

GUIDEBOOK OF VLACD-APPROVED
CONSTRUCTION SITE
STORM WATER RUNOFF BMP'S

SWQMP - Part C (MCM 4)

Guidebook and list developed for and approved by
Valparaiso Lakes Area Conservancy District (VLACD) - January 2005

Prepared by: R.W. Armstrong & Associates, Inc.

Construction Site Storm Water Runoff Best Management Practices (BMP) - (MCM 4)

Guide book and List Developed for and Approved by Valparaiso Lakes Area Conservancy District (VLACD) - January 2005

This BMP guidebook has been developed with the intent to assist Developers, Contractors, and/or Site Operators of construction sites with proposed land disturbing activities greater than 1 acre within the Valparaiso Lakes Area Conservancy District (VLACD) designated Municipal Separate Storm Sewer System (MS4) area comply with NPDES general permit requirements under 327 IAC 15-13 (Rule 13) Minimum Control Measure 4, with its purpose to control construction site storm water discharges and runoff. The guidebook is also intended to assist the VLACD with individual Storm Water Pollution Prevention Plan (SWPPP) reviews, and construction site (Rule 13) inspections.

This guidebook is intended to provide guidance to the application, design standards, and maintenance requirements of the construction site storm water runoff BMP's included herein. Reference is hereby made to the *Indiana Storm Water Quality Manual*, developed by the DNR, Division of Soil Conservation for further construction site storm water runoff BMP design standards and specifications.

The VLACD will periodically review the contents of this guidebook in order to maintain and keep information current. The VLACD will also periodically review new or other BMP's for inclusion into the guidebook. A copy of the latest revision of this guidebook will be made available at the following address:

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Construction Site Storm Water Runoff Best Management Practices (BMP) - (MCM 4)

Guide book and List Developed for and Approved by Valparaiso Lakes Area Conservancy District (VLACD) - January 2005

Category / Purpose	BMP #	BMP Name	Str. / Non-Str.	Temporary	Permanent
Runoff Control					
to minimize clearing	RC - 1	Preserve Existing Vegetation	S	T	P
	RC - 2	Permanent Diversions	S		P
to stabilize drainageways	RC - 3	Check Dams	S	T	
	RC - 4	Gravel Filter Berms	S	T	
Erosion and Sediment Control					
for site perimeter controls	ESC - 1	Temporary Diversion Dikes / Ditches	S	T	
	ESC - 2	Construction Entrances	S	T	
	ESC - 3	Silt Fence	S	T	
	ESC - 4	Brush and Rock Barriers / Filters	S	T	
for trapping sediment	ESC - 5	Sediment Retention Basins	S	T	P
	ESC - 6	Temporary Sediment Traps	S	T	
to stabilize exposed soils	ESC - 7	Revegetation (seeding, sodding)	S	T	P
	ESC - 8	Mulching	S	T	
	ESC - 9	Soil Binders / Chemical Stabilization	S	T	
to protect steep slopes	ESC - 10	Rip-Rap	S	T	P
	ESC - 11	Geotextiles / Erosion Control Blankets	S	T	P
	ESC - 12	Slope / Gradient Terraces	S	T	P
	ESC - 13	Temporary Slope Drains	S	T	
to protect waterways	ESC - 14	Temporary Stream Crossings	S	T	
	ESC - 15	Storm Drain Outlet / Inlet Protection	S	T	P
	ESC - 16	Catch Basin Inlet Filters	S	T	
for overall site erosion control	ESC - 17	Wind Erosion and Dust Control	S	T	
Planning					
for overall site planning	P - 1	Phased Construction	N	T	
	P - 2	Contractor / Employee Training	N	T	
Good Housekeeping					
for overall site storm water control	GH - 1	Spill Prevention & Control	N	T	
	GH - 2	Solid & Demolition Waste Management	N	T	
	GH - 3	Designated Vehicle Maintenance & Wash Areas	N	T	
	GH - 4	Stockpile Management	N	T	
	GH - 5	Street Sweeping	N	T	

* The guidebook will generally contain the following information for each of the Structural BMP's

- * Application or Selection Criteria
- * Standards or Specifications
- * Inspection and Maintenance

SECTION 1 - RUNOFF CONTROL

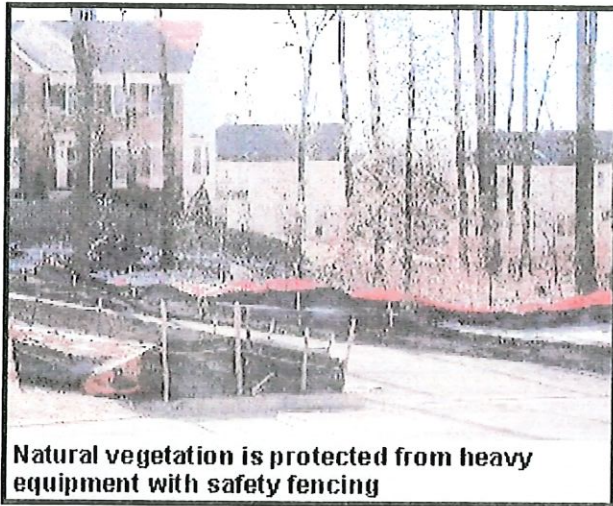
RC-1 through RC-4

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PRESERVE EXISTING VEGETATION

RC - 1



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To protect and preserve existing plants, trees and vegetated areas that will be exposed to land-disturbing activities, that have present and future value for erosion protection, wildlife habitat, landscape aesthetics, or other economic or environmental benefits.

Application or Selection Criteria:

- Can be used on all types of construction sites containing vegetated or forested areas.
- Applicable for floodplains, wetlands, streambanks, steep slopes, future construction areas, and sensitive habitat areas that have existing desirable vegetation.
- Requires advanced planning.
- May constrict the area available for construction activity.
- Improper grading might negatively impact vegetation.

Standards or Specifications:

- Install temporary fencing to protect existing vegetation before beginning clearing or other soil-disturbing activities.
- Consider tree health, age, species, space needed, aesthetic values, and wildlife benefits when deciding which vegetation to preserve.
- Follow existing contours and avoid stands of trees when locating temporary roadways.

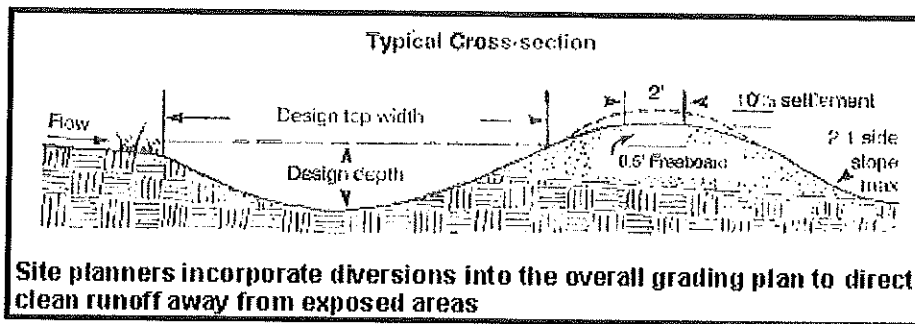
- Do not place equipment, construction, materials, topsoil, or fill dirt within the limit of the preserved area, or within a "critical root zone".
- Maintain existing irrigation systems.
- Consider installing tree wells or retaining walls.
- Fires are not permitted within 100 feet of the tree drip line.
- Mark clearly any areas that are not to be disturbed with construction fencing or wooden snow fence.
- Extend limits of fencing to one foot outside of the tree drip line (end of tree branches) when protecting trees, also referred to as the "critical root zone".
- Do not cut tree roots within the tree drip line. Excavate trenches around trees to avoid large root concentrations.
- Smoothly cut off the ends of damaged roots.
- Consult a local certified arborist or professional forester when requested by the County Authority or Conservancy District.

Inspection and Maintenance:

- Repair or replace damaged vegetation immediately. Smoothly cut off the ends of damaged roots.
- Monitor the protected areas to ensure that new structures won't compromise vegetation.
- Loosen compacted soil around the tree root zone.
- Fertilize broadleaf trees that have been stressed or damaged to aid the recovery. Consult an arborist to determine if and what kind of fertilizer is needed.
- Fertilize protected vegetation in late fall or early spring.
- Exposed tree roots should be covered with soil or wet burlap as soon as possible.
- Mitigation of trees damaged may be required as appropriate.

PERMANENT DIVERSIONS

RC - 2



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To design permanent channel and ridge facilities to collect stormwater runoff and/or stream flow and convey it away from disturbed ground to an appropriate outlet or downstream drainage channel.

Application or Selection Criteria:

- To decrease the threat of runoff from upstream watersheds that could pose a hazard resulting in property damage or erosion.
- To protect upland slopes by reducing slope lengths and minimizing erosion and soil loss.
- To reduce runoff velocities and increase stability by reducing channel slope and adding channel liners.
- May require watershed modeling and engineering design.
- Constructed channels must be stabilized so that they are not subject to the same erosion potential as the disturbed areas they are meant to protect.
- May require additional measures to ensure channel stability and function.

Standards or Specifications:

Open Channels for Storm water and Diverted Stream Flows

- Permanent open channels must be designed by a professional registered engineer according to the criteria outlined in the Indiana Storm water Quality Manual and shall have capacity to carry peak runoff from the 100-yr 24 hr storm.
- Refer to the Indiana Storm water Quality Manual regarding velocity limitations, channel liners, channel drops and energy dissipation structures.
- The channel maybe parabolic, triangular or trapezoidal shaped, shall be vegetated and have stable side slopes not steeper than 3:1.

- Open channels shall minimize standing water by ensuring sufficient velocity of 2 FPS or higher in design.
- The design height of ridge or bank shall be a minimum of 0.5 feet above the design water elevation.

Paved Flumes

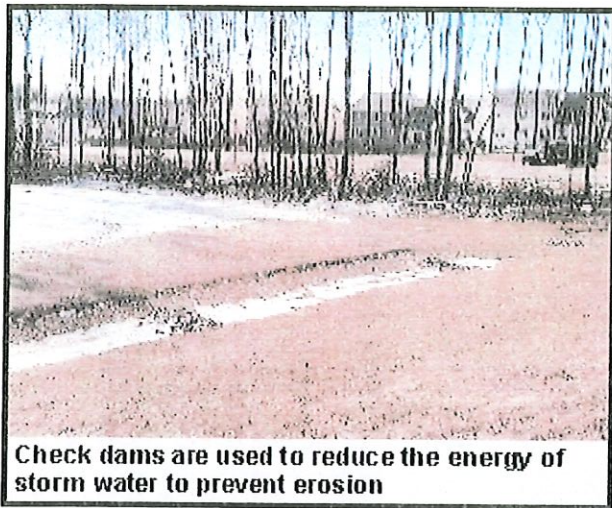
- Divert storm water runoff down the face of a slope without causing erosion problems on or below the slope.
- Outfall protection must be provided to prevent damage from high velocity flows.
- Maximum slope of the flume structure should not exceed 1.5H:1V
- Cutoff walls should be installed at upstream and downstream ends and along the length of the flume to prevent undermining.
- Anchor lugs should be placed along the length of the flume to prevent movement & shall be at a minimum 6" thick & extend at least 1 ft. into the soil.
- Expansion joints and transverse joints should be placed along the length of flumes at a minimum of approx. every 90 feet.
- Outlets must be protected using the appropriate energy-dissipating structures.

