Soil Erosion and Sedimentation Control

Authorized Public Agency Procedures Manual

Ingham County Drain Commissioner
Patrick E. Lindemann

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Prepared By: Hope Croskey

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FOREWORD

This manual has been prepared to give information and guidance to the Drain Commissioner's personnel and their consultants and contractors who are responsible for soil erosion and sedimentation control during earth change activities conducted under their direction as an Authorized Public Agency (APA) under Section 324.9110 of Part 91, Soil Erosion and Sedimentation Control, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. If a Drain Commissioner is not an APA, he/she must submit an SESC plan and apply for an SESC permit from the appropriate county or municipal enforcing agent regardless of whether he/she is following the guidelines set forth in the manual. The manual incorporates changes brought about by new technologies, new or revised legislation, and improved materials and processes.

ACKNOWLEDGEMENTS

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The document was developed under the direction of a MACDC Special Task Force consisting of the following people:

- Janis Bobrin, President MACDC
- Pat Lindemann, Vice President MACDC
- Abby Eaton, Michigan Department of Agriculture
- Dick Mikula, Michigan Department of Environmental Quality
- Hope Croskey, Spicer Group, Inc.

The task force commends and thanks those Drain Commissioners who spent countless hours writing and editing individual procedure details and others who provided input and insight that was incorporated into the many drafts developed during formulation of the final document. Special appreciation is also given to the many Drain Commissioners' staff whose input made this a practical document that truly can be implemented in the field for the protection of our natural resources.

Credit also belongs to the Michigan Department of Management and Budget and the Michigan Department of Transportation whose staff provided digital copies of their SESC Procedures Manuals, including the digital graphic files, which were used extensively for and during development of this manual.

In addition, we wish to acknowledge the contributions of Hope Croskey and Spicer Group who went above and beyond the contractual obligations required to ensure completion of this document, which was approved by the Department of Environmental Quality on February 9, 2006.

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SECTION 1

Program Guidelines

INTRODUCTION

The goal of the Drain Commissioner is to implement SESC measures that are cost effective; will effectively minimize erosion and off-site sedimentation; and will protect the soil, water, and other natural resources when earth change activities are conducted under their authority. Achieving this goal is fundamental to the efficiency and economical service life of drainage and stormwater facilities, and lake level control structures.

A copy of this manual, which includes Part 91, Soil Erosion and Sedimentation Control (SESC), of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Part 91), and the associated administrative rules (Rules) promulgated under Part 91 will be made available to the Drain Commissioner's staff and their contracted personnel who are expected to understand and implement the contents of this manual. This SESC Procedures Manual is adopted by the Drain Commissioner and details the SESC measures that will be utilized during all earth change activities, including maintenance, construction, and restoration activities as an Authorized Public Agency (APA).

Individual Part 91 permits are not required for designated APAs. However, all earth change activities must meet Part 91 and Rule requirements. To maintain this APA status, earth change activities regardless of size or location must be conducted in accordance with these approved SESC procedures unless a variance is requested by the APA and granted by the Michigan Department of Environmental Quality (MDEQ). As standards and/or techniques for SESC evolve, this manual will require modifications that must be approved by the MDEQ prior to formal adoption. **Having the APA designation does not exempt the Drain Commissioner from obtaining all other applicable federal**, **state, and local permits**.

COMMITMENT

To maintain the APA designation, the Drain Commissioner is committed to comply with the SESC Procedures while undertaking all earth change activities. This manual presents procedures for conducting earth change activities and implementing SESC measures that fulfill this commitment through stabilization of disturbed soils and preventing off-site sedimentation (downstream of the project limits or outside of the drain easement). Part 91 defines stabilization as the establishment of vegetation or the proper placement, grading, or covering of soil to ensure its resistance to soil erosion, sliding, or other earth movement. The following basic principals will be included in the planning, design, specification, construction, and inspection of drain maintenance and improvement projects that include earth change activities:

1. Inspect and maintain drains, prioritizing maintenance activities that emphasize preventive measures and procedures that will minimize soil erosion and the resulting sedimentation, including but not limited to:
   (a) Disturbing the least amount of soil for the shortest period of time.
   (b) Encourage and maintain vegetated buffer strips whenever possible.
   (c) Repair blowouts, seeps and slumped areas along a drain as soon as possible.
   (d) Evaluate if dredging only specific reaches of a drain would provide effective drainage rather than dredging the entire drain.
   (e) Remove obstructions and sediment which are causing scouring and other erosive forces.
   (f) Establish stable streambank slopes that can withstand anticipated flow at non erosive velocities.

2. In non emergency situations, conduct earth change activities during the time of year and flow conditions that will minimize erosion and the resulting sedimentation.

3. Provide control measures that will effectively control erosion of, and sediment from, the exposed area, and stabilize disturbed areas, except for actively cultivated agricultural fields, either temporarily or permanently, as soon as possible. Seed, apply mulch when necessary, or otherwise stabilize disturbed drain banks daily. During hydraulic or mechanical dredging, spread spoils to prevent erosion and ditch bank surcharge and seed or otherwise stabilize spread spoils within 5 days unless spoils are being spread in actively cultivated agricultural fields. If spoils will be spread at a later date either place spoils where surface runoff from the spoil piles will drain away from the drain; or seed, apply mulch when necessary, or otherwise stabilize spoil piles within 5 days.

4. During the non-growing season when vegetation cannot be established, additional control measures will be implemented to ensure the prevention of soil erosion and off-site sedimentation. These measures may include, but are not limited to, silt fence, erosion control blankets, various geosynthetic products, polyacrylamides, and/or other BMP's that will ensure the temporary stabilization of the soil until the next growing season when permanent vegetation can be established. The increased need and cost for additional soil erosion and sedimentation control measures during the non-growing season will be considered in planning for projects that start or finish in late fall or winter.

5. Install and maintain adequate, temporary or permanent, SESC measures prior to commencing other earth change activities. Temporary SESC measures shall be installed and functioning prior to commencement of earth change activities and shall be removed only after permanent SESC measures are in place, functioning, and the site has been stabilized.

6. Where feasible, design channel and drain bank slopes that will be easily stabilized for the site specific soil types and anticipated flow velocities.

7. Select a route and course for new drains that will achieve project objectives while minimizing soil erosion, taking into consideration areas with unstable soils and wetland complexes. Establish adequate right-of-ways for construction and future maintenance operations.

8. Minimize erosion and control sediment at points of concentrated flow or grade changes utilizing appropriately designed and installed SESC measures.

NOTIFICATION OF PROPOSED EARTH CHANGE

As an APA, individual permits are not required from the applicable County or Municipal Enforcing Agency. However, Part 91 requires an APA to notify the applicable county or municipal enforcing agency of each proposed earth change that would have required a SESC permit [See Rule 323.1706 (4)]. The complete list of County and Municipal Enforcing Agencies is available on the MDEQ website. Written notice will be sent to the Cities of East Lansing and Lansing and the Charter Townships of Delhi and Lansing, as Municipal Enforcing Agencies, whenever earth disturbance work will occur within their jurisdictions. The Ingham County Drain Commissioner is the County Enforcing Agency.

SESC CERTIFICATE OF TRAINING

Section 324.9110 (4) (b) of Part 91 requires those individuals with decision-making authority who are responsible for administering the Drain Commissioner's SESC Program have current certificates of training under section 324.9123. Therefore, all Drain Commissioner personnel who make decisions regarding the design, inspection, or implementation of SESC measures must have a valid Certificate of Training. A certificate can be obtained by completing the MDEQ's SESC training class or the self study training and passing the final exam. This requirement applies to the following positions that have decision-making authority: Deputy Drain Commissioner, Drain Engineer, Drain Project Coordinator, Drain Assistant Project Coordinator, Drain Maintenance Supervisor.

PLANNING PHASE

Effective erosion and sediment control begins with planning, including designing and locating projects to best meet each project objective while minimizing the potential for erosion and avoiding sensitive and high erosion potential areas when feasible. Installation and maintenance of properly designed SESC measures and conducting routine maintenance activities prevent erosion and control sediment. **This manual provides procedures for the design, implementation, and maintenance of individual SESC measures, as well as information for developing SESC plans.**

Per the guidelines provided in this manual, some Routine Maintenance Activities in Section 6 require a SESC plan when the earth disturbance exceeds 100 linear feet. The specific activities include: 81. Sediment Removal; 84. Vegetation Removal with Selective Grubbing; and 85. Slope and Streambank Stabilization. All Construction and Restoration Activities in Section 7 require a SESC plan. See the specific procedures for further guidance.

In addition, several of the SESC measures identified in Sections 3, 4, and 5 of this manual involve earthwork that would normally require a SESC plan prior to implementation. However, a SESC plan is not required for those SESC measures involving earthwork if they are installed in accordance with this manual's guidelines identified under the "How" for each SESC measure and the total earthwork associated with implementing one or more measures does not exceed 100 linear feet of disturbance. Any deviation from the manual guidelines or earthwork resulting in a disturbance in excess of 100 linear feet will require that a SESC plan be developed prior to initiating that earthwork.

When a drain activity or SESC measure requires a SESC plan, a plan shall be developed to effectively reduce accelerated soil erosion and sedimentation. The plan shall identify factors that may contribute to soil erosion or sedimentation or both. The plan shall include, but not be limited to, the following:

1. A map or maps at an adequate scale to illustrate the:
   (a) Extent of the earth change activities;
   (b) Existing and any proposed drain locations;
   (c) Proximity of proposed earth change to lakes, streams or drains;
   (d) Predominant land features; and
   (e) Contour intervals or slope descriptions.

2. A soils survey and the associated soil types or a written description of the general soil types of the exposed land area contemplated for the earth change.

3. Details for proposed earth changes including all of the following:
   (a) A description and the location of the physical limits of each proposed earth change.
   (b) A description and the location of all existing and proposed on-site drainage and dewatering facilities.
   (c) The timing and sequence of each proposed earth change.
   (d) The location and description for installing and removing all proposed temporary SESC measures.
   (e) A description and the location of all proposed permanent SESC measures.
   (f) Proposal for continued maintenance of all permanent SESC measures.

DESIGN PHASE

It is the responsibility of the Drain Commissioner to ensure that a project is designed correctly. A staff engineer or engineering consultant and/or qualified professionals shall be utilized during the design phase when required in the details for a specific SESC measure. The project design should minimize adverse impacts to areas with high erodible soils or areas next to lakes, streams, or wetlands while incorporating project specific permit requirements. Those responsible for recommending SESC measures need to specify control measures that are practical, reasonable and effective during the construction phase of a project to achieve adequate SESC. The design plans, included as part of the contract documents, must clearly indicate the location and installation details for all appropriate SESC measures.

CONTRACT DOCUMENTS

As an APA, the Drain Commissioner is ultimately responsible for conducting and documenting SESC inspections and assuring that all earth change activities undertaken by their staff or contractors working under their APA designation meet the requirements of Part 91, the Rules, and this Manual. Therefore, the Drain Commissioner shall ensure that all contract documents include a clear description of the contractor's responsibilities including: compliance with this manual, by reference; installation, and ongoing monitoring and maintenance of site specific SESC measures by the contractor until all disturbed areas are stabilized and temporary SESC measures are removed. The contract document must provide the ability to adapt, adjust and add SESC measures necessary to maintain a level of SESC required to comply with Part 91, the Rules, this manual, and other project specific permit requirements.

Contract documents must clearly state the authority of the Drain Commissioner to enforce compliance with Part 91, the Rules, and this manual, and the consequences for noncompliance. To assist with contractor compliance, contract documents should also include, but not be limited to, the following:

1. Acquisition of cash, a certified check, an irrevocable bank letter of credit or a surety bond acceptable to the county in the amount sufficient to assure the installation and completion of such protective or corrective measures, and/or site restoration, as may be required by the Drain Commissioner to assure compliance with Part 91, the Rules, and this manual.

2. The ability of the Drain Commissioner to expend these funds if, in the opinion of the Drain Commissioner, the site may result in or contribute to soil erosion or sedimentation

of adjacent properties or to the waters of the state, if the SESC measures required in the SESC plan are not properly installed or maintained, or if the site is not in compliance with Part 91, the Rules or this manual.

3. The ability of the Drain Commissioner to assess costs for site restoration, site stabilization, and/or restore or repair off-site damages if the contractor does not comply with their contract or Part 91, the Rules or this manual.

INSPECTION AND WRITTEN DOCUMENTATION

Inspections and written documentation are not required for an earth change activity of a minor nature that is stabilized within 24-hours of the initial earth disturbance. However, inspections and written documentation are required for all other earth change activities.

Adequate inspections and follow-up maintenance provide the APA with the tools necessary to meet their ultimate responsibility to minimize soil erosion and off-site sedimentation. The inspection frequency is outlined in the Maintenance Category of each individual procedure and uses terms such as routinely or periodically. These generalized terms provides the needed flexibility in determination of an adequate inspection schedule based on site conditions such as soil types and moisture content; time of year; flow conditions; anticipated weather, etc.

Routine inspections are required until the site is stabilized with permanent SESC measures. The frequency of routine inspections must consider factors such as seed germination period; weather conditions including wind and precipitation; and anticipated vehicular and pedestrian traffic. Periodic inspections would be required for permanent SESC measures that were stabilized when installed but may need to be monitored occasionally to assure continued functionality as designed. High traffic areas that may be susceptible to vandalism or vegetation removal in an area where flow may be constricted resulting in flooding of adjacent properties are examples of areas needing periodic inspections.

Required inspections will be conducted by the Drain Commissioner's personnel, or their contracted inspector, at an adequate frequency to assure minimization of soil erosion and off-site sedimentation and will be coordinated with the contractor's work schedule to assure timeliness and to obtain maximum inspection benefits. All inspections will be conducted and documented by a person with a valid SESC Certificate of Training from the MDEQ. The completed Inspection Form, provided in Section 1.6, will document at a minimum the following:

1. Date of inspection.
2. Name of inspector
3. Name of engineer, project manager, and contractor or responsible APA personnel.
4. General weather conditions during inspection and previous 48 hours.
5. Are SESC measures installed and/or stabilized per plan and SESC details?
6. Are SESC measures effectively controlling erosion and sediment?
7. Note deficiencies such as a SESC measure is ineffective, needs maintenance or has failed or a slope stabilization failure has occurred.
8. Other relevant information such as photographs

If no deficiencies are found, a report is still required to be completed and placed on file. If deficiencies are found, the inspector will initiate the following actions to correct the deficiencies.

1. Note the deficiencies, including maintenance requirements and corrective actions, on the Inspection Form being specific about the type and location of the deficiencies.
2. Advise the contractor or responsible Drain Commissioner personnel of the deficiencies and provide sufficient verbal or written instructions to ensure a complete understanding of the deficiencies and the necessary corrective actions. These instructions may include a work order, a revised SESC plan, or reference to specific SESC measures.
3. Specify an appropriate time frame with which to complete the corrective actions. Deficiencies which are determined to be of an emergency nature must be corrected within 24 hours. Examples of deficiencies deemed an emergency are sedimentation of the waters of the state and erosion of or sediment on a roadway which could jeopardize public safety. Deficiencies which are not considered an emergency should be corrected within five days.

