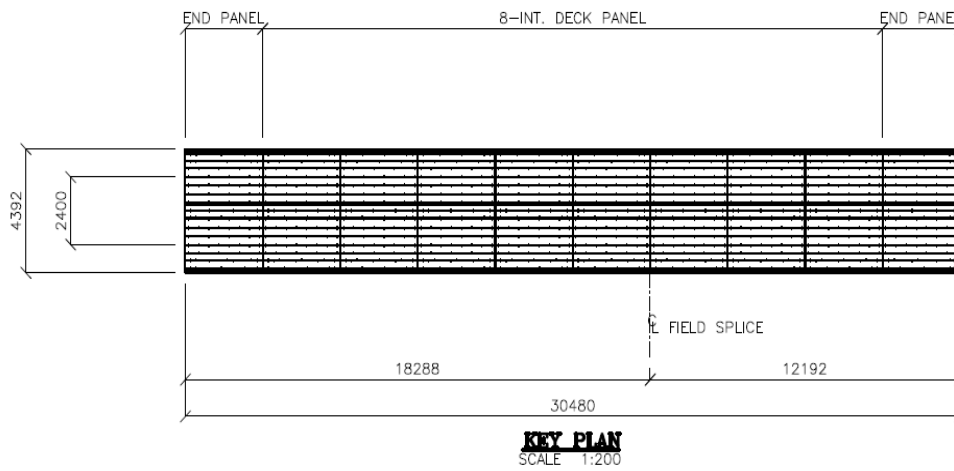
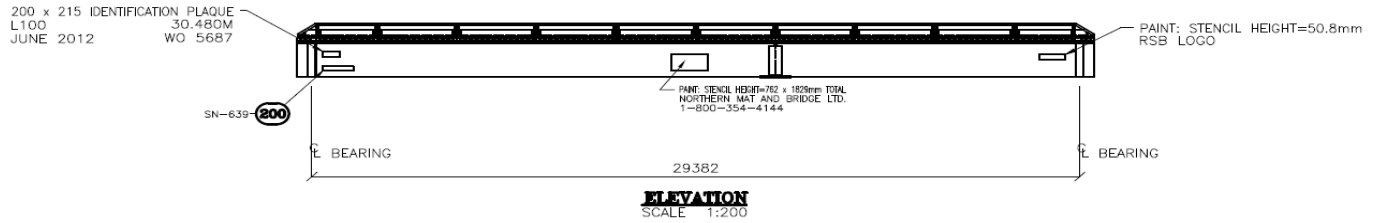


General Elevation



Vehicle Crossing - Engineered Bridge

Type C - 60' and greater



Appendix H
Winter Construction Plan

<<PENDING>>