Outlet Protection

- Structurally lined aprons or other energy dissipating devices placed at the outlets of pipes to decrease the velocity of stormwater flows.
- No bends should be present in the horizontal alignment.
- Invert elevations should be equal at the receiving channel and at the downstream of the apron.
- No overflow should occur at the end of the apron.
- Side slope of the receiving channel should not be steeper than 2H:1V.
- Rip-rap, grouted rip-rap, concrete, or gabion baskets should be used to line the apron.
- Where velocities warrant, filter cloth should be placed between the channel and the rip-rap to prevent soil movement.
- Diversion must not outlet onto a right-of-way without authority of appropriate agency.

Inspection and Maintenance:

- Inspect channels and outlets a minimum of once every 2 weeks and after every rainfall until the area is stabilized.
- Inspect competency of rip-rap or channel lining after runoff events.
- Keep channels clear of sediment.
- Reseed areas if vegetation cover is not established.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To reduce erosion in channels, swales and ditches caused by high flow velocities through the installation of temporary dams constructed of rocks or gravel/sand bags which will improve stabilization of the drainageway.

Application or Selection Criteria:

- Used in small open channels draining 10 acres or less.
- Used in steep temporary or permanent channels when runoff velocities exceed 5 feet/second.
- Used to provide erosion protection when establishing grass linings in channels or drainage ditches.
- Do not use in live streams or perennial streams.
- Do not use in channels draining areas greater than 10 acres.
- Do not construct a check dam with slit fencing or straw bales.
- Check dams should not be used as primary sediment-trapping devices.
- Extensive maintenance may be required following high flow events.

Standards or Specifications:

- Place check dams at a distance and height to allow small pools to form behind them.
- Space the dams at regular intervals based upon soil types and slope gradients. The first check dam should be installed approximately 30 feet upstream of the outfall device.

- Design a check dam to pass a 2-year, 24-hour storm without causing damage to the dam or any upstream flooding.
- Rock diameters should range between 6 and 12 inches.
- The maximum height of a dam is 3 feet from the upstream toe to the crest and the center of the dam.
- The crest and the center of the dam should be 6 inches lower than the edges.
- Install (keyed) dam materials at least 6 inches into the sides and bottom of the channel. Filter fabric is recommended to be installed beneath the rock to provide a stable foundation and facilitate removal of the rock.
- Rocks should not be dumped in the construction of the check dam. Rocks should be placed individually by hand or by mechanical methods.
- The downstream toe of the dam should be met by the backwater from the downstream check dam if multiple check dams are installed.
- Check dams should be removed once vegetation has been established in a channel. Check dams may be left in place if the check dam is designed as a permanent structure in accordance with local drainage policies.
- Do not allow water to pond behind check dams for more than 7 days.

Inspection and Maintenance:

- Inspect regularly and after each runoff event for sediment buildup and signs of erosion under or around the dam.
- Replace loose material.
- Remove accumulated sediments when it reaches one half of the check dam height.
- Remove accumulated sediments prior to performing soil stabilization or permanent seeding practices.
- Remove check dam and accumulated sediments when dams are no longer needed or their useful life is completed.
- Dispose of accumulated sediments properly.

BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose: To detain sediment laden from disturbed areas and to allow settling of sediment prior to release to storm drains, streams or other watercourses.

Application or Selection Criteria:

- Used across gently sloping areas.
- Near the top of slopes.
- Used in areas where vehicular traffic needs rerouted because roads are under construction.
- To act as temporary check dams across construction roads or other unpaved roads when not in use.
- Used around the base of stockpiled materials.
- Upstream drainage area should be less than 5 acres in size.
- Difficult to clean when applied to landscaping areas.
- Gravel bags will be damaged by vehicles if not moved.

Standards or Specifications:

- Use well graded crushed rock or gravel.
- Rock gradation: 3/4 inch open graded when used for sheet flow, 3 to 5 inch open graded for concentrated flows.
- Use woven wire mesh to anchor gravel in concentrated flows.
- Provide multiple berms in series every 300 feet on slopes less than 5 percent, every 200 feet on slopes 5-10 percent, not recommended on slopes greater than 10 percent.

Inspection and Maintenance:

- Non- traffic areas: Maximum berm height should be approximately 18 inches, top width approximately 24 inches, and side slopes shall be 2H: 1V or flatter.
 - Traffic areas: Maximum berm height shall be 12 inches.
-
- Inspect monthly and after each rain event. Reshape or replace as needed. The maintenance required is proportional to the location, slope & rainfall amount.
 - Repair any washouts or other damage caused by construction.
 - Remove silt when the depth reaches one-half the berm height.
 - Remove silt and dispose of to avoid siltation problems.
 - Prevent flows around the ends of the barrier.
 - Do not allow water to pond behind gravel filter berms for more than 7 days.
 - Remove the berm at the end of construction or when the site is stabilized.

SECTION 2 - EROSION AND SEDIMENT CONTROL

ESC-1 through ESC-17

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BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To prevent erosion by capturing and diverting runoff away from above unprotected slopes. Also used along the perimeter of construction sites to prevent runoff from leaving the site. Temporary diversion dikes, ditches and swales should be used to convey runoff to sediment trapping devices or stabilized outlets.

Application or Selection Criteria:

- Utilize on up-slope of disturbed areas, or above sloped areas before stabilization.
- Utilize at perimeter locations of construction sites to keep sediment-laden water from leaving the site.
- Intercepts runoff from paved surfaces.
- Directs runoff to sediment trapping devices or stabilized outlets.
- Temporary application during construction, where permanent diversion is not applicable.

Temporary Diversion Dikes / Ditches

- Do not remove or trap sediments.
- Surrounding slopes should not exceed 5%.
- Upstream drainage areas should not exceed 3 acres.
- Dikes may become barriers to construction equipment.
- Concentrated runoff may damage adjacent areas.
- Diversion dikes should not cross roadways.
- Dikes must not adversely affect upstream or downstream properties.
- Scour and erosion in newly graded swales and ditches may occur.
- Ditches may require lining or check dams to prevent erosion and gully formation.

- Can be expensive if engineering design is required.
- Vegetation and ponded water in the bottom of these facilities can provide a mosquito habitat.

Standards or Specifications:

- Upstream drainage area shall not exceed 3 acres.
- Dikes & Ditches should be firmly compacted to minimize erosion and prevent unequal settling.
- Dikes & ditches shall drain to protected outlets and/or sediment-trapping devices.
- Provide a continuous positive grade to the outlet to prevent water from ponding. Maximum channel grade shall be 1%.
- Keep in place until the disturbed area is permanently stabilized.

Temporary Diversion Dikes

- Dikes should have the following minimum dimensions: top width of 24 inches, height of 18 inches, and side slopes of 2H: 1V or flatter.
- When revegetation is not possible, stabilize with filter cloth if necessary to reduce erosion potential.

Temporary Diversion Ditches

- No bushes, trees, shrubs, straw bales or silt fences should be located within ditches or swales.
- Stabilization with liners and/or check dams is required if channel grades exceed 1 percent or velocities are in excess of 5 ft/sec.

Inspection and Maintenance:

- Inspect at a minimum every 2 weeks and after rainfall events for debris buildup or damage to dikes, ditches, swales and liners.
- Remove accumulated sediment and debris and repair embankments and repair linings as needed.
- Do not allow water to pond behind dikes or in ditches for more than 7 days.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To limit the tracking of mud and dirt onto public roads by construction vehicles, to limit the amount of sediment leaving the construction site, and to limit the spread of air borne dust.

Application or Selection Criteria:

- On construction sites where tracking dirt onto public roads is a potential problem.
- Outlets from disturbed areas.
- Near water crossings.
- Where poor soil conditions may cause sediments to adhere to vehicle tires.
- To control dust in trafficked areas.
- Most effective when used in conjunction with wash areas.
- Site conditions and layout will determine the design.
- Can be expensive to install and maintain.

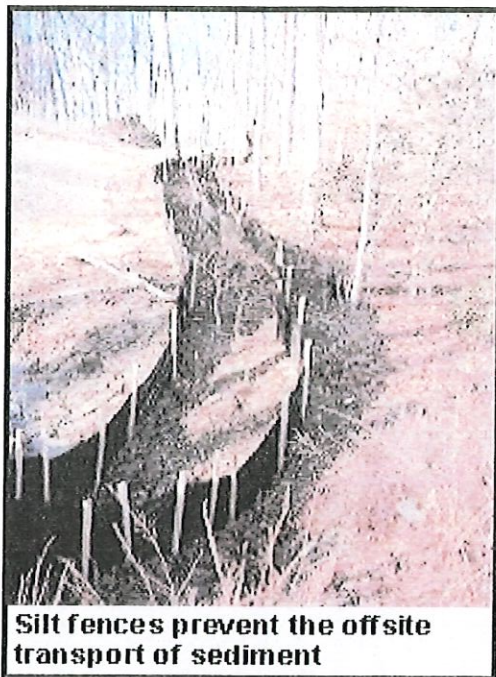
Standards or Specifications:

- Grade the exits and entrances to prevent runoff from leaving the construction site.
- Design entrances and exits for the heaviest vehicle using the site.
- Temporary construction entrance and exits shall be constructed of crushed stone aggregate over geotextile or filter fabric. Concrete or asphalt may be substituted as desired to provide additional stability.

- The construction site access should be constructed of washed well-graded gravels or crushed rock. A minimum thickness of 6 inches (12 inches is recommended) should be applied. Sharp edged stone shall be avoided.
- Geotextile or filter fabric shall be placed beneath the stone in order to prevent soils under the aggregate from migrating into the aggregate and to reduce the amount of rutting.
- Minimum entrance or exit length shall be 50 feet.
- Minimum entrance or exit width shall be wide enough to accommodate the largest vehicle utilizing the access.
- Provide turning radiuses where entrances or exits intersect a public way.
- Provide stop signs or other warning signs prior to leaving the site.
- Bridges or culverts shall be provided to maintain drainage and prevent bank erosion.