CORRECTIVE ACTIONS

Contracted Projects

In the event that the Drain Commissioner personnel, or their contracted inspector, is unsuccessful in getting a contractor to perform corrective actions, the Drain Commissioner will assume responsibility for ensuring that SESC corrective actions are implemented. The following progressive steps shall be taken if a contractor fails to comply with their contract or Part 91 regulations.

1. Issue or reissue a work order describing the work to be completed by the contractor specifying a completion date.
2. Issue a Notice of Non-Compliance with Contract Requirements for failure to respond to SESC corrective actions in a timely manner.
3. Contract with another specialty contractor to complete the required corrective actions to ensure compliance with regulations.
4. Prepare and place on file a Contractor Evaluation to document the contractor's inability to meet contract obligations and implementation of required SESC measures.

In-House Projects

SESC corrective actions will be implemented and, when necessary, the appropriate disciplinary action will be taken.

FORMS

The following forms shall be used for the administration of the SESC Program.

1. SESC Inspection Log
2. SESC Plan Checklist

Inspection Log
Soil Erosion and Sedimentation Control

Drain Name	Drain Number	NPDES Permit #	Inspection #	Inspection Date

Drainage District	Section	Town	Range	Township

Project Scope (e.g., sediment removal 2200 feet)

Inspection Location: □ Entire Project
□ Station _____ to _____
□ Other (specify)

Contact Information

Responsible Person □ Engineer □ Contractor □ APA Personnel | Company Name | Contact Phone

Observations

Is sediment coming onto site from elsewhere?	□ Yes	□ No
Is sediment properly contained on project site?	□ Yes	□ No
Is earth change confined to areas specified on plans?	□ Yes	□ No
Is there a potential for sediment to leave project site?	□ Yes	□ No

Are controls installed per plans?	□ Yes	□ No	Are controls adequate for this site?	□ Yes	□ No
Are controls properly maintained?	□ Yes	□ No	Are storm sewers being protected?	□ Yes	□ No

Weather and Stream Flow Conditions

Current Weather: □ Clear Skies □ Cloudy □ Rain □ Snow □ Frozen Ground □ Other Temp

Weather conditions previous 24 hours:

Stream Flow: □ Zero flow □ stagnant □ slow □ moderate □ swift □ other (describe)

Inspector Comments

Specific on-site conditions, note deficiencies (e.g., SESC measure is ineffective, need maintenance or has failed; slope failure) and the location (e.g. station 3+50 or 400 feet upstream of Thomas Road) □ Photos attached □ Yes □ No

Documentation (samples, measurements, etc.): □ Photos attached □ Yes □ No

Maintenance requirements & corrective actions (be specific & provide location). Emergency repairs are required within 24 hrs.

Corrections (if any) must be made by _____/_____/_____ (date) : Attachments □ Work Order □ Revised SESC Plan

Persons attending inspection:

Inspection Report	**Actions Taken Since Last Inspection**
□ Left on-site with: _____	Follow-up corrections were accomplished by _____on ___/____/_____
□ Verbally discussed with: _____	Is site fully stabilized? □ Yes □ No
□ Report provided to: _____	Are temporary control measures removed? □ Yes □ No
Follow-up inspection needed by ___/____/_____	File closed? □ Yes □ No

Inspector

Inspector's Printed Name | Inspector's Signature | Date

Ingham County Drain Commissioner, SESC Authorized Public Agency
707 Buhl Ave. P.O. Box 220 Mason, MI 48854 Ph: (517) 676-8395 Fax: (517) 676-8364

Ingham County Drain Commissioner
Patrick E. Lindemann
707 Buhl Ave. P.O. Box 220 Mason, MI 48854 Ph: (517) 676-8395 Fax: (517) 676-8364

Authorized Public Agency Soil Erosion and Sediment Control Plan Checklist

- **Scaled drawing: Use adequate scale to show project details and note scale.**
- **Legal Description: Note or draw drain easements. Note Section, Town, Range, and Township Name.**
- **Site sketch: Drain plan and profile drawings are adequate, if available. Include other Drainage and dewatering facilities, if applicable (e.g., pumps, etc.).**
- **Proximity to lakes and streams: Show Drain location relative to nearest roads.**
- **Predominant land features: Drain and roads.**
- **Contour intervals or slope description: Slope of Drain profile and typical bank slopes.**
- **Description of soil types: Reference your county NRCS soils maps and note on plan adjacent soil types (e.g., sand, clay, silt, loam). Also note sediment soil types. A photocopy of the NRCS soil map may be useful if the soil types are complex.**
- **Physical limits of earth change: Show all areas of the earth change disturbance including spreading of spoils. Estimate total disturbed acres by using the following formula:**

$$\frac{\text{project length (ft) x average project width (ft)}}{\text{acres 43,560 (ft2/acre)}} =$$

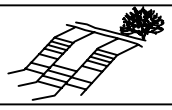
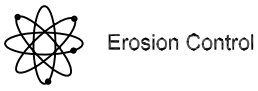
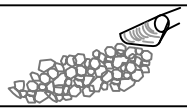
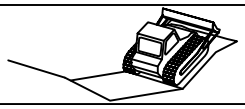
Note: Drain Commissioners are exempt from NPDES storm water permit requirements for drain maintenance activities disturbing less than 5 acres to restore the drain to the original grade and design capacity. If the total earth disturbance, including the drain side slopes and disposal area, is 5 acres or greater, excluding dredged area below the ordinary high-water mark (normal water level) "Notice of Coverage" must be submitted to the DEQ prior to commencing work. When the site is stabilized a "Notice of Termination" must also be submitted. If you have questions, contact the DEQ Water Bureau, Mark Fife at: 517-241-8993 or fifem@michigan.gov.

- **Timing and sequence of earth change: Note approximate start and end dates for each project segment, include installation and removal of control measures (e.g., installation of downstream control measures, sediment removal, spoil leveling, temporary and permanent seeding, and removal of control measures).**
- **Description and location of temporary and permanent control measures: Identify and locate SESC Control Measures; Routine Maintenance Activities; and Construction and Restoration Activities using the MACDC keying system number (circled) followed by a "T"**
- **Maintenance plan: The Drain Code provides a process for the continued maintenance of drains. Note inspection frequency for maintenance of temporary and newly installed permanent control measures if not included in your APA operating procedures.**

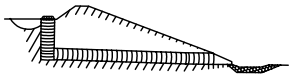
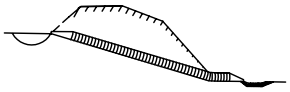
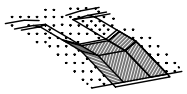
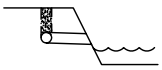
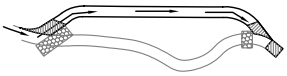
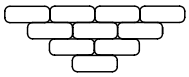
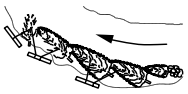
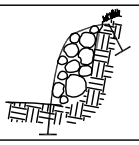
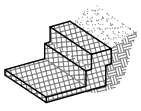
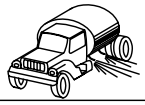
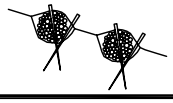
SECTION 2

MACDC Keying System

3. EROSION CONTROL MEASURES

KEY	SESC MEASURE	SYMBOL	WHERE USED
1	SEEDING		When bare soil is exposed, temporarily or permanently, to erosive forces from wind and or water on flat areas, mild slopes, grassed waterways and spillways, diversion ditches and dikes, borrow and stockpile areas, and spoil piles.
2	MULCH		On flat areas, mild slopes, grassed waterways and spillways, diversion ditches and dikes, borrow and stockpile areas, and spoil piles when areas are subject to raindrop impact, and erosive forces from wind or water.
3	SODDING		When a temporary or permanent vegetative cover is necessary or desired to prevent soil erosion and filter sediment in residential, commercial or high traffic areas; or on steep slopes, auxiliary spillways, and grassed swales
4	SLOPE ROUGHENING AND SCARIFICATION		On disturbed slopes and stream or drain banks when site grading or construction activities result in grades that may cause increased erosive velocities or off-site sedimentation.
5	PLASTIC SHEETING OR GEOTEXTILE COVER		As a temporary measure to line a channel, cover stockpile areas or to provide immediate cover on exposed slopes
6	SOIL BINDING POLYMERS		Over all exposed soil surfaces or prepared seed beds that need protection from precipitation impact, sheet flow, rill flow or wind prior to erosive force impact.
7	RIPRAP		Along drain banks, shorelines, or where concentrated flows occur. Slows velocity, reduces erosion and sediment load.
8	RIPRAP TOE OF SLOPE		Riprap and toe of slope protection is used in areas where velocities are causing drain bank erosion and are too high to stabilize using other methods
9	OUTFALL STABILIZATION		In the stream or drain bank usually above the ordinary high water mark where an enclosed drain or tile discharges to an open drain.
10	SIDE DITCH OUTLET		In a ditch or drain just upgradient from the discharge into a stream or open drain to prevent erosive velocities.
11	GRASSED WATERWAYS		In intermittent streams or drains and constructed ditches and drainage swales where flow velocities and channel grades do not warrant armoring the channel with riprap or cobble
12.1	TEMP CROSSING - FORD DRAIN		Where access to the opposite side of a drain is temporarily required and crossing the drain by fording will result in less damage than constructing a crossing.
12.2	TEMP CROSSING - NATIVE SOIL FORD		Where access to the opposite side of a drain is temporarily required and the crossing location will be dredged and stabilized the same day.
12.3	TEMP CROSSING - TIMBER FORD		Where access to the opposite side of a drain is temporarily required and timbers are available for use as a temporary crossing.
12.4	TEMP OR PERMANENT CROSSING - ROCK FORD		Where access to the opposite side of a drain is temporarily or permanently required and installation will require minimum bank excavation.
12.5	TEMP CROSSING - TEMP CULVERT		Where access to the opposite side of a drain is temporarily required and the channel is narrow and can accommodate a culvert with minimum backfill.
12.6	TEMP CROSSING - TEMP BRIDGE		Where access to the opposite side of a drain is temporarily required and the banks are stable and can support a bridge deck.

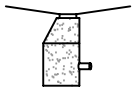
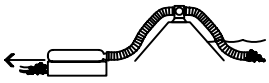
3. EROSION CONTROL MEASURES (CONTINUED)

KEY	SESC MEASURE	SYMBOL	WHERE USED
13	PIPE DROP SPILLWAY		Where surface runoff accumulates at the top of a slope and must be conveyed, either temporarily or permanently, from a higher to lower elevation within a short horizontal distance, down steep slopes, or when soils are highly erodible or excessively wet. Also used when velocities must be reduced to prevent channel scour or drain bank erosion at the outlet.
14	SLOPED PIPE SPILLWAY		Where surface runoff accumulates at the top of a slope and must be conveyed to a lower elevation without causing slope erosion, gully formation, slope failure, or channel scour.
15	ARMORED SPILLWAY		When concentrated flow must be conveyed down a drain bank or slope or discharge into another drain. Where slope failure or channel scour is observed or is likely to occur, or when runoff must be redirected around work in the drain.
16	REINFORCED VEGETATED SPILLWAY		When slope failure at eroded outfalls are observed or are likely to occur from concentrated runoff on very shallow slopes (where flow velocities will be low enough not to undermine the reinforced grass root structure).
17	TOE DRAIN		Were piping is causing erosion and unstable drain banks.
18	TEMPORARY BYPASS CHANNEL		In and adjacent to a stream when flow conditions prevent completing work activity without diverting flow around a work area
19	ENERGY DISSIPATORS		Where the discharge velocity of concentrated flow exceeds the erosive velocity of the receiving area or channel.
20	CONCRETE BAG RIPRAP HEADWALL		At culvert ends as a headwall when culvert backfill is eroding or a longer culvert is impractical.
21	SHEET PILING		As a permanent measure in locations where a vertical bank is required and other erosion control measures have failed. As a weir. As a temporary cofferdam during construction.
22	SAND OR STONE FILLED BAGS		Within or adjacent to a stream to isolate or divert flow during construction. Can also be used to temporarily impound water for very short time periods.
23	TREE REVETMENT		Where stream banks are eroding or undercutting. The placement of trees or tree tops along the edge of the stream provides a place for sediment to settle out behind the trees when water levels recede. The sediment remains in place behind the logs and allows a stream to "naturally" rebuild its banks.
24	LOG REVETMENT		Where stream banks are eroding or undercutting. The placement of logs along the edge of the stream provides a place for sediment to settle out behind the logs when water levels recede. The sediment remains in place behind the logs and allows a stream to "naturally" rebuild its banks
25	GABION BASKETS		At the toe of steep slopes and drain banks within or adjacent to the stream channel when Flow velocities are resulting in major drain bank or slope failure or instability and slope and drain bank reshaping with or without riprap is not practical.
26	DUST CONTROL		As a temporary measure on exposed and unstabilized areas that must be protected from wind or water erosion.
27	LIVE STAKING		Slopes and drain banks, wetland buffer and reservoir drawdown areas. In areas requiring stabilization but with limited access for equipment or when little site disturbance is required.
28	WATTLES		Where a slope or streambank requires stabilization and minimal disturbance is preferred or the site has limited access.

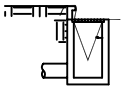
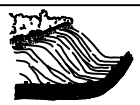
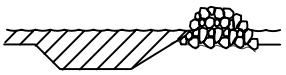
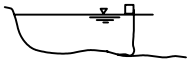
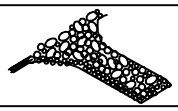
3. EROSION CONTROL MEASURES (CONTINUED)

KEY	SESC MEASURE	SYMBOL	WHERE USED
29	CELLULAR CONFINEMENT SYSTEMS		On steep slopes and stream or drain banks and in high velocity vegetated channels.

4. EROSION AND SEDIMENT CONTROL MEASURES

KEY	SESC MEASURE	SYMBOL	WHERE USED
40	CHECK DAM		In constructed and existing flow corridors to reduce flow velocities.
41	CATCH BASIN		Where surface water accumulates and needs an outlet or an open drain discharges to a stream or drain at erosive velocities. Within an enclosed drain system to provide an inlet and a sump.
42	VEGETATED BUFFER STRIPS		Along stream and drain corridors, sensitive areas, and shorelines when earth changes will occur during a drain maintenance or improvement project or when an eroding bank or drain easement area needs to be stabilized.
43	DIVERSION DIKE		Runoff needs to be diverted around sensitive areas, unstable or easily eroded soils, bare soils, away from steep banks, or around earth change activities.
44	DIVERSION DITCH		Runoff needs to be intercepted and or diverted around sensitive areas, unstable or easily eroded soils, bare soils, away from steep banks, or around earth change activities.
45	DIVERSION DITCH AND DIKE		Within existing flow corridors to divert runoff, temporarily or permanently, around sensitive areas, unstable or easily eroded soils, steep banks, along narrow drain easements or around maintenance or improvement activities.
46	STONE FILTER BERM		When runoff must be filtered prior to entering a lake, stream, drain or wetland. Never use in place of a check dam in a flowing stream.
47	SAND FENCE		In areas susceptible to wind erosion, particularly where the soil has not yet been stabilized by other means. To re-build a slope.
48	DEWATERING		When construction or maintenance activities are limited by the presence of water and a dry work area is required.
49	STRAW BALES		As a temporary diversion structure. Occasionally as an alternative to silt fence for projects that will be completed within a very short time period (less than one month).

5. SEDIMENT CONTROL MEASURES

KEY	SESC MEASURE	SYMBOL	WHERE USED
60	STORM DRAIN INLET PROTECTION		Around the entrance to a newly constructed catch basin or an inlet that will capture runoff from an earth change activity.
61	SILT FENCE		As a temporary measure used to capture sediment from sheet flow. May also divert small volumes of sheet flow to protected outlets.
62	SEDIMENT BASIN		When working in the drain, or drain easement. In streams or drains where sediment sumps are inadequate.
63	SEDIMENT SUMP (TRAP)		When working in the drain, or drain easement and the soil disturbance and anticipated sediment is limited.
64	POLYMER FLOCCULANTS	 Sediment Control	Where turbid water can be collected and suspended sediments removed prior to discharging runoff to a lake, stream, drain, or a wetland or runoff leaves the drain easement.
65	TURBIDITY CURTAIN		Within a stream or drain parallel to flow when a slack water area is necessary to isolate earth change activities from a lake or channel.
66	STABILIZED CONSTRUCTION ACCESS		At locations where construction equipment will enter and exit the drain easement and tracking of soil is anticipated.

6. ROUTINE MAINTENANCE ACTIVITY DETAILS

KEY	BEST MANAGEMENT PRACTICE	SESC PLAN
80	Debris Removal	NO
81	Sediment Removal	> 100 FEET
82	Stormwater Basin Maintenance	NO
83	Vegetation Removal Without Grubbing	NO
84	Vegetation Removal With Selective Grubbing	> 100 FEET
85	Slope and Streambank Stabilization	> 100 FEET
86	Drain Crossing Maintenance	NO
87	Enclosed Drain Maintenance	NO

7. CONSTRUCTION & RESTORATION ACTIVITY DETAILS

KEY	BEST MANAGEMENT PRACTICE	SESC PLAN REQUIRED
100	Stormwater Basin Construction	ALWAYS
101	Drain Relocation	ALWAYS
102	Drain Enclosure	ALWAYS
103	Drain Crossing	ALWAYS
104	Weir Installation	ALWAYS
105	Beaver Dam Removal	ALWAYS
106	Low Flow Channel	ALWAYS
107	Floodway Shelf	ALWAYS
108	Riffle Zones	ALWAYS
109	Pools	ALWAYS
110	Meanders	ALWAYS
111	Cross-Vanes	ALWAYS
112	J-Hook Vanes	ALWAYS

SECTION 3

Erosion Control Measures

1. SEEDING

When	• Bare soil is exposed to erosive forces from wind and or water.
Why	• A cost effective way to prevent erosion by protecting the soil from raindrop impact, flowing water and wind. • Vegetation binds soil particles together with a dense root system, increasing infiltration thereby reducing runoff volume and velocity.
Where	• On all disturbed areas except where non-vegetative stabilization measures are being used or where seeding would interfere with agricultural activity.
Scheduling	• During the recommended temporary and permanent seeding dates outlined below. • Dormant seeding is acceptable.
How	1. Site Assessment. Determine site physical characteristics including available sunlight, slope, adjacent topography, local climate, proximity to sensitive areas or natural plant communities, and soil characteristics such as natural drainage class, texture, fertility and pH. 2. Seed Selection. Use seed with acceptable purity and germination tests that are viable for the planned seeding date. Seed that has become wet, moldy or otherwise damaged is unacceptable. Select seed depending on, location and intended purpose. A mixture of native species for permanent cover may provide some advantages because they have coevolved with native wildlife and other plants and typically play an important function in the ecosystem. They are also adapted to the local climate and soil if properly selected for site conditions; can dramatically reduce fertilizer, lime and maintenance requirements; and provide a deeper root structure. When re-vegetating natural areas, introduced species may spread into adjacent natural areas, native species should be used. Noxious or aquatic nuisance species shall not be used (see list below). If seeding is a temporary soil erosion control measure select annual, non-aggressive species such as annual rye, wheat, or oats. See MDEQ's *"Guidelines for Vegetative Erosion Control"* or the *USDA-NRCS-MICH "Critical Area Planting Guide 342-1"* for specific seeding rates by species. 3. Site Preparation. Final grade or shape area to be seeded. Remove large clods, rocks, tree roots, etc. that will interfere with seeding. A spring tooth drag, field tiller, disk or other suitable equipment may be used. When feasible, replace the topsoil after grading. If soils are compacted, scarify or rake seedbed to a minimum depth of 3 inches and roughen slopes steeper than 3 horizontal to 1 vertical. If needed, divert concentrated flows away from seeded areas until vegetation is established. 4. Soil Amendments. Properly sited native vegetation should not require fertilization and, in such instances, fertilizing may promote competition from unwanted species at the expense of natives. Do not apply nitrogen for warm season mixes. If fertilizer is needed, fertilize with a low or no phosphorus fertilizer when near water, and/or add lime only when necessary for proper establishment and maintenance of vegetation. Conduct a soil test to determine required soil amendments if having difficulties with vegetation establishment. See Soil Amendments Table below. 5. Seeding. Apply seed as soon as possible, but within 5 days, after final grading, shaping, and/or seedbed preparation by hand broadcasting, hydroseeding, or using mechanical drills following seeding dates outlined below. Water as needed or possible for successful germination. Apply temporary seeding to disturbed areas within 5 days if final grading and permanent seeding will be delayed for more than 5 days. Apply temporary

	seed daily to dredged spoil piles that will be flattened at a later date if they do not slope away from the drain except where they will interfere with plowing tilling or the harvesting of crops. Seed streambanks daily and other disturbed areas within 5 days. 6. Dormant fall seeding. In late fall after the soil temperature remains consistently below 50^{o}F prior to the ground freezing. No seed germination will take place until spring therefore mulch or another stabilization technique may be required to prevent erosion and off-site sedimentation. A cool season annual grass may be added in an attempt to have some fall growth. 7. Dormant winter seeding. Apply seed daily to disturbed areas and dredged spoil piles before they freeze. Seed will germinate in the early spring. 8. ***Mulch*** is recommended for dormant fall and winter seeding and on all slopes, unstable soils, heavy clay soils and all areas adjacent to wetlands, streams, drains, or sensitive areas and should be applied immediately after seeding. 9. Protect seeded areas from pedestrians and vehicular traffic.
Maintenance	• Inspect newly seeded areas subsequent to anticipated germination date and after each significant rainfall event that produces runoff until areas are stabilized. • Repair eroded areas, applying supplemental seed, mulch and water as needed. • If seed does not establish, conduct soil tests, amend soils as needed, and reapply seed and/or mulch during the recommended growing season. • To assist in the establishment of native species remove unwanted competing vegetation in the first year. • Mowing can be used periodically to discourage weeds.
Limitations	• Soil is susceptible to erosion until seedbeds are established. Sites may require re-seeding. • Seasonal limitations include excessive heat or early frost/freeze and adequate moisture for germination and early growth. • May not be appropriate in high traffic areas. • Native species may be more costly, however, the increased awareness of the benefits of planting native species is beginning to reduce their price and increase their availability.

TEMPORARY SEEDING DATES

Seed Type	Lower Peninsula south of US 10	Lower Peninsula north of US 10	Upper Peninsula	Amount (lbs. per)	
				1000 sq. ft.	Acre
Oats, Barley	April 1 - Sept. 15	April 15 - Aug. 1	May 1- Aug. 1	2	96
Cereal Rye	Aug. 1 - Oct. 15	Aug. 1 - Oct. 10	Aug. 1 - Nov. 1	3	120
Wheat	Sept. 20 - Oct. 15	Sept. 10 - Oct. 10	Sept. 10- Oct. 1	3	120
Buckwheat	June 1 - July 15	June 1 - July15	June 15 - July15	2	75
Perennial Ryegrass	Aug. 1 - Oct. 15	June 1 - Aug. 1	Aug. 1 - Oct. 1	0.5	20

Source: Adapted from USDA NRCS Technical Guide #342 (1999)

PERMANENT SEEDING DATES

Seeding Conditions	Lower Peninsula south of US 10	Lower Peninsula north of US 10	Upper Peninsula
Permanent Seeding with irrigation or mulch.	April 1 - Oct. 10	May 1 - Oct. 1	May 1- Sept. 10
Permanent Seeding w/o irrigation or mulch	April 1 - May 20 Aug. 10 - Oct. 10	May 1 - June 10 Aug. 1 – Oct. 1	May 1 - June 15 Aug. 1 - Sept. 20
Dormant Seeding	Nov. 1 - Freeze	Oct. 25 - Freeze	Oct. 25 - Freeze

Source: Adapted from USDA NRCS Technical Guide #342 (1999)

SOIL AMENDMENTS

Lime	Nitrogen (N)	Phosphorous (P2O5)	Potash (K20)
As needed*	50-60 lbs/acre 1.25 lbs/1000 sq ft	50-60 lbs/acre 1.25 lbs/1000 sq ft	50-60 lbs/acre 1.25 lbs/1000 sq ft
If seeding with legumes, soils should be limed, if needed, to pH of 6.5 to 7.0. If seeding without legumes, a pH of 5.5 is adequate. Legume seeds must be freshly inoculated with the proper nitrogen fixing bacteria, within 24 hours prior to seeding.			

Source: USDA-NRCS-MICH Technical "Critical Area Planting 342"

NOXIOUS OR AQUATIC NUISANCE SPECIES

Act 359 of 1941 , identifies the following noxious weeds

Canada thistle, Cirsium arvense
Dodder, Cuscuta species
Mustards (charlock, black mustard, Indian mustard, species of Brassica or Sinapis)
Wild carrot, Daucus carrota
Bindweed, Convolvulus arvensis
Perennial sowthistle, Sonchus arvensis
Hoary alyssum, Berteroa incana
Ragweed, Ambrosia elatior
Poison ivy, Rhus toxicodendrum
Poison sumac, Toxicodendron vernix

R 285.715.7 Prohibited and restricted noxious weeds.

Rule 7. (1) All of the following are prohibited noxious weeds:

(a) Field bindweed, Convolvulus arvensis.
(b) Hedge bindweed, Convolvulus sepium.
(c) Canada thistle, Cirsium arvense.
(d) Morning glory, Ipomoea species.
(e) Puncturevine, Tribulus terrestris.
(f) Plumeless thistle, Carduus acanthoides.
(g) Musk thistle, Carduus nutans.
(h) Bull thistle, Cirsium vulgare.
(i) Perennial sowthistle, Sonchus arvensis.
(j) Whitetop = hoary cress = perennial peppergrass, Cardaria draba.
(k) Russian knapweed, Centaurea picris.
(l) Spotted knapweed, Centaurea maculosa.
(m) Leafy spurge, Euphorbia esula.
(n) Quackgrass, Agropyron repens = Elytrigia repens.
(o) Johnsongrass, Sorghum halapense, including sorghum almum and seed which cannot be readily distinguished from Johnsongrass.
(p) Dodder, Cuscuta species.

(q) Horsenettle, Solanum carolinense.
(r) Yellow nutsedge, Cyperus esculentus, both seed and tubers.
(s) Serrated tussock, Nasella trichotoma.

(2) All of the following are restricted noxious weeds:
(a) Fanweed, Thlaspi arvense.
(b) Black mustard, Brassica nigra.
(c) Charlock, Sinapis arvensis.
(d) Indian mustard, Brassica juncea.
(e) Wild radish, Raphanus raphanistrum.
(f) Hoary alyssum, Berteroa incana.
(g) Buckhorn plantain, Plantago lanceolata.
(h) Wild carrot, Daucus carota.
(i) Wild onion, Allium canadense.
(j) Wild garlic, Allium vineale.
(k) Giant foxtail, Seteria faberii.
(l) Yellow rocket, Barbarea vulgaris.
(m) Curled dock, Rumex crispus.
(n) Velvetleaf, Abutilon theophrasti.
(o) Wild oat, Avena fatua.
(p) Jimsonweed, Datura stramonium.
(q) Cocklebur, Xanthium strumarium.
(r) Nightshade complex, including all of the following Solanum species and any other species with indistinguishable seed:
(i) Bitter nightshade, Solanum dulcamara.
(ii) Black nightshade, Solanum nigrum.
(iii) Eastern black nightshade, Solanum ptycanthum.
(iv) Silverleaf nightshade = purple nightshade, Solanum eleagnifolium.
(v) Hairy nightshade, Solanum sarrachoides.

Source: MDA website: www.michigan.gov/mda search on “noxious weeds"

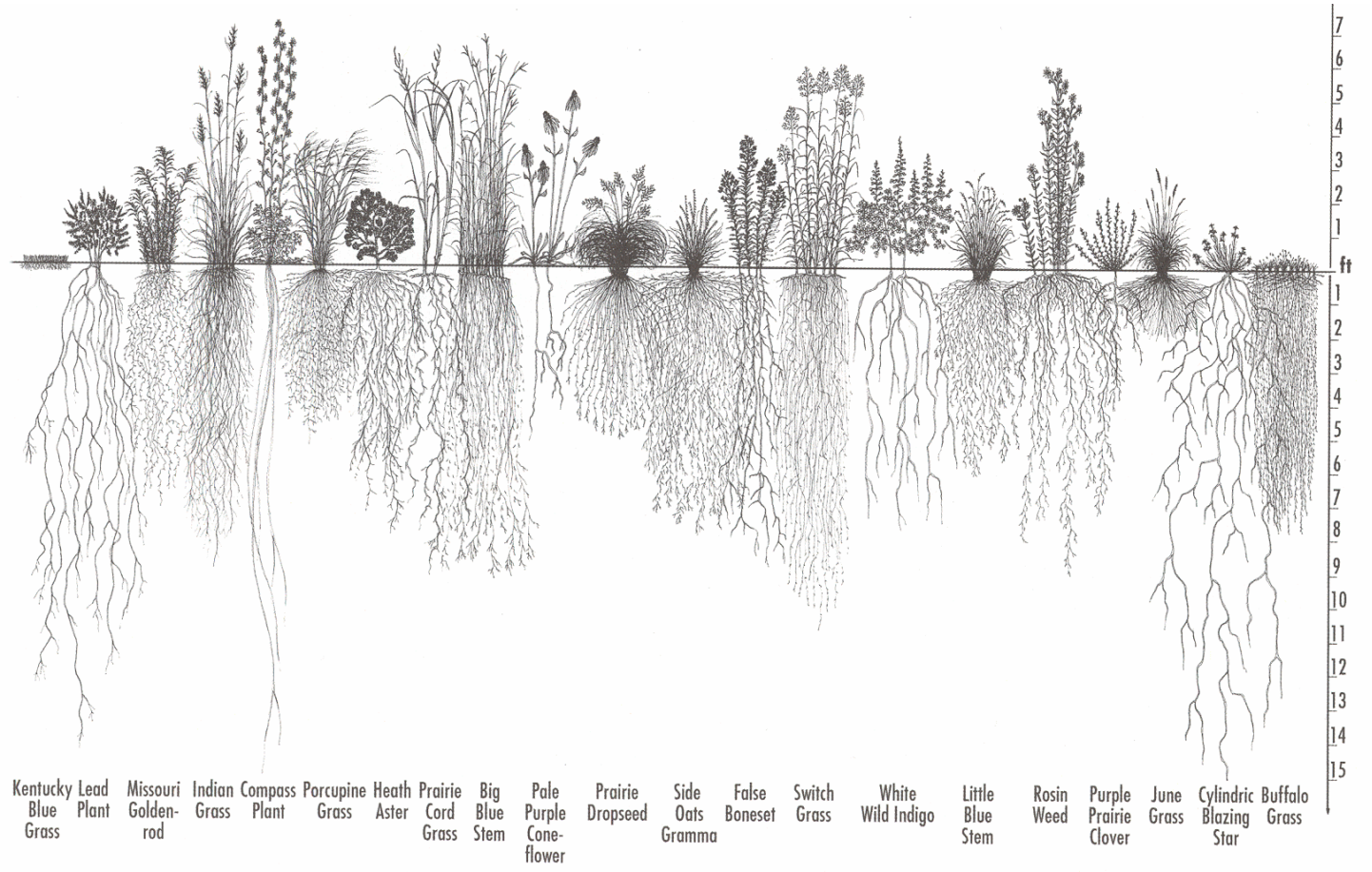
Aquatic Nuisance Species identified by the MDEQ include:

Purple loosestrife, Lythrum salicaria
Eurasian watermilfoil, Myriophyllum spicatum

Evasive Plants identified by Washtenaw County Drain Commissioner:

Autumn olive, Elaeagnus umbellata
Barberry, Berberris spp.
Buckthorn
Common buckthorn, Rhamnus cathartica
Glossy “Tall hedge” Buckthorn, Rhamnus frangula
Crown vetch, Coronilla varia
European alder, Alnus glutinosa
Honeysuckle,(Lonicera tatarica, L. japonica, L. maackii, L. morrowi, L. x-bella & their cultivars
Multiflora rose, Rose multiflora
Norway Maple, Acer platanoides
Oriental bittersweet, Celastrus orbiculatus
Periwinkle (Myrtle), Vinca minor
Privet, Ligustrum vulgare
Purple loosestrife, Lythrum salicaria
Siberian elm, Ulmus pumila

NATIVE SPECIES



"Native landscaping uses only plants indigenous (or "native") to the area. Once established, this low-maintenance form of landscaping provides habitat for many birds, butterflies and other wildlife. Thanks to their extensive, deep root system, native landscapes hold rain and survive drought much better than non-native plants and turf grass. Native landscapes are becoming more common. A popular technique is to reduce lawn sizes and use native landscaping for attractive borders. Because native plants have adapted to local soils and pests, they require less watering and need no chemicals or fertilizers to protect them. Unfertilized landscapes mean less contamination of waterways."

Source: Heidi Natura & Conservation Research Institute

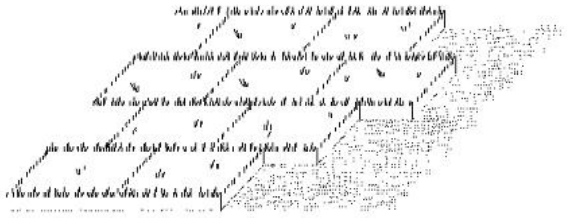
2. MULCH

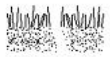
When	• Protection against raindrop impact, runoff or wind is needed to prevent erosion or loss of seed. • Moisture retention and temperature control are required for seed germination.
Why	• Cost effective way to protect seeded and non-seeded areas and slopes against erosion from rain or wind. Holds soil moisture to allow for seed germination and reduces wind desiccation of germinated seeds. Inhibits seed consumption by birds.
Where	• On flat areas, drain banks, slopes, ***vegetated channel and spillway***, ***diversion ditch and dike***, and borrow and stockpile areas.
Scheduling	• Year around.
How	1. Install other surface runoff control measures, compact soil as required, final grade and seed or install vegetation sprigs prior to mulching. 2. Select mulch material appropriate for the site characteristics including slope, expected flow, level of traffic, installation method, accessibility and length of time protection is needed. Place loose mulch open enough to allow some sunlight and air to penetrate to the soil but thick enough to shade the ground, conserve soil moisture and prevent or reduce wind and water erosion. 3. On flat and mild slopes (less than 2 horizontal to 1 vertical) with no concentrated flow, straw or hay may be used. Spread clean (no invasive or noxious species), dry straw or hay uniformly at a rate of 1-1/2 to 2 tons per acre or 100 lbs. (2-3 bales) per 1000 square feet. Other organic materials may be used where acceptable rates can be established. For native plantings, only the cleanest straw mulch should be applied; hay should not be used. If hydraulic mulches are used, bonded fiber matrixes, which include a tackifier, are preferred. 4. On slopes steeper than 2 horizontal to 1 vertical or areas with concentrated flow apply mulch or other approved material other than loose straw. Mulch should be anchored with, a tackifier, mulch-anchoring disks, crimping with a mulch crimping tool or by placing and stapling netting over the mulch. 5. Mulch blankets are effective in controlling erosion on steeper slopes, grassed waterways and spillways, diversion ditches and dikes, borrow and stockpile areas, and flat areas and slopes during the winter. ♦ On ***grassed waterways, spillways***, and ***diversion ditches*** unroll the mulch blanket across the channel and/or slope and toe or trench in 6 inches deep at the top edge of the mulch blanket. When mulch blankets must be overlapped in the direction of flow always install the downstream blanket first overlapping the upstream blanket on top a minimum of 12 inches and secure the joints with staples or stakes. ♦ On flat areas and slopes, drain banks, borrow areas and stockpiles unroll the mulch blanket, linearly along the slope at roughly the same elevation, installing the lower blanket first. Toe or trench in at the top edge of each blanket 6 inches deep, overlap the next layer a minimum of 12 inches and secure the joints with staples or stakes.

Maintenance	• Inspect mulched areas routinely and after each significant rainfall event to check for movement or erosion until areas are stabilized. If washouts or erosion occur, repair the surface, re-seed and re-mulch. Continue inspections as necessary until vegetation is firmly established. • Keep vehicular and pedestrian traffic and concentrated runoff away from mulched areas until they are well established. • Mulch effectively controls erosion for at least three months, but can be windblown or washed out.
Limitations	• Mulch can be blown or washed away if not secured. • Tackifiers are slippery when wet. Equipment must be kept clean to prevent accidents. Tackifiers can also mark vehicles, signs, or other objects if these items are not protected. • For native plantings only the cleanest straw should be applied; hay should not be used. • Mulch blankets and anchors may inhibit mowing.

3. SODDING

When	• An immediate, temporary or permanent, vegetative cover is necessary or desired.
Why	• To prevent soil erosion • To provide immediate site restoration.
Where	• In residential, commercial or high traffic areas. • On steep slopes, auxiliary spillways, and grassed swales.
Scheduling	• During the growing season.
How	1. Final grade, add topsoil if necessary, and scarify area prior to laying sod. 2. Lay sod in a staggered pattern aligning angled edges so the sod lays flush. 3. On slopes steeper than 3 horizontal to 1 vertical or in concentrated flow areas, the sod shall be pegged with wooden pegs, spaced not over 2 feet apart, in any direction, and shall be driven flush with the sod surface. 4. Water sod until roots have established. 5. Use sod grown on soils reasonably close to the site soil type.
Maintenance	• Water regularly. • Inspect weekly and following each significant precipitation event that results in runoff for slippage and gullies, make repairs and secure as needed until well established. • Heavy maintenance equipment should not be used until the sod is established
Limitations	• Requires irrigation. • Cost. • Does not work well in concentrated flow areas. • Shallow root structure is susceptible to slipping, gullying and failure. • Requires high maintenance to establish on steep slopes.





Correct

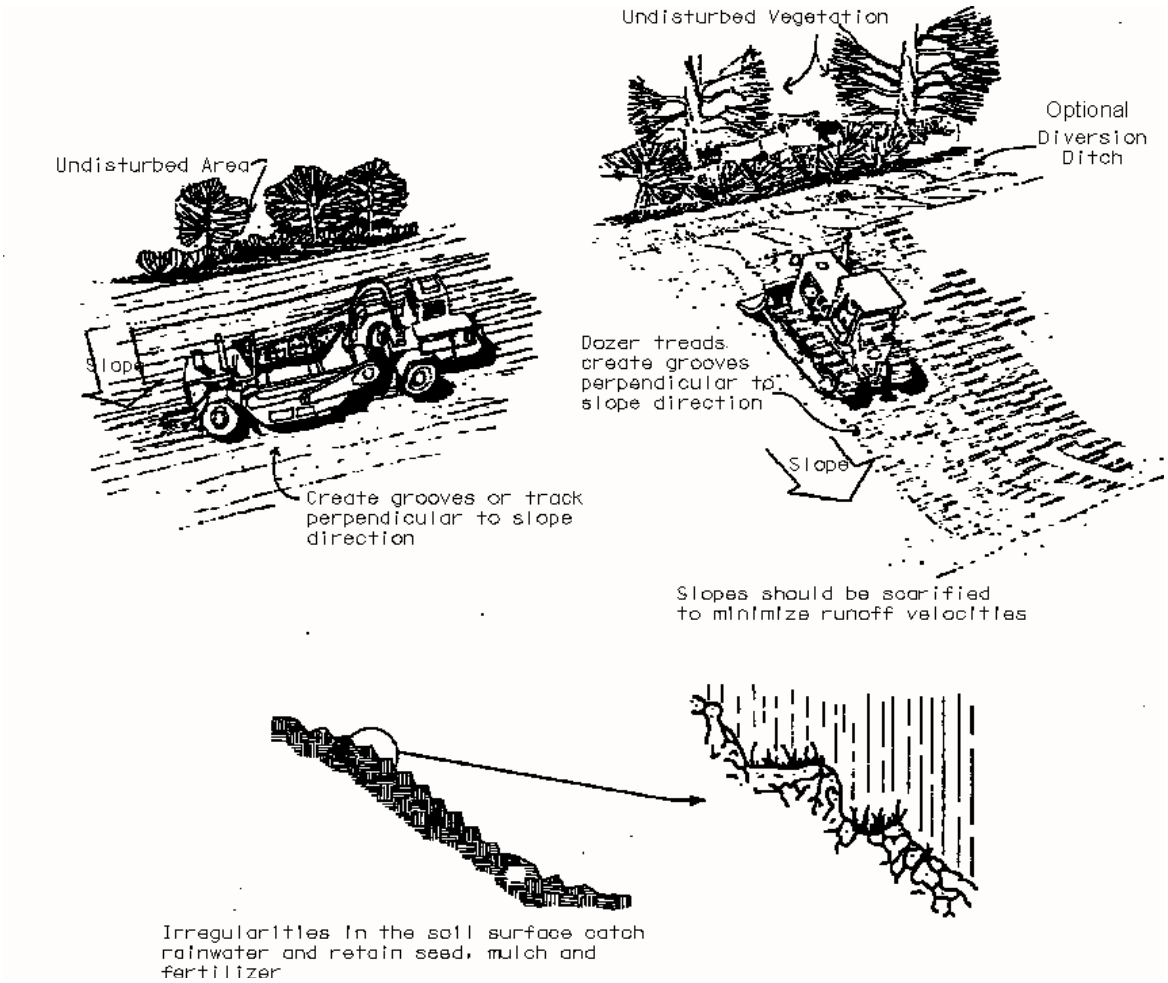
Incorrect

Lay sod in a staggered pattern with strips butted tightly against each other matching angled ends correctly. A sharpened mason's trowel can be used to tuck down the ends and trim pieces.

Source: Michigan Department of Transportation

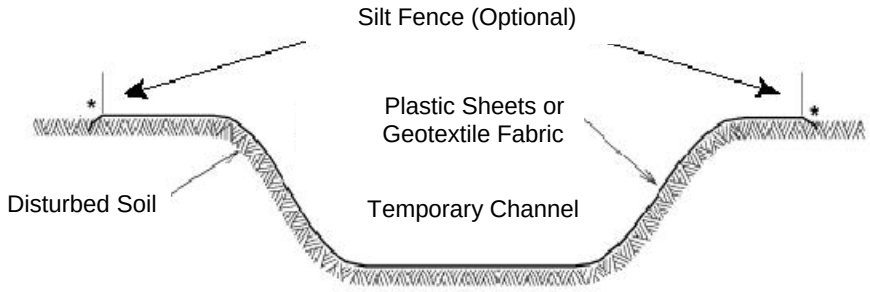
4. SLOPE ROUGHENING AND SCARIFICATION

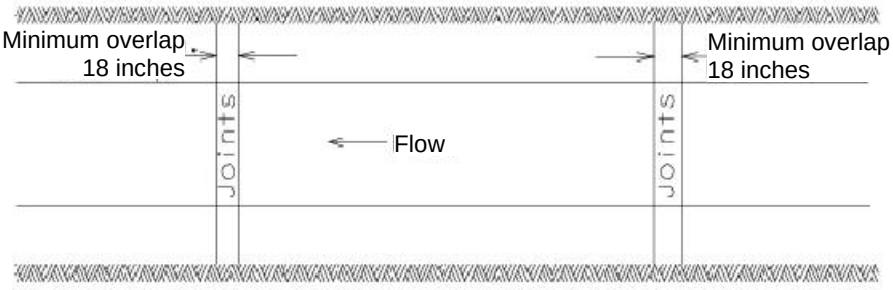
When	• Site grading or construction activities result in grades that may cause increased erosive velocities or off-site sedimentation.
Why	• To reduce runoff velocity, increase infiltration, aid in the establishment of vegetation, reduce erosion.
Where	• On disturbed slopes and stream or drain banks.
Scheduling	• During the growing season.
How	1. Remove vegetation and conduct grading activities. 2. Final grade, add topsoil if necessary. 3. Roughen or scarify slope to create horizontal depressions perpendicular to the slope by running tracking machinery up and down the slope, scarifying the slope or back-blade along a slope contour. 4. Establish vegetation or cover soil to ensure its resistance to soil erosion, sliding, or other earth movement. 5. Remove temporary SESC measures when disturbed areas are stabilized.
Maintenance	• Inspect routinely and following each precipitation event that results in runoff and make repairs until all disturbed areas are stabilized.
Limitations	• Roughening and scarification has limited effectiveness on its own, but is used to speed revegetation. • Steep slopes and accessibility limit ability to use heavy equipment to roughen soil.