Inspection and Maintenance:

- Perform routine inspections and repair as needed.
- Require all vehicles traffic to enter and exit at these locations only.
- Sediments deposited on paved roadways should be removed daily and disposed of properly.
- All temporary roadway ditches should be kept clear and should be graded to prevent ponding.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To slow and detain sediment laden sheet flow from disturbed areas and to allow settlement of sediment prior to discharge to storm drains, streams or other watercourses.

Application or Selection Criteria:

- Use as temporary perimeter controls along the construction site perimeter.
- Below the toe of slopes.
- Along streambanks and channels.
- Around temporary stockpiles.
- Effective where runoff will be occurring as low level shallow flow.
- Not effective unless properly installed.
- Do not use on slopes greater than 4H: 1V.
- Labor-intensive maintenance may be required.
- Fencing must be removed and disposed of properly upon completion of construction.

Standards or Specifications:

- Do not install silt fences across streams, channels, or in any location where flows may be highly concentrated.
- Fencing must be located where waters may temporary pond and sediments can be deposited.
- Application in environmentally sensitive areas requires additional practices.
- Install the fencing along a levee contour at the toe of a slope.
- Install fencing a minimum of 3 feet from the toe of the slope or at the top of the bank.
- Limit drainage area upstream of fence to 0.25 acre/100 feet of fence.
- The length of slope drainage to any point along the silt fence shall be less than 100 feet.
- Maximum length of any single run of fencing shall be 500 feet.
- The last 8 feet of fence shall be angled upslope in a "J" or "L" shape to allow for ponding.
- Silt fence material shall be a pervious sheet of synthetic fabric such as woven nylon reinforced polypropylene with a built-in top cord running along the top of the fabric.
- Silt fence material shall meet the minimum requirements of fabric for tensile strength (ASTM D4632) puncture rating (ASTM D4833) and Mullen burst rating (ASTM D3786).
- Fence posts should be free from decay, splits, or cracks, have a minimum thickness of 2 inches, have a minimum length of 4 feet, should be installed a minimum distance of 12 inches into the ground, and should have a maximum spacing of 8 feet.
- Steel fence posts may also be used.
- Areas prone to high winds will require closer spacing of fence posts
- Fence posts shall be located on the downstream side of the fabric and mesh.
- Fabric must be stapled or wired to the posts.
- Locate a 6-inch X 6-inch trench on the upstream side of the fence.
- Insert at least 6 inches of fabric into the trench. Fill the trench with tamped native soil or washed gravel on top of the 6 inches of fabric.
- Silt fence fabric filtering efficiency: Average depends on installation and maintenance.
 - TSS Removal - 70%,
 - Sand Removal - 80-90%
 - Silt Loam Removal - 50-80%.

Inspection and Maintenance:

- Inspect before and after each rain event.
- Repair any damage caused by construction (undercutting of the fence, split, torn and weathered fabrics, or slumping of the fence).
- Fabrics shall be replaced every 6 months at a minimum.
- Remove silt before the depth of the deposit reaches one-half the fence height.
- Remove silt and dispose of to avoid siltation problems.
- Water shall not be allowed to pond behind silt fences for more than 7 days.
- Remove fencing at the completion of the construction project or when the site has been stabilized.
- Backfill any holes or depressions caused by the removal of the silt fence according to standard specifications.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

Runoff filters are used to temporarily detain and filter runoff, retain sediment on construction sites, and slowly release water as sheet flow to a stabilized or undisturbed area.

Application or Selection Criteria:

- Along the border of disturbed areas, or used as perimeter sediment control on a construction site.
- At the toe of slopes that are prone to sheet flow and erosion.
- Along streams and channels.
- Rock filters encased in steel wire enclosures are also known as gabions.
- Not appropriate where drainage area are greater than 5 acres.
- Sufficient space is needed for water to pond behind the erosion control structure.
- Rock filters are not effective for diverting runoff.
- Not appropriate for high-velocity flow areas.
- It is difficult to remove rock filters.
- Brush barriers may be covered with filter cloth to improve efficiency.
- Brush barrier materials decompose.

Standards or Specifications:

- Limit drainage area upstream of barrier to 0.25 acre/100 feet of barrier.

- The length of slope draining to any point along barrier shall be less than 100 feet.
- The minimum height of a brush or rock barrier is 2 feet from the ground surface and it should have base of 5 feet and slide slopes of 2H: 1V.
- The barrier should be entrenched 3-4 inches.
- Use a 3 to 5-inch diameter graded rock in the construction of rock berms.
- A rock berm should be constructed with woven wire sheath having a maximum opening of 1 inch.
- Install brush and rock filters along a level contour.

Inspection and Maintenance:

- Inspect before and after each significant storm event and weekly during the wet season.
- Replace lost or dislodged rocks, brush, or filter fabrics as needed.
- Remove sediment when the depth equals one-half the berm height.
- Water shall not be allowed to pond behind brush and rock filters for more than 7 days.
- Remove filter barriers upon the completion of construction activities.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To detain sediment-laden flows and allow for settling of suspended sediments prior to discharge of stormwater offsite or to storm water drains, streams or other watercourses. These devices can be constructed as temporary contrail that will be abandoned prior to the completion of site development or can be converted into permanent flood control and storm water runoff management ponds.

Application or Selection Criteria:

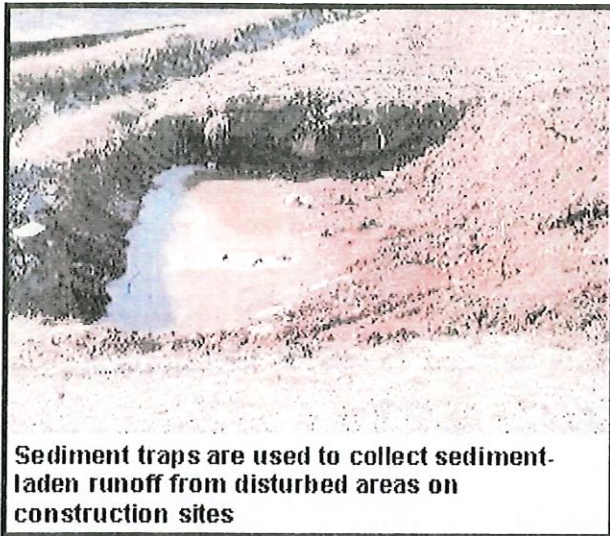
- Construction sites with disturbed areas during the wet season.
- Allows for prevention of sediment-laden stormwater from entering streams or watercourses.
- Intended for surface water only. Groundwater dewatering should not be discharged to the basin.
- Must be designed by a Registered Professional Engineer.
- Must use in conjunction with other methods to limit sediment.
- For temporary basins, maximum drainage area is 50 acres.
- Requires a large surface area to construct. Size may be limited because of site constraints.
- Site can be attractive and dangerous to small children.
- May require fencing.
- Not to be located in a live stream may pose a mosquito/pest problem if water pools longer than 7 days.
- Multiple basins may be needed for large sites.

Standards or Specifications:

- Requires regular maintenance to remove accumulated sediments.
- A Registered Professional Engineer must design and stamp all sediment retention basin plans.
- Design and control basin prior to grading or stripping the site.
- The size of the basin can be reduced by limiting the contributing area to only runoff from the disturbed soil areas if temporary controls are used to divert runoff from upstream undisturbed or stabilized areas away from the drainage area of the sediment retention basin.
- Locate the basin at a low point where failure will not cause property damage or extensive erosion.
- Maintain an access for maintenance and equipment vehicles.
- Capacity of temporary sediment retention basins should be designed to detain, at a minimum, the calculated volume of runoff from the 2-year, 24-hour storm.
- The basin outlet shall consist of a dewatering pipe and riser set just above the sediment removal cutoff levee which drains the basin into a primary spell way.
- Design the dewatering riser pipe to provide a minimum 24-hour drain time. Drain times up to 72 hours will increase sediment removal efficiencies.
- Locate the inlet and outlet to maximize sediment travel time within the basin. The length of the basin shall be more than twice the width of the basin. The length shall be determined by measuring the distance between the inlet and the outlet.
- Riser shall be located at deepest point of basin and extend no farther than 1 foot below the levee of the earthen dam.
- A water permeable cover shall be placed over dewatering riser pipe to prevent trash and debris from entering and clogging spell way
- Additional dewatering holes can be drilled near base of riser if protected with gravel in order to provide an additional path for water to enter the primary spillway.
- If this ratio cannot be met, silt fence baffles can be added to increase the flow length.
- Each basin must have an emergency overflow spillway.
- Outlets, inlets and spillways should be protected with riprap and filter fabric or other erosion protection measure.
- Above grade embankments shall be composed of compacted fill material. Side slopes shall not be steeper than 3H: 1V.
- Fence the area to prevent unauthorized entry where necessary.
- Remove sediments from the basin when the thickness of the deposit is 1 foot or one third the basin volume or becomes vegetated.

Inspection and Maintenance:

- Inspect before and after each rain event, and after each major storm.
- Perform daily inspections during an extended precipitation event.
- Inspect banks for seepage or damage.
- Repair any damages caused by construction or erosion.
- Check outlet structure and spillway for damages or obstructions. Repair as needed.
- Monitor inlet and outlet to determine effectiveness. Make corrections to the basin if it is not performing properly.
- Remove silt when the depth reaches one-third the basin volume and/or becomes vegetated.
- Remove silt and dispose of, to avoid siltation problems.
- Fill in temporary basins once construction activities are complete and final stabilization has been established.
- Water shall not be allowed to pond in sediment retention basins for more than 7 days.
- Permanent sediment retention basins shall be designed to meet standards of retention ponds as indicated in the Indiana Storm Water Quality Manual and the VLACD-approved Post Construction Storm Water Management BMP Guidebook.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To detain sediments in storm water runoff by slowing concentrated runoff and allowing sediments to settle out thus protecting or receiving waters, the storm drain system, and the surrounding area.

Application or Selection Criteria:

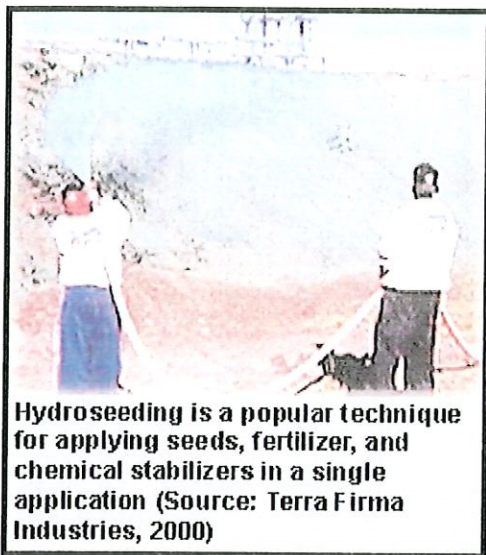
- Applies to drainage areas of 5 acres or less.
- In locations where sediment laden storm water might enter the storm water system.
- Usually installed in a drainage way or other point of discharge from a disturbed area.
- May require a large surface area. Size maybe limited because of site constraints.
- This BMP may develop a mosquito / pest habitat, if standing water remains after an extended period of time.
- Traps and removes medium to large sized particles, may not remove fine-grained sediments.
- Area may be attractive and dangerous to small children and may require fencing.
- Not to be located in live streams or dry channels.
- Multiply traps are needed for large sites.
- Requires regular maintenance to remove sediment.
- Effective life span of 24 months.