Undisturbed Vegetation
Optional
Diversion
Ditch
Undisturbed Area
Slope
Dozer treads
create grooves
perpendicular to
slope direction
Slope
Create grooves or track
perpendicular to slope
direction
Slopes should be scarified
to minimize runoff velocities
Irregularities in the soil surface catch
rainwater and retain seed, mulch and
fertilizer

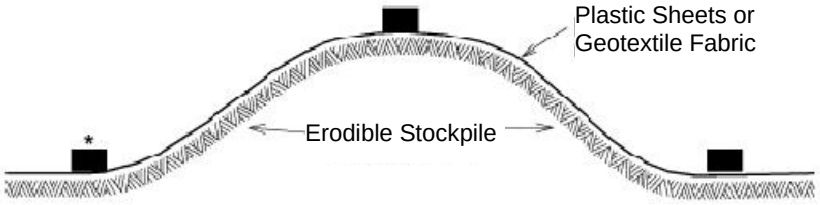
5. PLASTIC SHEETING OR GEOTEXTILE COVER

When	• Unstable areas are subject to erosive surface flows or severe wind.
Why	• To provide an immediate temporary protection of unstable areas and slopes from wind or water erosion.
Where	• As a temporary measure to line a channel, cover stockpile areas or to provide immediate cover on exposed slopes.
Scheduling	• Year around.
How	1. Prepare subgrade to design grade and compaction requirements. 2. Remove ruts, roots, soil clods, or other debris from the surface subject to plastic sheeting installation. 3. Consult with erosion control material supplier to select plastic sheeting based on slope gradient, expected surface runoff, and duration of use. Sheeting should be a minimum of 6 mils thick. 4. Position plastic sheets as close as possible to intended use location and unroll perpendicular to anticipated flow direction. 5. Install downstream sheets first, progressing upstream or up gradient overlapping all edges by a minimum of 18 inches. The upstream sheet must overlap the downstream sheet to prevent flow from traveling under the plastic. 6. The most upstream sheet edge must be trenched in a minimum of 18 inches. 7. Secure sheets with staples or pegs of size and length suited to soil conditions immediately after plastic sheeting is installed.
Maintenance	• Inspect routinely to ensure temporary plastic sheets are providing protection. • Maintain SESC measures to prevent soil from eroding onto the plastic sheeting. • Keep vehicular traffic off of plastic to prevent degradation of the plastic.
Limitations	• For temporary use only. • Will fail if water flows beneath the plastic sheeting. • Plastic is prone to damage by wind or high velocities. • Will deteriorate over time.





Plan View



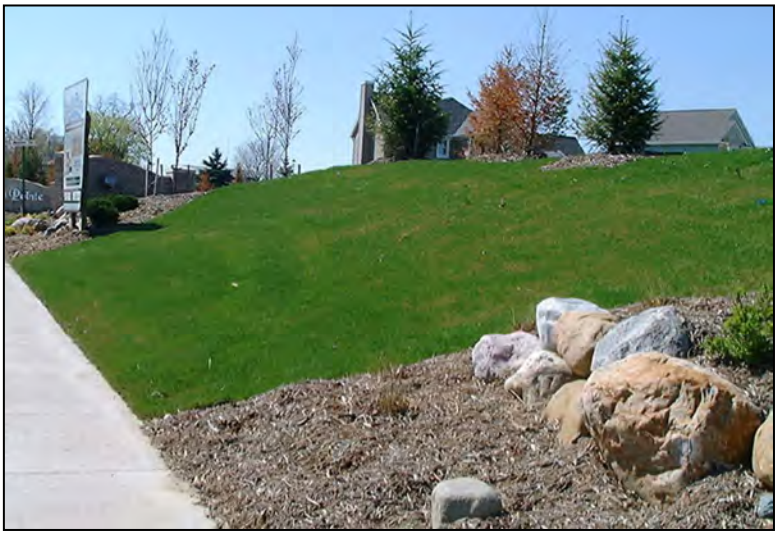
*Plastic Sheets or Geotextile Cover shall be anchored with a non-erodible material.

Source: Michigan Department of Transportation

6. SOIL BINDING POLYMERS

When	• Bare soil is exposed to raindrop impact, sheet flow, rill flow or wind.
Why	• When used as a bare-soil spray, it provides a cost effective alternative to reduce soil erosion and increase the infiltration rate in areas that will not be disturbed by foot or vehicular traffic. • When used as the binder for temporary or permanent seeding, it will help control movement of seed, fertilizer, soil and amendments, during both the germination and early plant development stages. It may improve plant establishment and growth rates by increasing infiltration, reducing runoff and holding nutrients in-place for plant use. • When used in conjunction with other appropriate SESC measures, such as erosion control blankets or turf reinforcement mats, or as part of a bonded fiber matrix, polymer binders will help minimize suspended solids in runoff.
Where	• Over all exposed soil surfaces or prepared seed beds prior to erosive force impact.
Scheduling	• Year around under bare ground conditions. The soil cannot be frozen at the time of polymer application; however, the ground can freeze after the polymer has been applied.
How	1. Soil binding polymers must be applied by a knowledgeable applicator. 2. Select polymer based on bench tests which show proper chemical interaction between the subject soil and desired polymer. All polymers must be anionic polyacrylamides or anionic polyacrylamide blends in aqueous [pure] emulsion, granulated or partially hydrated form. 3. If used in granulated form over soil: spread evenly over soil surface at a rate not to exceed 10 lbs/acre. 4. If used in granulated form within compost: mix into compost and spread ½" thick composite so that 20-25 lbs of polymer is used per acre. 5. If used in spray applications, add seed, mulch and other additives first, then add polymer to vigorously agitated water so that mix ratio does not exceed 1 lb polymer for 300 gallons water. Spray soil until the water/polymer sufficiently coats all soil particles without producing runoff.
Maintenance	• Visually inspect all areas where the polymer has been applied without walking or traveling over the area following each significant precipitation or wind event and prior to expected events. Reapply if soil areas indicated disturbance by erosive forces, or if deemed necessary, reapply in conjunction with additional management practices. • Reapply if treated area is disrupted.
Limitations	• Polymer performance is subject to the chemical matching between the subject soil and the polymer, i.e., one polymer will not provide suitable performance for all soil types. • Concentrated flows may create erosive stress beyond the strength associated with polymeric or other spray-applied Management Practices. • When used alone, without seed or mulch, polymers should only be used on slopes 3 horizontal to 1 vertical, or flatter. • Limit use to areas that will not be disturbed by foot or vehicular traffic.

Seed, mulch and spray soil binding polymer applied prior to 1 inch rainfall in October 2001.



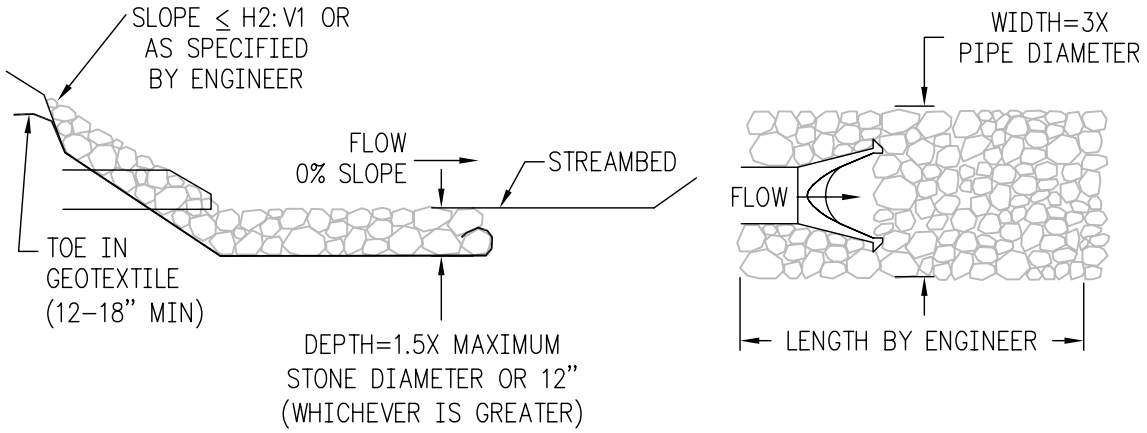
Observed in late April 2002 without any required maintenance.

Soil binding polymer and seed being applied with hydroseeding equipment.

Source: Price and Company, Inc.

7. RIPRAP

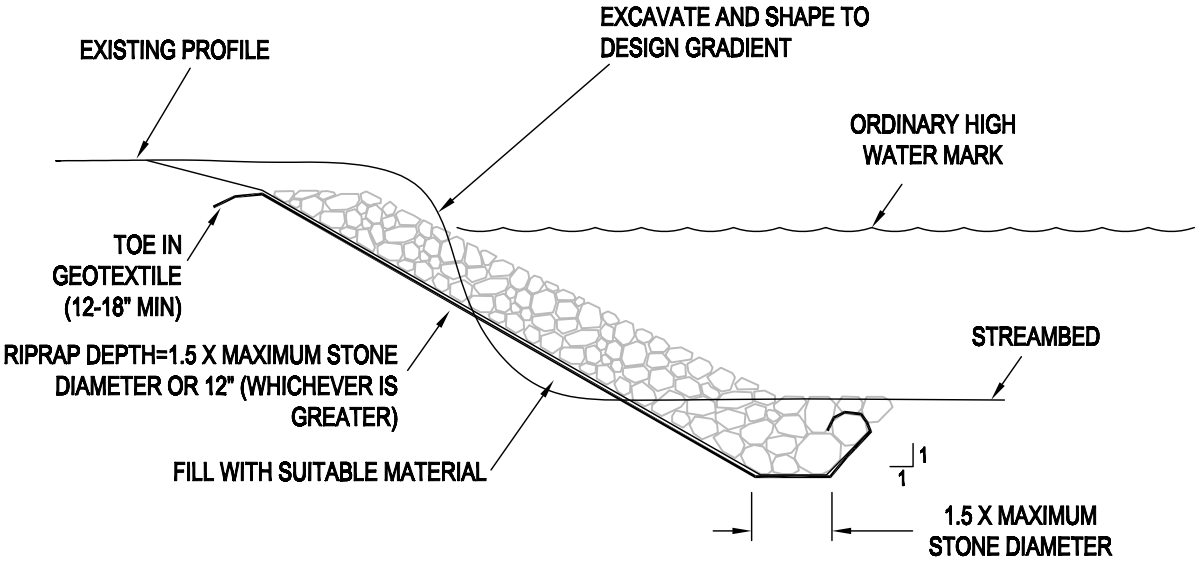
When	• Raw, erodible areas need protection against concentrated flows that have the potential to create scour, down-cutting, or lateral cutting.
Why	• To stabilize and protect stream and drain banks, control channel meander, maintain capacity, protect against wave attack, and reduce sediment load.
Where	• On steep slopes subject to weathering or seepage, for channel liners, inlet and outlet protection at culverts, drain bank protection and to protect shorelines subjected to wave action. • At culvert outlets can be used to protect the stream bed and channel, thus reducing the flow velocity to a level that is non-erosive. • At the outlet of storm drains and as channel linings when flow velocities and concentrations are high and/or the channel slope is steep. • On channel banks where the direction of flow changes and to stabilize erodible slopes.
Scheduling	• During lower flow periods or when emergency repairs are required.
How	1. Riprap must be clean, free of extruding rebar, sized correctly based on anticipated velocities, and placed to the proper thickness. 2. Where high water velocities are anticipated (greater than 6 ft/sec), the Riprap should be designed by an Engineer to ensure that the size of stone is adequate to protect the area from erosion and off-site sedimentation. 3. Over excavate area where riprap will be placed if needed. Riprap should be placed on geotextile fabric to prevent soil from washing out from under the riprap. The edges of the geotextile fabric should be overlapped at least 2 feet. Place riprap immediately after installing geotextile fabric. 4. Install riprap to full thickness in one operation. Do not dump through chutes or use any method that causes segregation of stone sizes. When placing stone, avoid dislodging or damaging underlying geotextile fabric. Tamp individual pieces until firmly bedded. 5. Place smaller, 4 inch to 6 inch stones, in voids to form a dense, uniform and well-graded mass, or as directed by the engineer or representative of the _CDC. Some hand placement may be necessary to obtain an even distribution of stone sizes.
Maintenance	• If riprap has been displaced and the geotextile fabric is damaged during high flow conditions or from vandalism, remove riprap and repair geotextile fabric by adding another layer overlapping the damaged area by 2 feet and anchoring with pins spaced 3 feet apart. Replace riprap over geotextile fabric. • Inspect following each precipitation event that results in runoff and confirm effectiveness, make necessary adjustments. Expand riprap area as needed.
Limitations	• Cost and access. • During winter frozen ground must be excavated and loose fill placed before the geotextile fabric and riprap are placed. • When using large concrete slabs it is difficult to provide adequate support to prevent undermining and failure.



Source: Adapted from State of Michigan, Department of Management and Budget, SESC Guidebook

8. RIPRAP TOE OF SLOPE

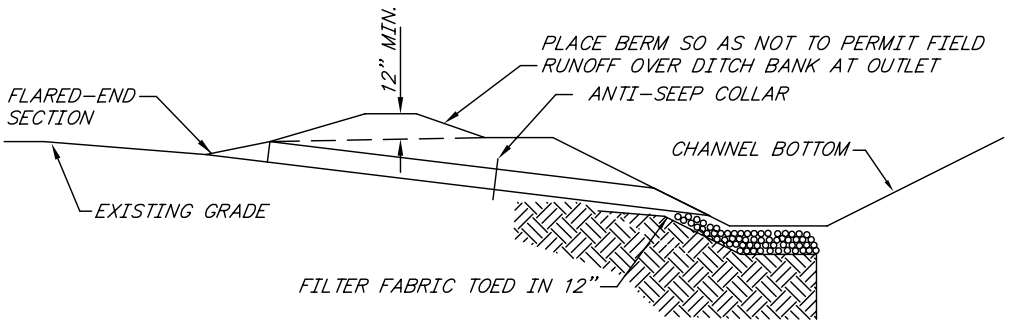
When	• Erosion at the toe of slope is occurring. • On the outside of a channel bend.
Why	• To control further erosion and stabilize and protect drain banks from the erosive force of stream flow.
Where	• In areas with high stream velocities such as: on the outside bend of a drain; at the confluence of two streams or drains or at tile outlets; and on the banks in an area where the drain slope increases and flow velocities are higher. • Modest seepage is causing slumping and slope failure at the toe of slope.
Scheduling	• During lower flow periods or when emergency repairs are required.
How	1. If anticipated high water velocities will exceed 6 feet/second utilize an engineer to properly design the toe of slope riprap protection including the required size of the stone, rock or broken concrete. 2. Install downstream sediment control measures. 3. Isolate work area from flowing water. 4. Clear and grub existing grade. 5. Over excavate streambed and bank beginning at point of proposed stream width where riprap will be placed. 6. Toe in geotextile fabric 12-18 inches below streambed and bank. 7. Cover geotextile fabric with well graded, clean, properly sized stone, rock, or broken concrete. If broken concrete is used, it shall not contain any protruding steel, soil or other fines, asphalt, soluble chemicals, or organic material. 8. Stabilize all disturbed areas. 9. Remove temporary SESC measures after all disturbed areas are stabilized.
Maintenance	• If the riprap has been displaced and geotextile fabric is damaged during high flow conditions or from vandalism, remove riprap and repair geotextile fabric by adding another layer overlapping the damaged area by 2 feet and anchoring with pins spaced 3 feet apart. Replace riprap over geotextile fabric. • Inspect following each precipitation event that results in runoff and confirm effectiveness, make necessary adjustments. Expand riprap area as needed.
Limitations	• Cost and access. • During winter frozen ground must be excavated and loose fill placed before the geotextile fabric and riprap are placed. • Large concrete slabs should not be used because adequate support to prevent undermining and failure is difficult to provide.