Standards or Specifications:

- Construct the sediment trap prior to grading or stripping the site. Do not install the sediment trap in wet or muddy weather.
- Locate the trap at a low point where failure will not cause property damage, extensive erosion or loss of life.
- Fence the area to prevent unauthorized entry.
- Maintain an access for machinery.
- Form sediment trap by excavating an area or by placing an earthen embankment.
- Construct an outlet for excavation or a spillway from embankment using large crushed rock, rip rap or aggregate to slow the release of runoff.
- Each trap should have an approximate storage capacity for the 2-year 24-hour storm or 1800 cubic feet per acre of total drainage area.
- The maximum height of an embankment shall be 5 feet from the original ground surface. Embankments should be composed of engineered fill compacted to a minimum of 90 percent relative density (ASTM D1557). Slide slopes shall not exceed 3H: 1V.
- The maximum depth of sediment in the trap shall be 1 foot or one-third the trap volume.
- The trap outlet should be sized to allow passage of the 2-year, 24-hour storm peak flow. The outlet shall be stabilized with well graded rip rap, crushed rock, or gabions to prevent erosion.
- The trap spillway should be located 1.5 feet or more below the top of the excavation or embankment.

Inspection and Maintenance:

- Inspect before and after each rain event. Daily inspections are necessary during extended and intense storms.
- Repair any damages caused by construction or erosion.
- Inspect banks of the sediment trap for seepage or damage.
- Remove silts when the depths of the sediment deposits reach one half the trap volume. Dispose of silt properly.
- Check outlet structure and spillway for damage or obstructions. Repair as needed
- Water shall not be allowed to pond in sediment traps for more than 7 days.
- Fill in temporary sediment basins when construction activities have ceased and final site stabilization has been established.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To stabilize exposed and disturbed soils and slopes from raindrop impact and erosion, conserve soil moisture, decrease runoff, increase infiltration, and to provide wildlife habitat.

Application or Selection Criteria:

- Can be applied on slopes, adjacent to waterways, as buffer strips and landscape corridors, on stream banks and in cut and fill areas.
- Irrigation during dry weather may be required.
- Additional erosion control methods may be required if the site is prone to erosion.
- Sod is much more expensive than seeding.

Standards or Specifications:

- Necessary erosion control practices must be in place prior to re-vegetation.
- With the exception of frozen ground conditions, permanent re-vegetation must be seeded or planted no later than 21 days after final grading.
- Consider climate, soils, and topography when choosing the appropriate vegetation and seed mixes for installation. They should be developed based on site-specific conditions and soil testing may be required.
- Conventional drilling, broadcast seeding, dormant seeding, or hydroseeding are allowable methods of applying seed mixes.

- A combination of seed species should be used when the objective is to re-establish native species that require little to no irrigation.
- Reference the INDOT Standard Specification Manual, section 621 for a general guidance of suitable species and application of seed for re-vegetation.
- All seeding rates must be as recommended by INDOT Standard Specification Manual section 621.
- Local climatic conditions and plant species will determine when to install vegetation. Generally, seeding is to occur prior to Oct. 15th and after March 15 annually, but specifically shall not occur when ground is frozen or saturated.
- Increase re-vegetation success by roughening soils prior to seeding than applying mulch with a tackifier.
- All permanent seeding shall be mulched in accordance with ESC-8 upon completion of seed application or planting.
- Erosion control blankets shall be substituted for mulch on steep slopes to provide erosion control.
- Normally, unless slow release, fertilizers should not be applied.
- After seeding, grasses and legumes should emerge between 4-28 days.
- Plants should have a uniform density and should be well intermixed.
- Final stabilization requires that perennial vegetation has been established with a density of 70 percent of the native background cover.

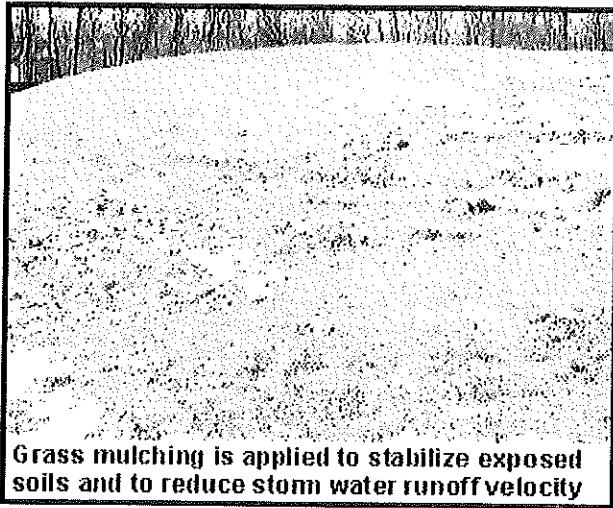
Sod

- Sod can provide immediate cover for critical areas.
- Sod should be free of noxious weeds, diseases, and insects.
- Strips of sod with a thickness between ½-inch and 2 inches should be laid perpendicular to the direction of runoff flows and should be staggered in a brick-like pattern.
- Sod should be secured with stakes when the slope is steeper than 3H: 1V.
- The harvesting, delivery, and installation of sod should occur within 36 hours.
- Avoid installing sod on gravel or non-soil surfaces.
- Avoid installation during unusually hot, wet, or cold weather and do not mow the sod for 2-3 weeks after installation. No installation on frozen ground.

Inspection and Maintenance:

- Irrigation may be required until new vegetation has been firmly established.
- Seeded areas should be examined for failures. If failures have occurred the area should be reseeded, amended if necessary, and mulched during the planting season.

- Soil tests should be conducted to determine if soil inoculants, amendments or fertilizers are necessary in areas that vegetation is having difficulty in being established.
- Water sod regularly and uniformly.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To prevent erosion by stabilizing erosion soils, protecting them from rainfall, reducing runoff velocity, providing insulation, conserving moisture, and fostering plant growth. Mulches can be composed of organic materials, straw, wood chips, bark or other wood fibers, gravels, a variety of netting, or chemical stabilizers and they act to protect seeds from predators while reducing evaporation and insulating the soil.

Application or Selection Criteria:

- Applicable to all revegetated soil surfaces where construction activities will cease for 14 days or more and will not resume within 21 days.
- Provides a temporary cover and aids in stabilization measures.
- Mulching should immediately follow temporary and permanent seeding of an area.
- Mulching can assist in mud and dust control, or can provide protection during periods when construction or seeding cannot be performed.
- Additional control measures are necessary for the establishment of vegetation if the area is susceptible to erosion or in an area of slope.
- Straw and wood mulch may have to be removed before soil stabilization or permanent seeding is to take place.
- Straw and wood mulch are prone to removal by runoff and wind.
- Wood fiber hydraulic mulches usually last only part of a growing season.
- A potential for introducing weed-seed and unwanted plant material exists.
- Not all soil conditions are appropriate.

Standards or Specifications:

- The type of mulch to be applied depends on soil type, site conditions, landscape requirements, and economics.
- Embankments and fill areas should be roughened before applying mulch.
- All areas to be applied shall be rough graded, removing all rocks or debris larger than 2".

Straw Mulch

- Used as a temporary or permanent surface cover on disturbed areas until vegetation can be established.
- Straw should be applied at an approximate rate of 4,000 lb/acre.
- Straw mulch can be applied to a slope by crimping, punch roller-type rollers, or track-walking.
- The area must be within 150 feet of a roadway if straw blowers are to be used in the application of the mulch.
- Do not place straw in lined drainage channels, on sidewalks, or on sound walls.
- Straw should be held into place on steep slopes or in small areas by plastic netting or jute.
- Apply straw mulch at an approximate rate of 125 lb/acre if tackifier is to be used.
- Ensure that the mulch is weed free.

Wood Mulch and Shredded Wood

- Primary used as a temporary ground cover around trees, shrubs, and landscaping.
- Is applicable as a covering for ornamental or revegetated plantings.
- Should be applied by hand.
- Distribute mulch as a layer 2-3 inches thick.

Green Material/Compost

- Mulch should be composted to kill weed seeds.
- Apply mulch evenly to a maximum thickness of 2 inches.
- Typically applied by hand.

Hydraulic Mulches made from recycled paper

- Composed of a mixture of recycled newsprint, magazines, or other paper waste products.
- Mulch should be mixed with seeds, fertilizer, tackifier and can be applied on most sites.
- Erosion control effectiveness is limited by the short fiber length and lack of tackifier.
- Life span is less than that of the wood fiber mulches.

Hydraulic Mulches made from wood fiber

- Industry standard is composed of whole wood chips. Wood fiber mulch can also be made from lumber mill waste.
- Good for planting large areas quickly and economically.
- Provides limited erosion control (even with tackifier) when applied at high rates.
- Offers better wet-dry characteristics than paper mulch.

Hydraulics matrices (Bonded Fiber Matrix)

- Hydraulic slurries are a mix of wood or cellulose fiber held together by a chemical or mechanical bond.
- This mixture does not dissolve upon rewetting or contain any growth inhibiting factors.
- Application rates should range between 3,000 lbs/acre to 4,000 lbs/acre.
- Do not apply immediately before, during, or after rainfall. Allow 24 hours of drying before application.
- All mulch materials must be removed before working on the slopes.
- Weak spots should be covered to prevent soil erosion and to protect the soils.

Inspection and Maintenance:

- Inspect for failures and loss of mulch during the wet season.
- Replace lost mulch immediately.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose: To provide temporary stabilization of exposed and disturbed soils, assisting in wind erosion and dust control.

Application or Selection Criteria:

- Locations where other methods such as temporary or permanent seeding of vegetation can't be immediately applied.
- Used in combination with vegetative or perimeter practices to enhance erosion and sediment control.
- May limit infiltration and increase runoff.
- Overuse may adversely impact water quality.
- Chemical stabilizers are expensive compared to vegetative practices.
- Soil binders are only temporary and therefore need to be reapplied.
- Some binders need at least 24 hours to become fully effective.
- Heavy rainfall events may cause spot failures.
- Soil binders are weakened by pedestrian or construction traffic.
- Soil surfaces comprised of compacted silts and clays may be impenetrable to soil binders.
- Low temperatures may not allow soil binders to cure.
- Some soil binders do not perform well in climates with low relative humidity.

Standards or Specifications:

- Soil binders must be non-toxic to plants and animals, easy to apply, easy to maintain, economical, and should not stain paved surfaces.
- Spray should not reach sidewalks, lined drainage channels, or existing vegetation.
- Types of soil binders which can include copolymer or spray-on adhesive emulsions, should be effective on the applicable soil type and should be applied at a rate as recommended by the manufacturer.

Factors to consider when choosing a soil binder

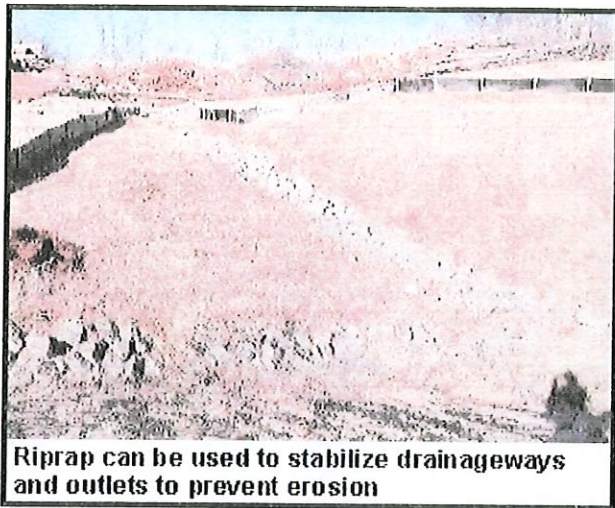
- Consider where the soil binder will be applied.
- Soil type and frequency of application.
- Follow the manufacturer's recommended application rates and procedures.
- Roughen embankments and fill areas prior to application of soil binders.
- Do not apply soil binders during or immediately after rainfall.
- Do not apply soil binders to frozen soils or areas with standing water or during rainy conditions or when the temperature is less than 40° F.
- Allow 24 hours for soil binders to cure.

The application of liquids agents requires:

- Pre-wetting the ground surface.
- Overlapping solution 6 to 12 inches.
- Curing for a minimum of 24 hours.
- Apply a second treatment when first treatment becomes 50 percent ineffective.
- Re-wetting the chemicals with water to reactivate them as necessary in dry climates.

Inspection and Maintenance:

- Inspect regularly areas that have been chemically stabilized.
- Inspect daily high traffic areas while lower trafficked areas need only weekly inspection.
- Reapply stabilizers if needed.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To stabilize and to protect soil from erosion in areas of concentrated runoff steep slopes or at outfalls.

Application or Selection Criteria:

- Used on cut-and-fill slopes, channel side slopes, channel bottoms, inlets and outlets of culverts and slope drains, and streambanks.
- Slopes greater than 2H: 1V may lose rip-rap, consider using other materials.
- Measure should be taken to minimize erosion and excess turbidity in flowing streams during construction.

Standards or Specifications:

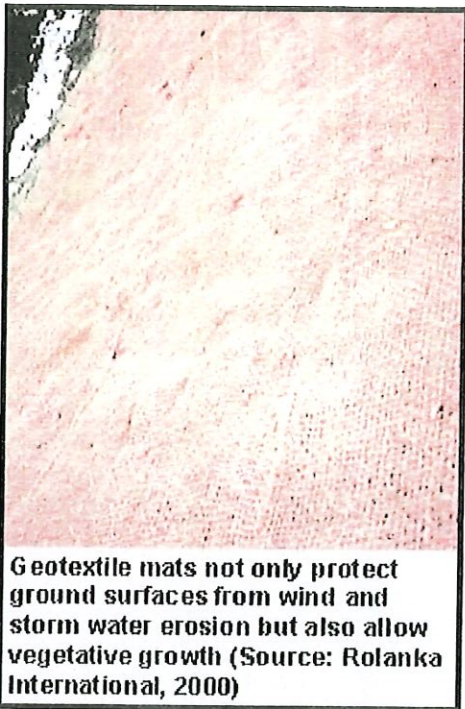
- Use a well-graded mixture of rock sizes.
- Use double stone that won't quickly decompose from freeze/thaw cycles (i.e. granite or limestone)
- Rip-rap layers should be twice as thick as the maximum stone diameter.
- Use a filter cloth material as a filter between the rip-rap and the underlying soil surface.
- Rip-rap should extend on the banks as high as the maximum flow depth in channels or streams (minimum of 4 feet) or to a height where vegetation will be satisfactory to control erosion.
- On curves, rip-rap should extend through the curve to five times the bottom width from upstream and downstream endpoints.

Inspection and Maintenance:

- Rip-rap size depends upon site-specific conditions.

- Inspect annually and after each major storm.

- Damaged rip-rap should be repaired immediately.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To protect soils and steep slopes from wind and water and to stabilize disturbed soil areas through the application of geotextiles, erosion control blankets or turf reinforcement mats.

Application or Selection Criteria:

- Effective on steep slopes (10% or greater) with high erosion potentials, slopes that are adjacent to streams or wetlands, on disturbed soils that are slow to establish vegetable cover, and on slopes where mulch must be anchored.
- Not appropriate for areas that will be mowed or that contain rocky surfaces.
- Erosion control blankets and geotextiles are seldom used as a temporary control measure, they typically become permanent.
- Erosion control blankets and geotextiles tend to be more expensive than other erosion control methods due labor costs and material expenses.
- Erosion control blankets and geotextiles should not be used in high wind areas.
- Turf reinforcement mats should only be used with irrigation or where there is surface hydrology (i.e. wetlands).
- Factors to consider when choosing an erosion control blanket include cost, effectiveness, acceptability, vegetation enhancement, installation and operation and maintenance.

Standards or Specifications:

- Erosion control blankets shall be secured in place with staples in accordance with the manufacturers recommendations.
- Turf reinforcement mats are a three dimension matrix of interwoven layers of polypropylene, nylon, and polyvinyl chloride netting. They allow for soil filling and retention as well as aiding in the enhancement of vegetable root and stem development.
- Turf reinforcement mats have high shear strengths, are resistant to ultraviolet light, and are inert to the chemicals in soils.
- Straw, coconut, straw/coconut, or Excelsior blankets are used as erosion control mats.
- All rocks, vegetation, clods, and debris should be removed from the site before installing erosion control mats to allow for direct contact with soil.
- Seed the area before installing erosion control blankets.
- To anchor mats, u-shaped wire staples, triangular wooden stakes, or metal geotextile stake pins can be used.
- Staples should be made of steel wire. Wire staples should be a minimum of 11 gauge.
- Metal stake pins should have steel washers at the head of the pins.
- All anchors should be 6-18-inches long.

Steps to install erosion control blankets on slopes:

- At the top of the slope, install a trench 6 inches deep by 6 inches wide to anchor the blanket and then backfill the trench.
- Follow the direction of water and unroll the blanket (downslope).
- Parallel rolls should be overlapped by 4 inches and stapled every 3 feet.
- Splice the blankets by laying them over each other with a 12-inch overlap.
- Keep the blankets in direct contact with the soil. Do not stretch them.

To anchor the blanket, install staples:

- Steep slopes (2H:1V and steeper) – minimum of 2 staples/yd
- Moderate slopes (2H:1V and flatter) – 1 ½ staples/yd
- Gentle slopes require a minimum of 1 staple/yd

Steps to install erosion control blankets in channels:

- Anchor trench should be 12 inches deep and 6 inches wide across the channel at the lower end of the project area.
- Dig 6-inch deep and 6 inches wide intermittent check slots across the channel at a spacing of 25 to 30 feet.

- To bury the edge of the matting, dig 4-inch deep and 4-inch wide anchor slots longitudinally along the channel.
- Place the initial roll in the center of the channel at the downstream end. Secure it every 12 inches. Note that the matting will be upside down initially.
- Repeat the previous step using the adjacent rolls and creating a 3- inch overlap of blankets. Be sure to anchor the ends of the mats down securely every 12 inches.
- Unroll the center mat upstream and follow with the others maintaining the 3-inch overlap.
- Secure all rolls snugly into transverse check slots by laying the mat into the slot, folding the mat back on itself, installing anchors, filling with backfill and compacting the soil.

Inspection and Maintenance:

- Blankets should be inspected after installation and periodically during construction activities.
- Before and after significant storm events, the blankets and mats should be inspected for erosion and undermining.
- Repair damages and failures immediately.
- Repair the slope or channel before reinstalling blankets if washouts or breakages have occurred.

BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

Terracing and soil roughening or tracking of slopes reduces erosion by creating stair-steps, furrows across slope and serrations in the soil. Uneven bare soil surfaces capture raindrops, decrease the velocity of runoff, trap sediments, increase infiltration into the soil, aid in the establishment of vegetation, and can be used to protect steep slopes.

Application or Selection Criteria:

- Appropriate for all construction sites, particularly sites with uneven topography, easily erodible soils, or steep slopes when suitable runoff outlets are provided.
- Applicable on graded areas that have smooth and hard surfaces.
- To be used in conjunction with seeding, planting, and mulching for temporary and permanent erosion control.
- Soil roughening will increase grading costs, may cause sloughing in certain soil types, and is not appropriate for rocky slopes.
- Stair-step grading or terracing may not be appropriate for sandy, steep, or shallow soils.
- Effectiveness of soil roughening or tracking is limited when used alone in intense rain events.
- Terracing installed as a permanent measure to shorten slope length should be designed based on site-specific conditions and under the direction and approval of a registered professional civil engineer.