Source: Adapted from State of Michigan, Department of Management and Budget, SESC Guidebook

9. OUTFALL STABILIZATION

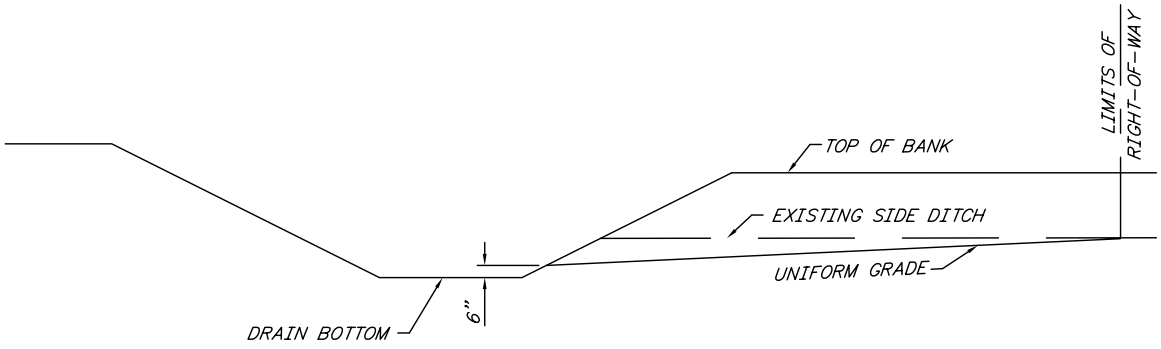
When	• Enclosed drain enters open drain. • Field tile discharges to an open drain. • Outfall area is eroding.
Why	• To prevent erosion at the outlet of an open drain or tile.
Where	• In the stream or drain bank, usually above the ordinary high water mark.
Scheduling	• During lower flow periods or when emergency repairs are required.
How	1. Install downstream sediment control measures. 2. Recess pipe outlet into bank to prevent protruding. 3. Install riprap around and beneath pipe over geotextile fabric. 4. Where possible, direct flow downstream. 5. Install riprap on opposite bank if needed to prevent erosion. 6. Construct a small berm at the top of bank above outfall to prevent gully erosion at trench. 7. Install rodent guard if necessary. 8. Stabilize all disturbed areas. 9. Remove temporary SESC measures after all disturbed areas are stabilized.
Maintenance	• Inspect following each precipitation event that results in runoff for scour beneath the outlet and at opposite bank, and erosion of the trench until area is stabilized.
Limitations	• Cost. • Access. • During winter frozen ground must be excavated and loose fill placed before the geotextile fabric and riprap are placed. • Large concrete slabs should not be used because adequate support to prevent undermining and failure is difficult to provide.



Source: Spicer Group, Inc.

10. SIDE DITCH OUTLET

When	• An open ditch or drain is discharging to a stream or open drain at erosive velocities.
Why	• To prevent erosive velocities at intersection.
Where	• In the incoming ditch or drain, just upgradient from the discharge to a stream or open drain. • A shallow side ditch enters a deeper ditch, drain or stream at a higher elevation.
Scheduling	• During lower flow periods or when emergency repairs are required.
How	1. Install downstream sediment control measures. 2. If a stable grade can be constructed within the drain easement, excavate ditch bottom and side slopes per design specifications, otherwise install an appropriately designed ***armored spillway*****,** ***sloped pipe spillway*****, or** ***pipe drop spillway*** within the available right-of-way. 3. Seed disturbed areas with seed and mulch appropriate to site conditions the same day. 4. Add riprap as conditions require. 5. Stabilize all disturbed areas. 6. Remove temporary SESC measures after all disturbed areas are stabilized.
Maintenance	• Inspect routinely and following each precipitation event that results in runoff until stabilized.
Limitations	• Prevents access along ditch bank. • Existing road and drain right-of-ways may limit grading. • Difficult to construct during frozen ground conditions.

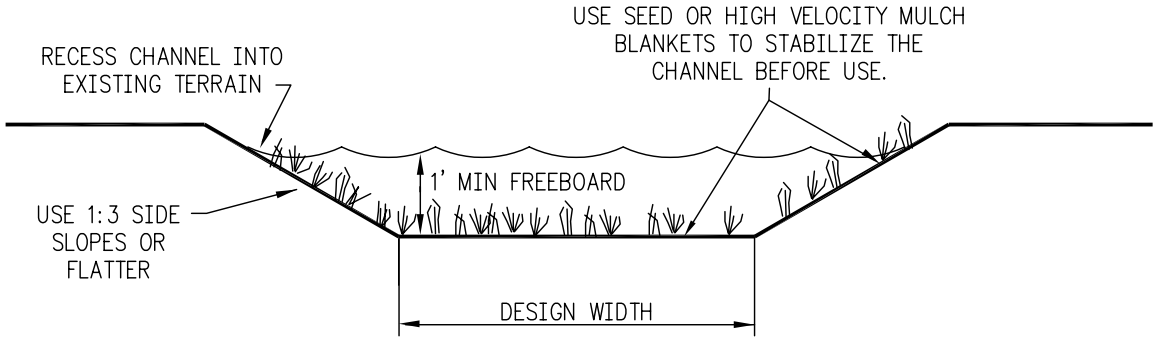


Source: Spicer Group, Inc.

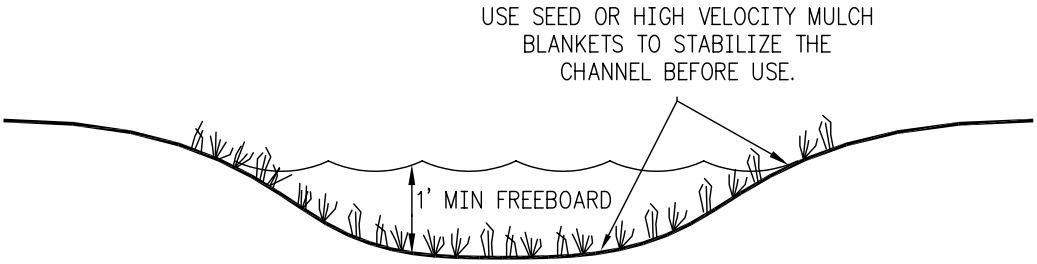
11. GRASSED WATERWAYS

When	• When anticipated flow velocities, either temporary or permanent, have the potential to cause erosion when not protected by vegetation.
Why	• To stabilize the grassed waterway by reducing flow to non erosive velocities and to trap sediment.
Where	• In intermittent streams or drains and constructed ditches and drainage swales where flow velocities and grades do not warrant armoring the waterway or swale with riprap or cobble.
Scheduling	• During the growing season during low flow conditions.
How	1. Identify areas that have the potential for concentrated flow and erosive velocities. Grassed waterways should be capable of conveying a 10-year, 24-hour storm at non erosive velocities. Utilize a qualified professional when designing a channel based on discharge volume, channel slope, flow velocity and soil type. 2. The channel cross section should be wide and shallow with relatively flat side slopes to allow surface water to enter over the vegetated banks without causing erosion and to facilitate maintenance. Trapezoidal or parabolic shapes at least one foot deep are recommended. V-Shaped channels should not be used because the resulting higher flow velocities can create gullies. Sharp bends and steep grades should be avoided. 3. Construct the grassed waterway in stable areas that conform with the natural drainage system or along roadways or property boundaries recessing the swale into the existing grade so that the top of the swale is flush with adjacent grades. Remove and properly dispose of excess soil so that surface water may enter the swale freely. 4. Select vegetation with the appropriate retardance for reducing velocity when required and for the anticipated flow velocities, soil type, depth to water table, climate, and desired vegetative height. The use of native species should be considered. Silt, sand, loam, silty loam, and sandy loam soils are easily erodible with or without vegetation. However, clay loam, silty clay loam, sandy clay loam, silty loam clay soils are erosion resistant, when protected by vegetation. 5. Establish channel vegetation immediately after grading using seed and mulch when needed. Turf reinforced mats, high velocity mulch blankets, pre-vegetated erosion control blankets, or other available products are recommended for ditch grades between 3 and 6 percent and can assist establishment of vegetative ditch bottoms. When installing high velocity mulch blankets unroll in the direction of flow. Extend the blanket to an elevation 1 foot above the anticipated flow depth being careful not to stretch the blanket. 6. Temporary *check dams* may be required to reduce flow velocities on long slopes and in channels that must be used prior to establishment of vegetation.

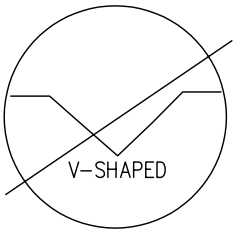
Maintenance	• Inspect periodically and after each rain event until vegetation has been established. Watering may be necessary during dry weather. • If necessary, repair and reseed or replant eroded areas immediately. • Remove accumulated sediment from grassed waterways. • Remove fallen woody debris that may direct flows towards the channel banks.
Limitations	• Channel should not be used until vegetation has been established. • Channel vegetation cannot be established during winter months or when insufficient precipitation is available. • Dormant seedlings have a high failure rate in concentrated flow areas and should be avoided.



TRAPEZOIDAL CHANNEL
CROSS-SECTION



PARABOLIC CHANNEL
CROSS-SECTION

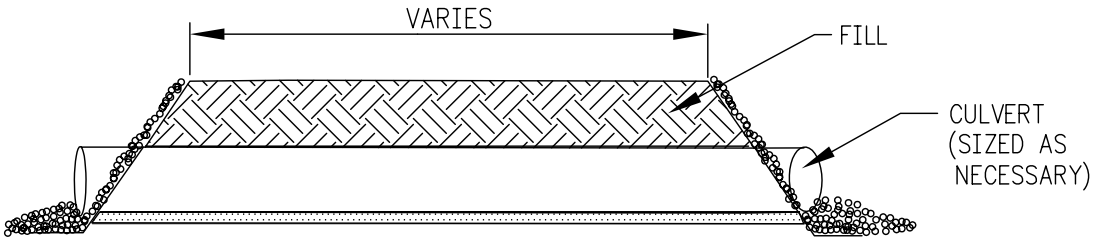


Source: Adapted from State of Michigan, Department of Management and Budget, SESC Guidebook

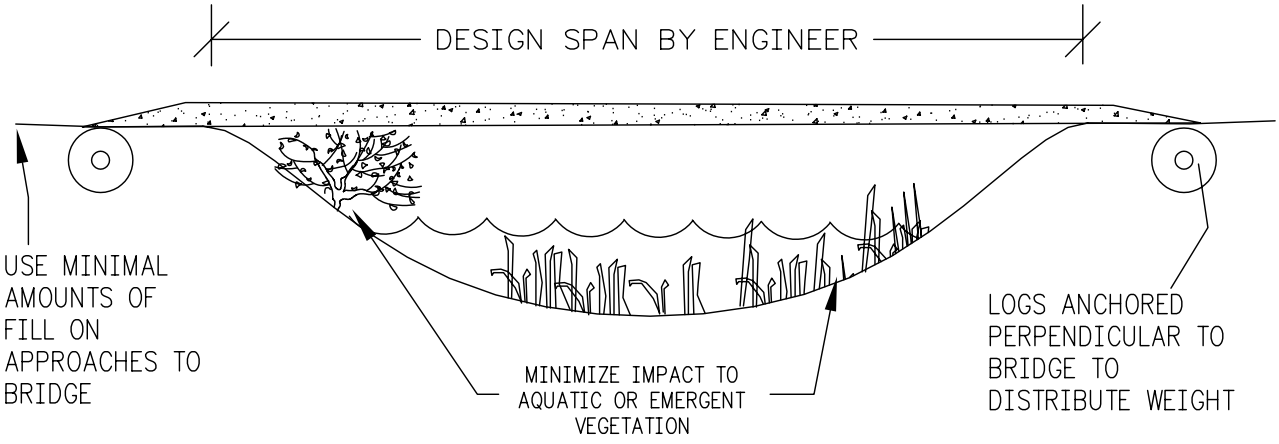
12. TEMPORARY CROSSING

When	• Construction or maintenance equipment requires temporary crossing of a drain to complete activities such as: repairing erosion on the opposite bank; or dredging from the opposite side of the stream to minimize tree removal, maintain shade on the south and west banks minimizing algae growth and maintaining cooler water temperatures for improved water quality. • Erodible and unstable soils, wetlands, crops or residential landscaping needs to be avoided.
Why	• To minimize damage to drain bank vegetation and channel. • No other viable access is available.
Where	• Temporary access is required to the opposite side of a channel. • At locations that will minimize negative environmental impacts and cost.
Scheduling	• Year around during lower flow or frozen ground conditions.
How	• Evaluate the site and identify locations where the temporary crossing will not produce erosive velocities, consult an engineer when needed. • Select one of the following six (6) temporary crossing techniques to minimize the cost and negative environmental impacts. If necessary, install downstream sediment controls before constructing or removing a ford. 1. Ford Drain without Temporary Crossing ♦ Select a location with low banks and stable soils. ♦ Drive equipment across drain, reshape and stabilize drain banks the same day, stabilize all other disturbed areas within 5 days. 2. Native Soil Ford ♦ When ***dredging*** select an upstream location with low banks and stable soils. ♦ Fill channel with native soils sufficient to support equipment. ♦ Drive equipment across drain and excavate fill immediately. ♦ Reshape and seed streambanks the same day and stabilize all other disturbed areas within 5 days. Mulch streambanks if required for stabilization. 3. Timber Ford ♦ Line drain bottom with trees placing them lengthwise parallel with flow until adequate support for equipment is provided. Cross stream with equipment and immediately remove timber to outside edge of drain easement. Reshape and stabilize stream banks the same day, stabilize all other disturbed areas within 5 days. ♦ Crane mats can also be used. 4. Rock Ford ♦ Select a location with low banks and stable soils that will require minimum bank excavation. ♦ Excavate the channel banks as required to provide a shallow road slope adequate for equipment access. Excavate the channel bottom equal to the stone depth required to support the construction equipment. The rock depth typically ranges from 6 to 18 inches. ♦ Stockpile spoils along the back of the drain easement as far away from the stream as possible such that the spoil will not erode back into the drain. Stabilize spoils if they will be left for more than 5 days. If rock ford will remain in place, spread spoils and stabilize within 5 days.