Standards or Specifications:

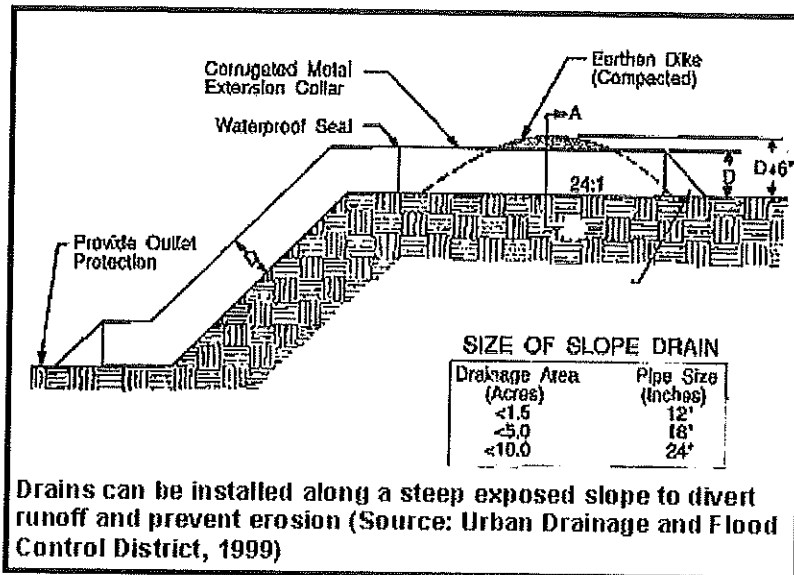
- Roughening methods include: stair-step grading, grooving, tracking, and rough grading.
- Consider factors such as slope steepness, mowing requirements, formation of slope by cutting or filling, and availability of equipment when selecting a method of roughening.
- Graded areas that will not be immediately permanently stabilized, steeper than 3H:1V shall be stair-stepped with terraces, grooved, or tracked.
- Use terraces where the slope length needs to be shortened.
- Each terrace shall have a vertical cut to horizontal step ratio of not less than 1:1.
- Horizontal portion of terrace shall slope back towards vertical face of cut.
- Cuts shall not exceed 3 feet when stair-stepping slopes with terraces.
- Grooving shall consist of machinery creating series of ridges running perpendicular to the slope. Ridges shall not be less than 3 feet deep, nor further than 15 inches apart, on graded slope areas.

Inspection and Maintenance:

- Inspect tracked and grooved slopes for gullies after storm events.
- Repair immediately small-scale eroded areas to prevent them from developing into significant gullies.
- Inspect permanent terraces annually and after significant storm events.

TEMPORARY SLOPE DRAINS

ESC - 13



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

Used as a temporary measure to convey concentrated runoff down the face or across a slope to a stabilized discharge point which will protect steep slopes from erosion.

Application or Selection Criteria:

- Used on construction sites where surface runoff above a cut or fill slope may cause slope erosion if allowed to flow over the slope.
- Clogged slope drains can cause flooding and severe erosion.
- High flows must be dissipated at outlet to avoid downstream erosion.
- Slope disturbance can occur during construction and removal of drains.
- Often used in conjunction with temporary diversions or diversion dikes to direct runoff to the slope drain.

Standards or Specifications:

- Size the slope drain at a minimum to convey the peak flow from the 2-year, 24-hour storm.
- Maximum allowable drainage area should be 5 acres per slope drain.

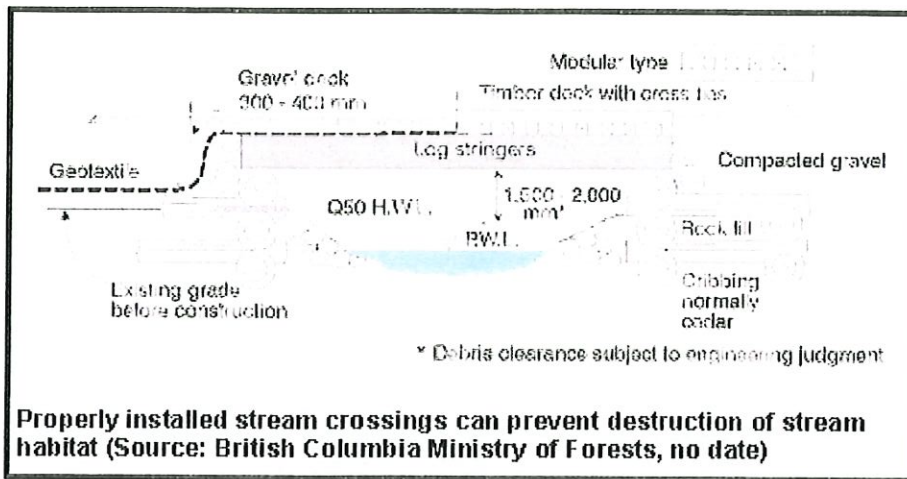
- Generally size drains as follows:

<u>Max. Drain Area</u>	<u>Pipe Diameter</u>
0.5A	12"
1.5A	18"
2.5A	21"
3.5A	24"
5A	30"

- Slope drains should not be used on slopes steeper than 2H:1V.
- Compact soil around inlet, outlet and along length of pipe.
- Inlet must be securely entrenched and stable so that surface water can enter freely.
- Pipe drains should have gasketed or watertight fittings or connecting bands.
- Pipes can be either placed on the surface or buried beneath the slope, but should be secured to the ground with stakes, anchors or grommets.
- Pipes should be installed perpendicular to slope contours, and must extend beyond toe of slope. To a stable area or outlet.
- Protect area around inlet with filter fabric.
- Stabilize the outlet using riprap or other materials to dissipate energy as a sediment trapping device.

Inspection and Maintenance:

- Inspect weekly and after every storm event that creates runoff, and promptly make necessary repairs.
- Inspect the inlet for undercutting and the outlet for scour.
- Inspect for accumulations of sediment and debris.
- Remove accumulations of sediment and debris prior to the next forecasted storm event.
- Water should not pond in inappropriate areas (e.g. active lanes, material storage areas, etc.).
- Avoid placing material on or construction traffic across slope drain.
- As the protected area has been permanently stabilized, temporary measures may be removed and remaining disturbed areas should be stabilized appropriately.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

A temporary stream crossing is a culvert, or bridge placed across a waterway for use by construction traffic. This structure stabilizes and minimizes erosion of the streambanks and channel.

Application or Selection Criteria:

- At sites where construction vehicles will frequently cross a stream or waterway.
- At sites where duration of construction activities will not exceed one year.
- May require a U.S. Army Corps of Engineers Permit, a construction in a floodway permit from IDNR, a 401 Water Quality Certification from IDEM or other permits.
- Disturbance of the waterway will occur during the installation and removal of temporary stream crossings. Therefore, sediment control measures may need to be installed downstream in the waterway during construction.
- Stabilization of the disturbed areas should occur both during construction and after removal of the structure.
- Structures may obstruct flow in the waterway during major or prolonged storm events causing flooding and/or washouts.
- Diversion or dewatering of the channel may be required during the installation of the stream crossing structure.

Standards or Specifications:

General Considerations

- A registered civil or structural engineer should design the structures.

- Sediment traps should be installed immediately downstream of crossings to capture sediments.

Temporary Bridge

- Must not restrict waterway area.
- Must span waterway with no intermediate supports.
- Must be designed by a registered engineer and constructed to carry design traffic loads.

Temporary Culverts

- Typically used on perennial, and intermittent streams.
- Install on a stabilized bed.
- Stabilize inlets and outlets with fabric and riprap or washed aggregate material.
- Stream channel banks and bed must be stabilized and restored following culvert removal.
- Appropriate for streams with high flow velocities, steep gradients, or where temporary constrictions in the channel are not allowed.
- Must be engineered and constructed to carry design traffic loads.
- Must be designed to safely handle a capacity of a 2 yr-24 hr storm at a minimum.

Inspection and Maintenance:

- Inspect weekly as well as before and after significant rainfall events.
- Inspect for sediments buildup in the culverts or blockage of the channel.
- Inspect for structural weakening of the temporary crossing.
- Inspect for channel sour, erosion of the abutments, riprap displacement, or piping in the soil.
- Remove silt in culverts and under bridges.
- Replace aggregate or riprap that has been lost from culvert inlets and outlets.
- Repair streambank erosion.
- Promptly remove temporary stream crossings when no longer needed. And stabilize/restore stream channel and banks.



BMP Type

Temporary / Permanent

Structural / Non-Structural

OUTLET PROTECTION

Purpose:

To reduce storm water flow velocities and energy from construction sites by placing a section of rock at culvert and drain pipe outlets and within channels, which will reduce erosion from the construction site and protect waterways.

Application or Selection Criteria:

- At locations where discharge velocities and energies may erode downstream reaches.
- Pipe, drain, culvert, conduit or channel outlets.
- At outlets located at the bottom of mild to steep slopes.
- At the outlets of channels that carry continuous flows.
- Outlets subject to short, intense flows of water.
- Points where lined conveyances discharge to unlined conveyances.
- Loose rock may be washed away during high flow events.
- Freeze and thaw cycles may break down grouted riprap.
- Inadequate drainage may cause grouted rip-rap to break up due to hydrostatic pressure.

Standards or Specifications:

- Rip-rap, grouted rip-rap, or concrete aprons should be installed at all outlets. Rip-rap aprons are well suited for use during construction.
- Provide additional protection for outlets on slopes steeper than 10 percent.
- Higher outlet velocities require larger rocks.
- Minimum rock size is 6-inch diameter.
- Flow must be slowed to non-erosive velocity.
- The apron should be aligned with the receiving stream and it should be kept straight throughout its length. If a curve is needed to fit site conditions, place it in the upper section of apron.
- The underlying filter fabric should be protected with a gravel blanket if the riprap is too large.

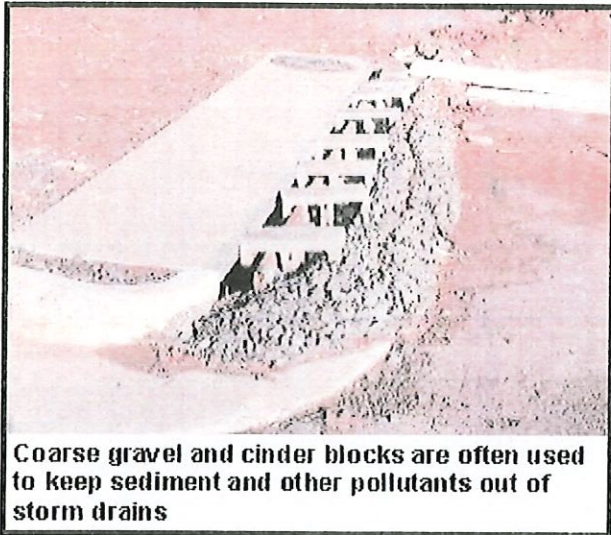
Inspection and Maintenance:

- Inspect weekly and after every significant rainfall event.
- Check for displacement of riprap or damage to underlying fabric.
- Check for scour beneath the riprap and around the outlet.
- Replace riprap as needed.
- Repair damage to slopes or underlying filter fabric.
- Remove promptly all device when the drainage area has been stabilized or at the completion of construction.
- Modify outlet protection if downstream erosion is evident.
- Remove temporary facilities from service when construction is complete. Outlet protection may be left in place if designed to be a permanent installation.

STORM DRAIN OUTLET / INLET PROTECTION

Continued...

ESC - 15



INLET PROTECTION

Purpose: To allow ponding and filtering of sediment-laden runoff prior to entering the storm drain system, at storm drain drop inlets.

Application or Selection Criteria:

- Use where inlets are potentially impacted by sediment laden surface runoff. Practical for low-sediment, low-volume flows.
- Recommended for use in drainage areas 1 acre or less.
- Use in disturbed drainage areas that have not been permanently stabilized.
- Applicable for wet and snowmelt seasons.
- May not be necessary if storm drain discharges to a sediment retention basin.
- Not to be used when ponding will encroach into roadway traffic or onto erodible surfaces and slopes.
- Sediment removal is minimal in high flow conditions.
- Frequent maintenance is required to remove sediment and debris.
- The inlet grate should not be covered with filter fabric.

Standards or Specifications:

Block and Gravel Protection

- Appropriate for drainage areas 1 acre and less with higher flows, where overflow is anticipated.
- Allow for overtopping to prevent flooding. Block heights shall be minimum of 1 foot, maximum 2 feet.
- Place concrete block around inlet grate with openings parallel to the ground surface at a determined height around the inlet.
- Blocks shall be set at a minimum 2 inches below grade for stability.
- Mortar shall not be used.
- Place filter fabric or (½ inch) wire screen around the outer openings and secure in place.
- Cover fabric or screen with (¾ to 1" diameter) washed aggregate approximately 1 foot wide, completely around the inlet protection blocks, with slope max 2:1.

Filter Fabric Fence

- Appropriate for relatively small (less than 1 acre), flat drainage areas subject to sheet flow and for flows not exceeding 0.5cfs.
- Only surround inlet with filter fabric fence when it is located in a sump and the top of the fence is below the top of the surrounding slopes in order to prevent runoff bypassing the inlet.
- Not appropriate for paved areas.
- Filter fabrics should not be placed underneath the inlet grate.
- Stakes should be driven a minimum of 8 inches into the ground. They should be spaced a maximum of 3 feet and have a minimum dimension of 2 inches by 2 inches.
- The fabric filter or frame support should be buried at least 1 foot below the soil surface and rise no higher than 2 feet above the ground surface.
- The fabric should be cleaned or replaced when it becomes clogged with sediment.
- The sediment should be removed when the accumulation behind the fabric fence reaches one half the height of the barrier.

Excavated Sediment Trap

- Used where relatively heavy flows are expected and overflow capacity is needed.
- Size trap to provide a minimum storage capacity of 50 yd/acre of drainage area, with an excavation at a minimum 1 foot deep and a maximum 2 feet deep.
- Side slopes should be excavated no steeper than 2:1.
- Remove sediments when the excavated sediment trap volume has been reduced by one half.

Inspection and Maintenance:

- Inspect before and after rainfall events and weekly during the wet/rainy season.

- Inspect inlet protection devices at least once every 24 hours during extensive rain events.
- Inspect storm drain inlets and downstream drains during major storms for bypassed material.
- Properly dispose of accumulated sediments.
- Water shall not be allowed to pond behind or within these control measures in excess of 7 days.
- Prior to removal of inlet protection devices, bring the disturbed area to the grade of the drop inlet and smooth and compact it. Appropriately stabilize all bare areas around the inlet.
- After site is stabilized, remove inlet protection devices or when protection is no longer needed.



A worker inserts a catch basin insert for oil and grease, trash, debris, and sediment removal from storm water as it enters the storm drainage system (Source: AbTech Industries, 2001)

BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To filter sediment-laden runoff and improve the quality of water entering the storm drain system at catch basins. Filters are held in place by the catch basin grates.

Application or Selection Criteria:

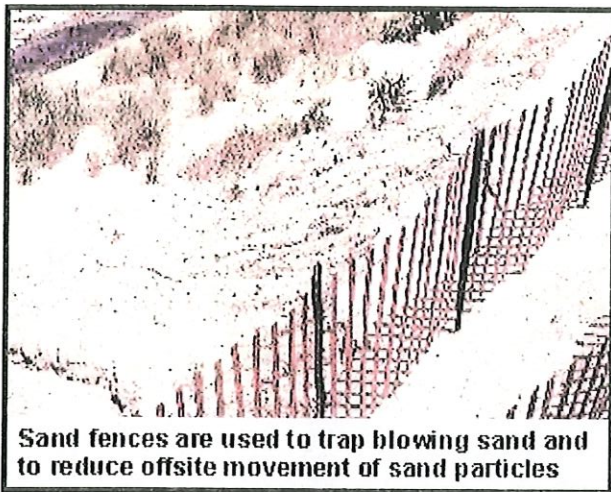
- At construction sites where disturbed areas may allow sediment laden water to enter catch basins or inlets.
- Where clogging of the drainage system by sediment laden stormwater may be a problem.
- For use at sites where space or traffic constraints limit the use of other forms of stormdrain inlet protection.
- To be used as a secondary sediment control with primary erosion control measures (hydroseeding, erosion control blankets, silt fence...)
- May cause flooding if not maintained.
- May cause a discharge of sediment to the stormdrain system if filter fabric tears or pulls away from the grate.

Standards or Specifications:

- Remove the drain grate and install the catch basin filter leaving 3 inches of flap exposed.
- Ensure that the filter will be held in place between the grate and catch basin by following the filters manufacturer's recommendations for installation.

Inspection and Maintenance:

- Inspect catch basin filters weekly and after every rain event at a minimum.
- Catch basins filters should e emptied when they are approximately half full.
- Follow manufacturer's guidelines for maintenance procedures, usually requires two people and two poles to remove.
- Properly dispose of sediments.
- Remove catch basin filters when construction activities are complete and final site stabilization has been accomplished.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

Storm water runoff, wind, erosion, and vehicle track-out from construction sites can re-disperse sediments to the air by high winds and traffic. Therefore, the purpose of dust control is to minimize these effects by implementing overall site erosion control.

Application or Selection Criteria:

- All construction sites having exposed soils should perform dust control measures, including water or adhesive application or barrier installation.
- Wind erosion and dust control is extremely important in arid and windy regions, and open construction sites.
- Areas with soils of silts and clays are prone to dust.
- Dust control is a treatment between disturbance and construction or re-vegetation and is a temporary measure.
- Dust control methods can help to minimize pollutants in the storm drain system, are expensive, and are easy to install and maintain.
- Dust control measures are only temporary and therefore require reapplication or maintenance.
- Discharges from the site can occur if excessive water is sprinkled on the soils during water applied dust control techniques.
- Factors such as soil type, temperature, humidity, and wind velocity will impact the effectiveness of the dust control measures.
- Spray on adhesives may be substituted for water on mineral soils, however are not effective on muck soils.

Standards or Specifications:

- A pressure-type distributor or a pipeline equipped with a spray system should be used to evenly distribute water, in water applied dust control techniques.
- A positive means to shutoff distribution equipment should be installed.
- At least one mobile unit should be available to immediately apply water to the construction site, throughout land disturbing activities for larger sites.
- If non-potable water is used for dust control, all tanks, pipes, and other conveyances should be clearly marked with "NON-POTABLE WATER-DO NOT DRINK". There should be no cross connection between portable and non-portable water.
- Soil binders such as spray-on adhesives may assist in wind erosion and dust control. Barrier installation perimeter fencing is a technique to assist in dust control that is recommended for larger sites.

Sprinkling/Irrigation

- Moistening road surfaces is an effective dust control method for traffic routes.
- Soil board fences, snow fences or burlap fences are most efficient.
- This technique can be applied to all sites but lasts less than 1 day so it must be reapplied often.
- Apply water uniformly to pre-wet the soil surface until surface is moist.
- Reapply water as necessary to accomplish dust control during land disturbing activities.
- Avoid ponding by crowning the soil surface.
- Compact soils if necessary.

Tillage

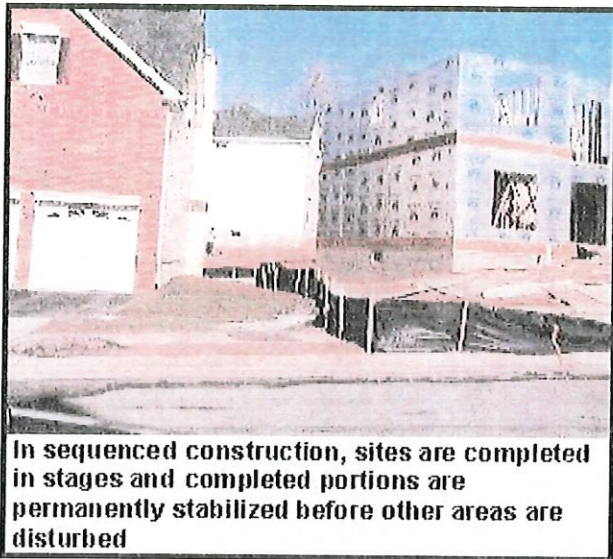
- Turning down the soil brings clods to the surface where they can act to keep down the dust.
- Other techniques that will aid in controlling and minimizing dust include the addition of vegetative covers, mulch, stones, soil binders.

Inspection and Maintenance:

- Daily inspections should occur for areas experiencing excessive winds, vehicle traffic, or rains.
- Periodic maintenance for perimeter fencing is necessary.

SECTION 3 - PLANNING

P-1 through P-2



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To reduce on-site erosion and sediment transport off-site by sequencing land disturbing and erosion and sediment control measures.

Application or Selection Criteria:

- All construction projects where water quality might be impacted by erosion from land disturbing construction activities.
- Weather and other unforeseen conditions may affect construction phasing.

Standards or Specifications:

- Construction phasing schedules shall include at a minimum the following:
 1. A schedule that is compatible with the general construction schedule.
 2. A schedule that lists all proposed land disturbing activities and the proposed sequencing thereof, including: construction access, land clearing, grading, building & construction.
 3. A schedule for the sequencing and installation of erosion and sediment control measures, including sediment traps, barriers, runoff control, conveyance system, surface stabilization, landscaping and final stabilization.
- The construction phasing schedule shall be followed and updated before any significant changes in construction activities occur.



BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To ensure that contractors, subcontractors, site operators and their employees are able to identify activities that may potentially impact stormwater quality, identify possible solutions, and implement appropriate construction site stormwater runoff BMPs.

Application or Selection Criteria:

- All construction, projects where water quality might be impacted by erosion from land disturbing construction activities.
- Any contractor, site operator, or personnel involved in soil disturbance activities, including filling, excavating, landscaping or other earthwork activities shall be offered training.

Standards or Specifications:

- Contractor, site operator, or personnel training should incorporate one or more or a combination of the following:
 - Incorporate storm water quality management training with existing construction related training programs.
 - Provide refresher courses or training classes on a regular basis.
 - Conduct "tailgate" training sessions at project sites prior to the start of construction activities.
- A formal training course should include information about the following:
 - Environmental concerns about runoff from construction sites
 - The Clean Water Act and the NPDES program
 - Principles of erosion and sediment control
 - Best Management Practices (BMP) and appropriate applications
 - Proper BMP installation and maintenance procedures

SECTION 4 - GOOD HOUSEKEEPING

GH-1 through GH-5

**Guidebook and list developed for and approved by
Valparaiso Lakes Area Conservancy District (VLACD) - January 2005**

Prepared by: R.W. Armstrong & Associates, Inc.