	♦ Install geotextile fabric in the excavated channel bottom to stabilize the foundation in silt, muck or other unstable soils. Place a clean, well-graded weather resistant stone (3 to 6 inch diameter) until the top of the stone matches the stream bottom elevation. Geotextile fabric in a flowing watercourse must be held in place against the stream bottom until sufficient stone is placed to keep the fabric from washing downstream. Hand placement of the stone along the upstream edge may be necessary. ♦ Shape side slopes of entrance and exit ramps to 2 horizontal to 1 vertical or flatter and stabilize. ♦ If rock ford is to be removed use excavated materials to restore natural bank contours and stabilize all disturbed areas. Stone can be left within the stream bottom. 5. <u>Temporary Culvert</u> ♦ Select a location where the drain is narrow and can accommodate a culvert with minimal backfill. The culvert size should be selected depending on the anticipated flow while the culvert crossing is in place. ♦ Line channel bottom and banks with geotextile fabric if needed to provide a stable foundation. Align culvert in center of channel placing culvert bottom at stream bottom elevation. ♦ Backfill with appropriate material and compact around culvert. ♦ Remove fill and culvert. Reshape and seed banks the same day, applying mulch as needed. ♦ Stabilize all other disturbed areas within 5 days. 6. <u>Temporary Bridge</u> ♦ Select a location where the banks are stable and can support a bridge deck preferably with no abutments. ♦ Utilize an engineer or qualified professional for structure design. ♦ Install anchor logs perpendicular to bridge length parallel with banks and anchor bridge deck to logs if necessary for stability and to distribute bridge weight. ♦ Remove Bridge. Reshape and stabilize drain banks the same day, stabilize all other disturbed areas within 5 days.
Maintenance	• If a rock ford or a temporary culvert or bridge will be used for an extended period of time, inspect routinely and following each precipitation event that results in runoff until area is stabilized. Make necessary repairs to maintain soil stability.
Limitations	• High flows make temporary crossings impractical.



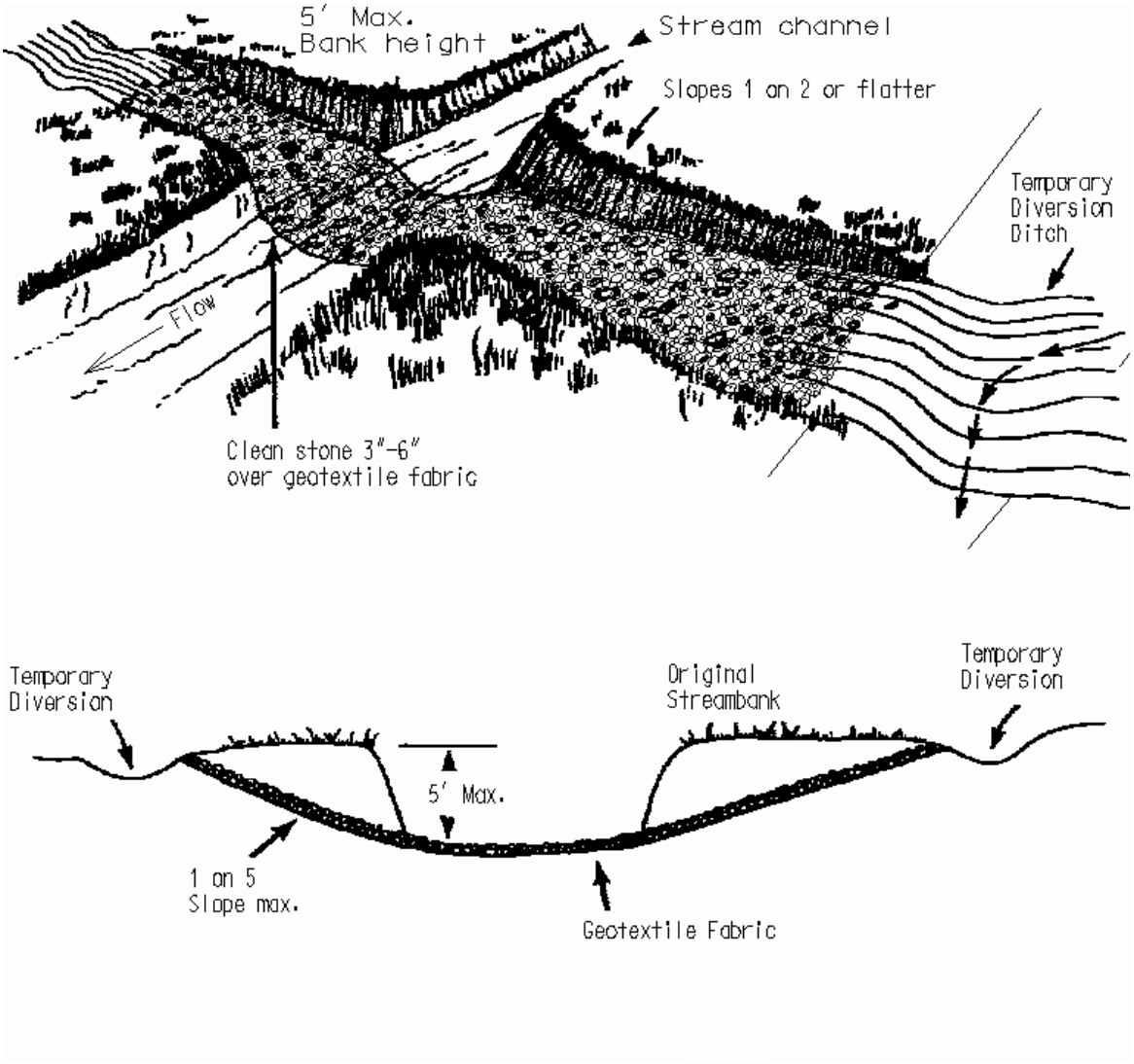
TEMPORARY CROSSING – CULVERT



TEMPORARY CROSSING – BRIDGE

Source: Michigan Department of Transportation

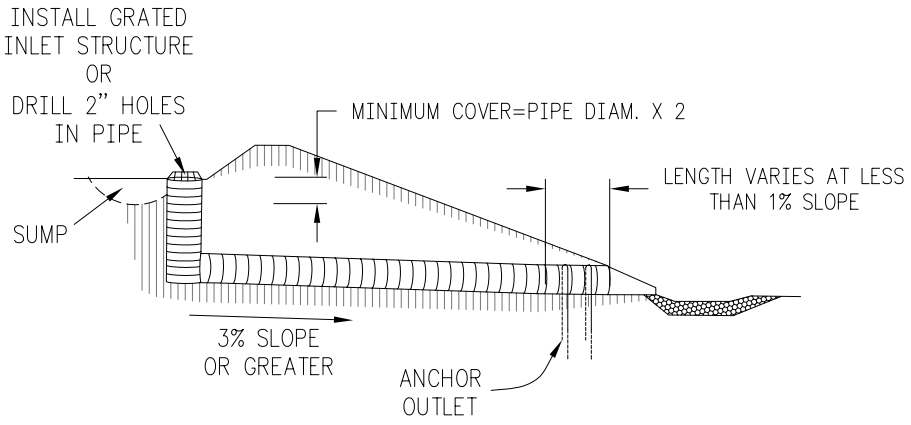
ROCK FORD



Source: Michigan Department of Transportation

13. PIPE DROP SPILLWAY

When	• Concentrated runoff must discharge from a higher to lower elevation within a short horizontal distance, down steep slopes, or when soils are highly erodible or excessively wet.
Why	• To effectively allow runoff to drop in elevation rapidly without causing an erosive condition.
Where	• Within a drain bank.
Scheduling	• During lower flow conditions preferably when vegetation can be established.
How	1. Identify locations of concentrated flow along the top of a slope. 2. Utilize an engineer when designing a pipe drop spillway and a stable pipe outlet that can convey, at a minimum, the 10-year, 24-hour storm discharge and velocity. This includes selection of the appropriate pipe size, the pipe inlet and outlet design, and a stable outlet. Drop pipe inlets with a debris rack or a flared inlet structure with ***sediment sumps*** are preferred inlet alternatives. Install the pipe with a minimum slope of 3 percent. The last 4 feet of pipe should be at a 1 percent slope or less to reduce outlet velocities. (see drawing) 3. Install downstream sediment control measures. 4. Thoroughly compact soil around and under the pipe entrance or inlet structure in multiple lifts and construct ***sediment sumps*** upgradient of the pipe inlet. 5. Install pipe and anti-seep watertight collars along pipe and at pipe joints. 6. Backfill around and over the pipe with a suitable soil and compact in lifts. 7. Construct a compacted earthen berm between the pipe inlet and drain. 8. Toe in geotextile fabric under the pipe outlet extending the fabric to the anticipated extent of the riprap. When riprap extends into moving water the geotextile fabric must be keyed in to a minimum depth of 18 inches below the channel bottom. Isolate work area from channel flow during construction using appropriate measures. 9. Adequately anchor pipe outlet. 10. Provide a stable outfall area and an auxiliary spillway at least 6 feet away from pipe trench over natural ground. 11. Stabilize all disturbed areas. 12. Remove temporary SESC measures after all disturbed areas are stabilized.
Maintenance	• Inspect routinely and following each precipitation event that results in runoff until spillway and surrounding area is stabilized. Inspect the inlet to ensure it is free of undercutting and no water is seeping past the inlet entry and the outlet is adequately anchored. • Once stabilized, inspect periodically to assure pipe inlet, anchor points, and outlet are stable and dissipation devices are functioning properly. Remove debris and accumulated sediment and make any necessary repairs.
Limitations	• More costly than surface or sloped spillways. • Requires bank excavation.

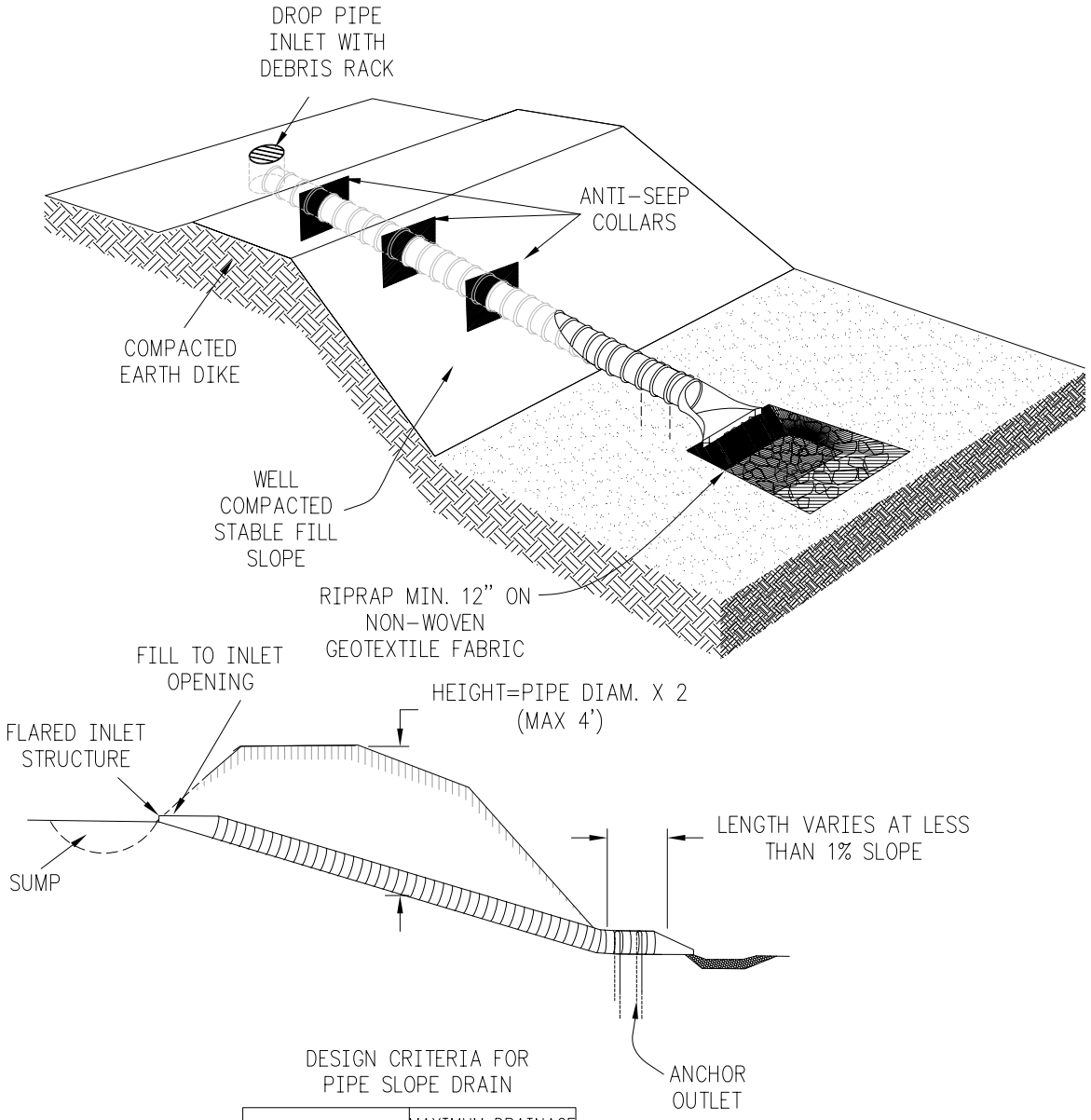


Source: Adapted from State of Michigan, Department of Management and Budget, SESC Guidebook

14. SLOPED PIPE SPILLWAY

When	• When concentrated runoff must be conveyed down a slope from a higher elevation to a lower elevation without causing slope erosion, gullying or slope failure.
Why	• To effectively allow runoff to drop in elevation down a slope without causing an erosive condition.
Where	• Within a drain bank.
Scheduling	• During lower flow conditions preferably when vegetation can be established.
How	1. Identify locations of concentrated flow along the top of a slope. 2. Utilize a qualified professional for the design of a sloped pipe spillway and a stable pipe outlet that can convey, at a minimum, the 10-year, 24-hour storm discharge and velocity. This includes selection of the appropriate pipe size, the pipe inlet and outlet design, and a stable outlet. If the inlet is a standpipe with holes, the holes should be a minimum of 2 inches in diameter and the pipe should extend vertically no more than 6 inches below the top of the dike. 3. Install downstream sediment control measures. 4. Thoroughly compact soil around and under the pipe entrance or inlet structure in multiple lifts. If sediment accumulation is anticipated construct ***sediment sumps*** upgradient of the pipe inlet. 5. Install pipe and anti-seep watertight collars along pipe and at pipe joints. 6. Backfill around and over the pipe with a suitable soil and compact in lifts. 7. Construct a compacted earthen dike between the pipe inlet and the drain and stabilize all disturbed areas. 8. Toe in geotextile fabric under the pipe outlet extending the fabric to the anticipated extent of the riprap. When riprap extends into moving water the geotextile fabric must be keyed in a depth of 18 inches below the channel bottom. Isolate work area from channel flow during construction using appropriate measures 9. Adequately anchor pipe outlet. 10. Provide a stable outfall area and an emergency spillway at least 6 feet away from pipe trench over natural ground. 11. Stabilize all disturbed areas. 12. Remove temporary SESC measures after all disturbed areas are stabilized.
Maintenance	• Inspect routinely and following each precipitation event that results in runoff until spillway and surrounding area are stabilized. Inspect the inlet to ensure it is free of undercutting and no water is seeping past the inlet entry and the outlet is adequately anchored. • Once stabilized, inspect after each significant runoff event to assure pipe inlet, anchor points, and outlet are stable and dissipation devices are functioning properly. Remove debris and accumulated sediment and make any necessary repairs.