Absorbent snakes can be used to protect storm drains from spills (Spill911, no date)

BMP Type

Temporary / Permanent

Structural / **Non-Structural**

Purpose:

Discharges of non-hazardous and hazardous materials to the storm drain system can be minimized or eliminated by preventing and controlling spills through defined procedures and practices designed to stop the source, contain the spill, cleanup the spill, dispose of contaminated materials, and train personnel.

Application or Selection Criteria:

- Applies to all construction sites.
- Implemented any time chemicals are used (including fuel areas).
- Chemicals include (but are not limited to): soil stabilizer, dust palliatives, pesticides, herbicides, growth inhibitors, fertilizers, deicing chemicals, fuels, paints, cleaners, solvents, cement, lubricants, and other petroleum products.
- The described practices are general and therefore should be adjusted by the contractor for the specific materials used or stored on-site.
- Applies only to spills caused by contractors or construction site operators.

Standards or Specifications:

- An individual spill prevention and control plan shall be developed and documented by each construction site contractor, and kept onsite during construction procedures.
- Do not bury or wash spills with water.

- Attempt to cover spills during rainfall events as long as clean up efforts are not compromised.
- Do not allow water used for clean up purposes to enter the storm drain system.
- Keep waste storage areas clean, well organized, and well equipped.
- Information on proper storage, clean up and spill reports should be posted at a visible and accessible location at all times.
- Educate employees and subcontractors about what a "significant" and "insignificant" spill is for each chemical used on-site and train in spill prevention and cleanup.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Locate chemical storage and handling areas away from storm drains, waterways, or reservoirs.
- Do not store chemicals in areas where they may be susceptible to rain.
- Provide a secondary containment structure or device in case of leaks or spills.
- Always use a secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Place drip pans or absorbent material under paving equipment when not in use.
- Promptly transfer used fluids to the proper waste or recycling drums. Do not leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and pollute stormwater. Place the oil filter in a funnel over a waste oil-recycling drum to drain excess oil before disposal.
- Store cracked batteries in a non-leaking secondary container.
- If vehicles will be fueled on site:
 - Discourage "topping off".
 - Use designated areas located away from waterways and drainages.
 - Use a secondary containment to catch drips or spills.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Clean up spills immediately and dispose of contaminated soils and clean up materials properly.
 - Sweep up dry spills. Do not wash or hose down the area.
 - Wet spills on impermeable surfaces should be absorbed.
 - Wet spills on soils require excavating and disposing of the contaminated soil.
- A secondary containment with enough capacity to contain a spill is required for fueling areas.

- Report significant spills to local and state agencies, such as the local Fire Department or IDEM, who may assist in the cleanup.
- Federal regulations require that any significant oil spill into a water body be reported to the National Response Center (NRC) at 800-424-8802 (24 hours).
- Only a reputable, licensed company should be used to clean up large spills and dispose of contaminated materials.

Inspection and Maintenance

- On a weekly basis, ensure that, an adequate supply of spill control cleanup materials are located close to storage, fueling, and unloading areas.
- Inspect containment structures in fueling and storage areas.
- Spill prevention plans should be updated when the types of chemicals stored on site changes.
- Regularly inspect on-site vehicles and equipment for leaks, and repair them immediately.

BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose: Proper management through the routine collection and regular disposal of soil and demolition wastes will prevent or reduce the discharge of pollutants to the storm drain system.

Application or Selection Criteria:

- All construction projects that generate non-hazardous solid wastes. These waste include:
 - Reusable materials (wood).
 - Recyclable materials (metal framing, concrete, brick, asphalt, cleared vegetation).
 - Non-recyclable materials (non-hazardous paint chips, steel and metal scraps, broken paving materials, domestic wastes).
- Temporary stockpiling of construction wastes may require stockpile management controls.

Standards or Specifications:

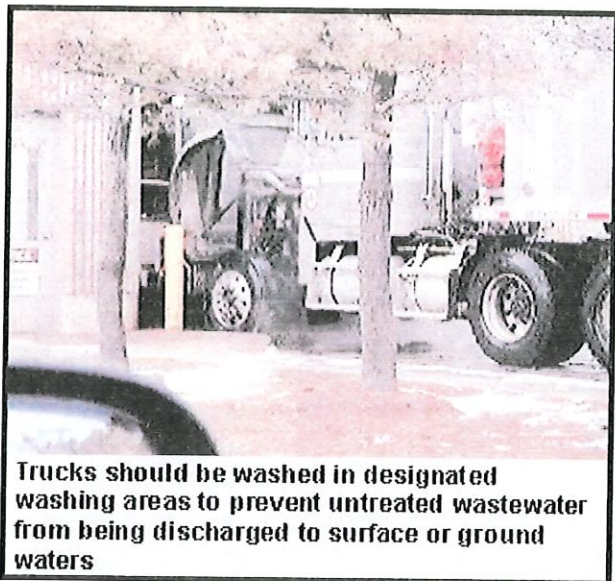
- Designate on-site waste collection areas away from streets, gutters, storm drain inlets, and the construction site entrance. Onsite areas shall be located away from substantial runoff areas and away from direct drainage to local water bodies.
- Properly train employees and subcontractors in solid waste management.
- Reuse and recycle construction materials and wastes whenever possible.
- Collect construction site litter and debris daily.
- Do not dispose of toxic liquid wastes and chemicals in dumpsters designated for construction debris.
- Do not wash out dumpsters on-site.
- Replace leaky dumpsters.

- Schedule haul off and disposal or collection to prevent overfilling containers or dumpsters.
- Clean up spills immediately.
- Cover dumpsters or containers at night and before periods of rainy and windy weather.

Inspection and Maintenance:

- The construction supervisor should monitor on-site solid waste storage and disposal.
- Inspect dumpsters for leaks and secure covers.
- Arrange for adequate regular waste collection
- Immediately cleanup and remove any materials, debris or wastes that fall into waterways and drainage ways on or adjacent to the site.

DESIGNATED VEHICLE MAINTENANCE / WASH AREAS GH - 3



BMP Type

Temporary / Permanent

Structural / **Non-Structural**

Purpose:

To minimize or eliminate the discharge of pollutants entering the storm drain system from vehicle and equipment maintenance or cleaning operations on construction sites.

Application or Selection Criteria:

- All construction sites where vehicle or equipment maintenance or cleaning occurs.
- Wash water discharges may need to be pretreated before releases.

Standards or Specifications:

- Onsite vehicle and equipment washing is discouraged.
- Contain wash water away from storm drain inlets or waterways.
- Off-site cleanings are required for all vehicles and equipment that regularly enter and leave the construction site.
- Conduct washing, fueling, and major maintenance offsite whenever possible.
- In the event that onsite, outside maintenance or cleaning must occur:
 - Maintenance areas must be separate from wash areas.
 - Locate maintenance or wash area away from storm drain inlets, drainage facilities or waterways.
 - Pave the wash area with concrete or asphalt, create a berm to contain wash waters and prevent run-on or runoff.

- Install a sump to collect wash water & discharge to sanitary sewer system as industrial process waste.
 - Do not discharge wash waters to storm drains or waterways.
 - Use wash area only when necessary.
- When cleaning vehicles with water:
 - Consider using a high-pressure sprayer or a positive shutoff valve to reduce water usage & limit use of detergents.
 - When providing vehicle maintenance areas:
 - Spills must be cleaned up and disposed of immediately.
 - (Dispose of products) should take place immediately and as directed by manufacturer, as they are hazardous wastes that require special handling and disposal.
 - Construction vehicles should be inspected for leaks daily and repaired immediately.
 - Recycle products as able at a designated facility such as used oil, antifreeze, and some solvents.

Inspection and Maintenance

- Minimum once per week inspection of the maintenance & wash areas.
- Monitor and educate employees and subcontractors to ensure that proper practices are being implemented for these areas.
- Regular inspection and maintenance of the wash area sump. Remove sediments and liquids as needed to ensure discharge to the sanitary sewer system.

BMP Type

Temporary / Permanent

Structural / **Non-Structural**

Purpose: Proper management of stockpiled materials can reduce or eliminate pollution of storm water from these sources.

Application or Selection Criteria:

- All locations and projects where materials such as soils, composts, aggregates, and paving materials are stockpiled.

Standards or Specifications:

- Locate stockpiles away from anticipated storm water flows, areas of substantial runoff and storm drain inlets.
- Use temporary berms, dikes, silt fences, fiber rolls, sandbags or gravel bag barriers to surround and contain stockpiles to prevent transport of materials offsite from storm water runoff.
- Periodic wind erosion and dust control measures are recommended to be applied to the stockpiled soil (water application).
- Place bagged materials on pallets and cover.
- Maintain stockpile management controls year-round.
- Install stockpile perimeter controls such as temporary berms, dikes, silt fences, fiber rolls, sandbags or gravel bag barriers as soon as possible after stockpiles are created. These temporary sediment transport barriers can be temporary removed or located to one side when materials are being removed or added to the stockpile.
- If stockpiles are not to be used within 21 days, temporary covers (e.g. hydro-mulch, plastic covers, etc.) must be installed as soon as practicable, and no later than 14 days after stockpiles are created. Covers shall be placed on stockpiles as soon as practicable where the initiation of temporary covers is precluded by snow or frozen ground conditions.

Inspection and Maintenance:

- Inspect perimeter controls and covers weekly and before and after storm events.
- Inspect temporary covers before, during and after windy weather.
- Replace or repair perimeter controls and covers as needed.

STREET SWEEPING

GH - 5



A street sweeper cleans up pollutants and sediments on the street to reduce the amount of pollutants entering receiving waters

BMP Type

Temporary / Permanent

Structural / Non-Structural

Purpose:

To remove tracked sediment from the construction site and to prevent it from entering the storm drain system.

Application or Selection Criteria:

- Any location where sediment is tracked from a private construction site onto paved roads inside or outside of the construction site.
- Wet soil or mud may not allow for effective sweeping.

Standards or Specifications:

- Follow all applicable District Health dust control standards.
- Consider reusing the sediments on the project if trash and debris are not mixed in with the soil.

Inspection and Maintenance:

- Daily inspection of potential sediment tracking locations.
- Daily inspection of egress/ingress access points.
- Daily sweeping and vacuuming of visible sediment tracking.
- Do not sweep up any potentially hazardous materials or objects.
- Adjust brooms on sweeper frequently to maximize efficiency.
- Proper disposal of sweeper waste is necessary.