Limitations	• More costly than surface spillways. • Requires some bank excavation. • Susceptible to failure if not installed properly. This includes proper soil compaction, installation of pipe and anti-seep collars, and adequately anchoring and stabilizing the pipe outlet including energy dissipation if necessary.



DESIGN CRITERIA FOR
PIPE SLOPE DRAIN

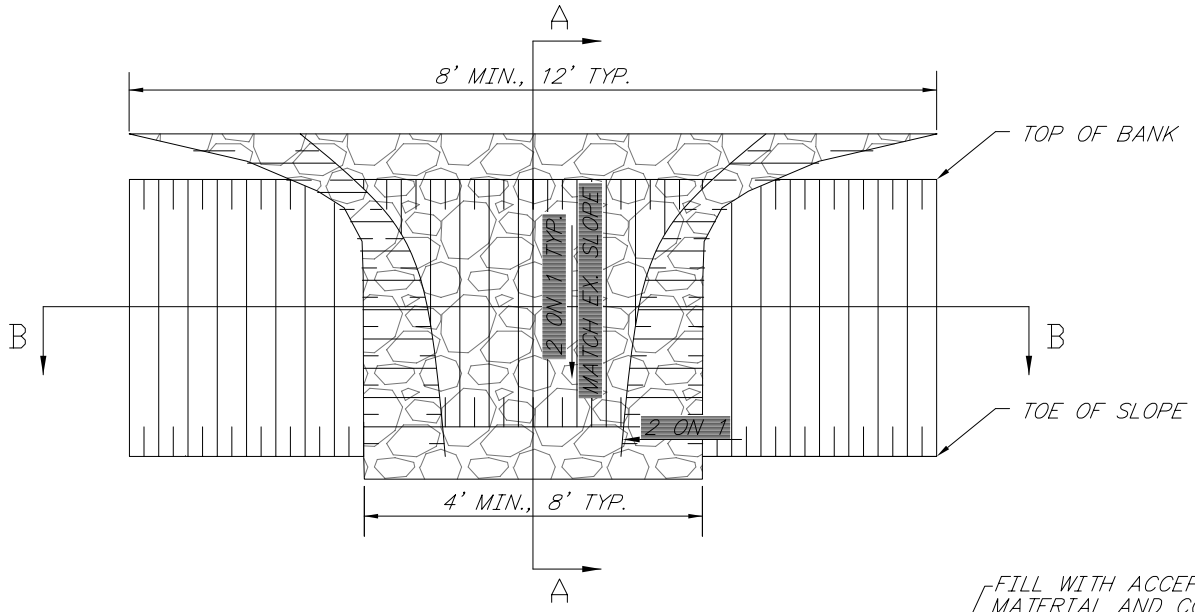
PIPE DIAMETER (IN.)	MAXIMUM DRAINAGE AREA (ACRES)
12	0.5
18	1.5
21	2.5
24	3.5
(2) 24	5.0

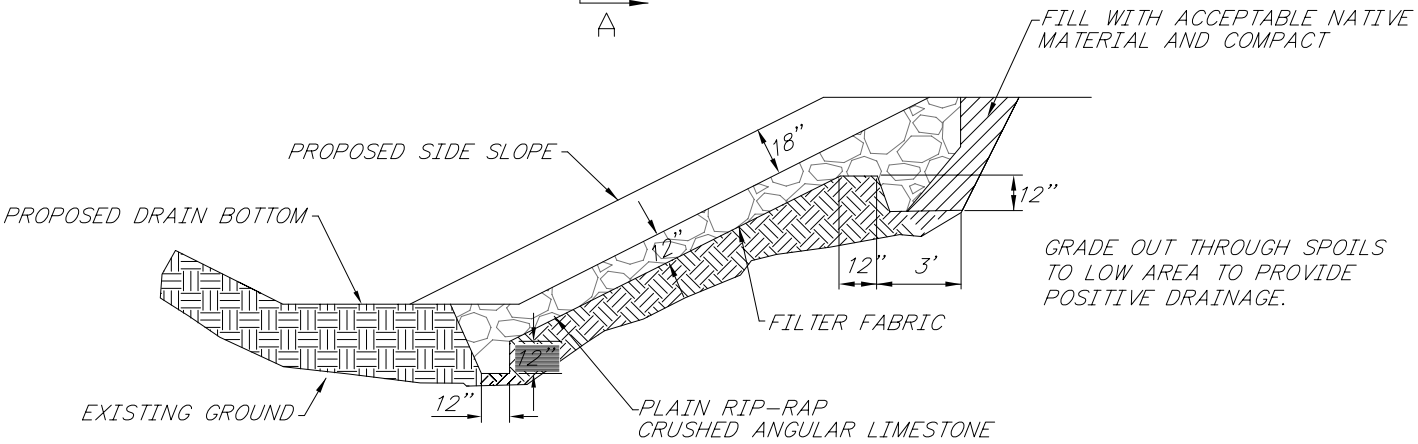
SOURCE: MARYLAND DEPT. OF ENVIRONMENT--WATER MANAGEMENT DIVISION

Source: Adapted from State of Michigan, Department of Management and Budget, SESC Guidebook

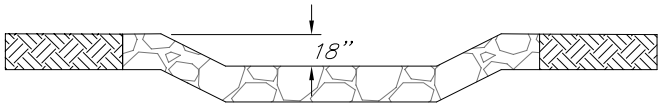
15. ARMORED SPILLWAY

When	• Concentrated flow must be conveyed down a drain bank or slope.
Why	• To convey concentrated surface runoff down a drain bank or slope without causing gullying, down cutting, slope failure, or channel scour. • Provides an immediate, non-erodible cover. • Prevents channel scour and drain bank erosion.
Where	• At the outlet of enclosed tile drains when flow velocities are erosive. • Slope failure or channel scour is observed or is likely to occur, or when runoff must be redirected around work in the drain.
Scheduling	• During low flow conditions when vegetation can be established.
How	1. Select a location at the top of the slope where runoff can be redirected to a natural drainage swale or a location where a channel can be constructed. 2. Utilize a qualified professional for the design of an armored spillway that can handle, at a minimum, the 10-year, 24-hour storm discharge and velocity. This includes selection of the appropriate riprap size, the spillway width and depth, and an evaluation of the hydraulic jump effects at the toe or hydraulic grade line interface to assure a stable discharge area. Material selected for ***riprap*** should be hard, angular, well graded, and resistant to weathering. 3. Install downstream sediment control measures. 4. The extent of the riprap should always start at least 2 feet above the upper edge of the geotextile fabric and end at a stabilized contour point. 5. Remove all vegetation and woody debris and shape and contour the spillway and discharge area. 6. Place ***riprap*** over geotextile fabric adequately anchoring all sides according to engineering drawing specifications. Add ***riprap*** to a depth of at least 12 inches and 1.5 times the maximum stone diameter, whichever is greater. Larger ***riprap*** should be uniformly distributed first followed by smaller rocks filling in the voids. Slightly overfill riprap material to allow for settling. 7. When ***riprap*** extends into moving water utilize an engineer to assure it is appropriately sized for the channel flow and the geotextile fabric is anchored at to a minimum depth of 18 inches below the channel bottom. Isolate work area from flowing stream during installation with appropriate diversion methods. 8. Stabilize all disturbed areas. 9. Remove temporary SESC measures after all disturbed areas are stabilized.
Maintenance	• Inspect immediately after the first precipitation event that results in runoff and promptly make any needed adjustments or repairs. Inspect routinely thereafter.
Limitations	• The ***riprap*** weight causes it to sink in unstable and mucky soils if it is not placed on geotextile fabric. • Limited to shallower slopes.





CROSS SECTION A–A

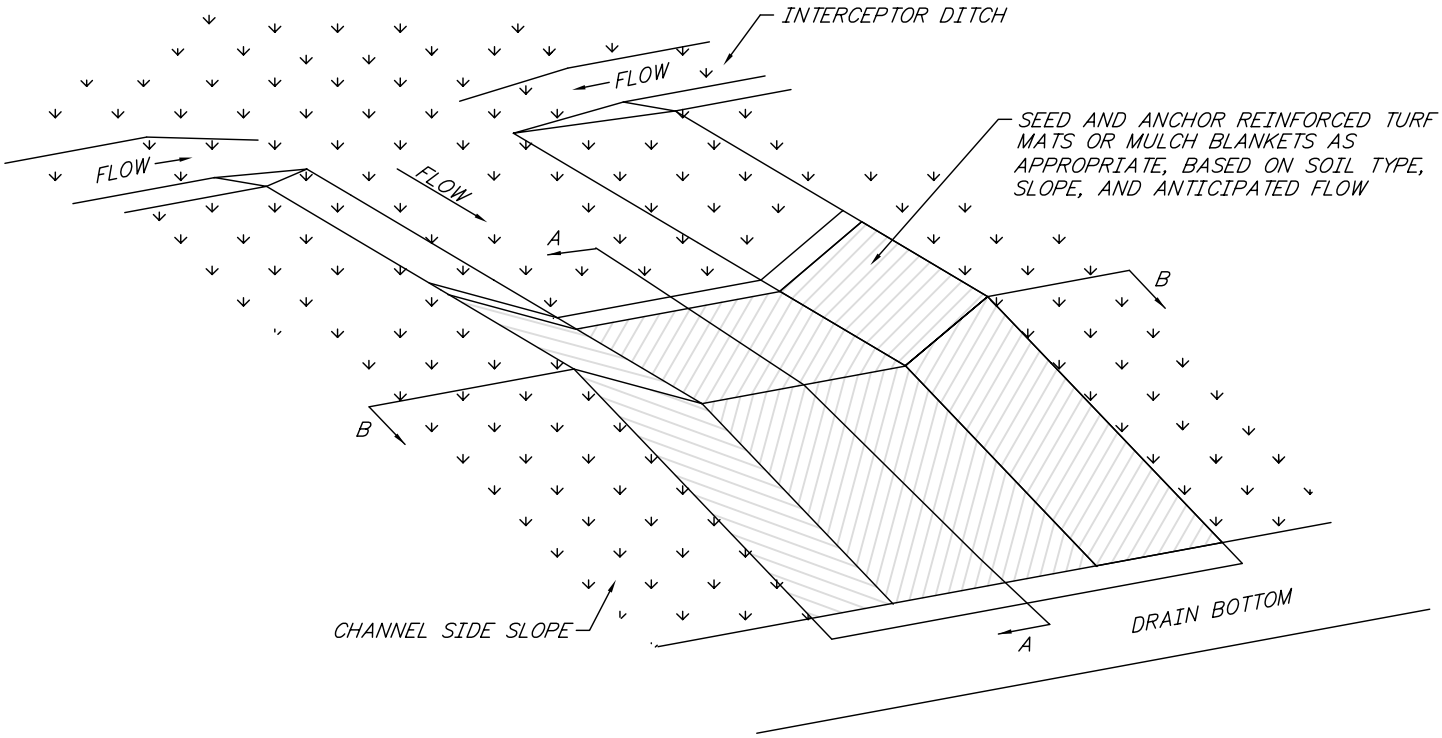


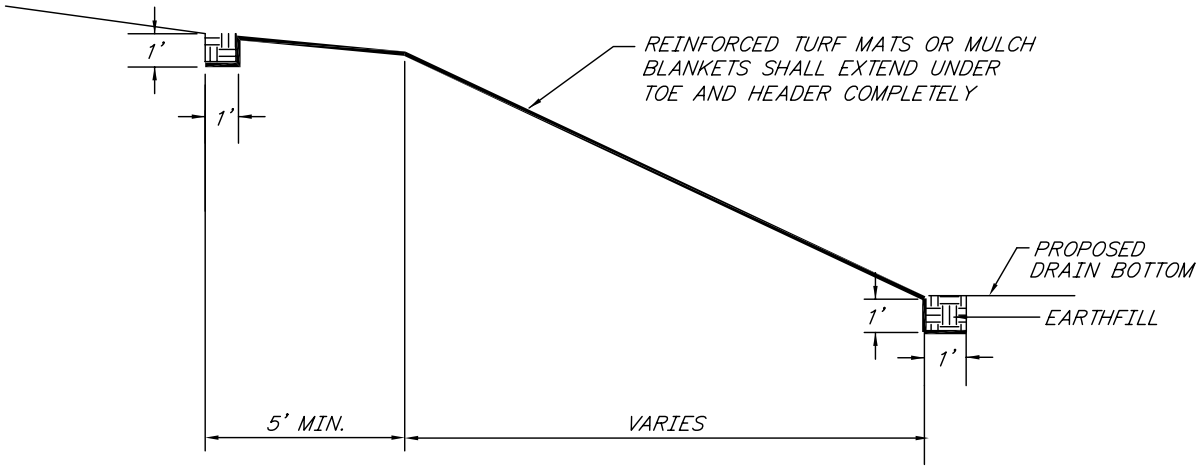
CROSS SECTION B–B

Source: Spicer Group, Inc.

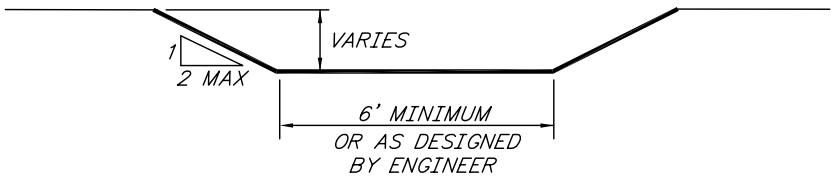
16. REINFORCED VEGETATED SPILLWAY

When	• Concentrated runoff must be conveyed down a gentle drain bank or slope without causing an erosive condition. • A natural appearance is desired.
Why	• To prevent gullying and slope failure.
Where	• When slope failure at eroded outfalls are observed or are likely to occur from concentrated runoff on very shallow slopes where flow velocities will be low enough not to undermine vegetation root structure.
Scheduling	• During low flow conditions when vegetation can be established.
How	1. Construct by shaping and contouring stable low areas that conform to the natural drainage system. The spillway channel cross section should be wide and shallow with relatively flat side slopes. This will allow surface water to enter over the vegetated banks without causing erosion. 2. Excavate and shape the spillway channel. Smooth slopes to facilitate maintenance. Remove and properly dispose of excess soil so that surface water may enter the channel freely. 3. Generally, a vegetated spillway that exceeds a slope of 6 horizontal to 1 vertical must be stabilized with turf reinforced mats, high velocity mulch blankets, pre-vegetated reinforced erosion control blankets, or other available products. Unroll blankets in the direction of flow and do not stretch. The stability is dependent on the ability to establish vegetation, soil type, and the anticipated flow velocity. When a natural appearance is desired and steeper slopes are required, the slope can be armored with lock blocks or plastic waffles, which are filled, compacted, and vegetated. 4. Select the vegetation for the desired appearance, soil type and anticipated soil moisture conditions. 5. Establish vegetation immediately after grading using seed or sod and fertilize, mulch, and water as needed.
Maintenance	• Mow and/or remove woody vegetation as needed to maintain flow capacity. • Inspect periodically. • Repair gullies and reestablish vegetation as needed.
Limitations	• Can only be used on flatter slopes with minimal flow. • Soil type limits vegetation selection and slope stability. • Unstable until vegetation is established therefore *timing and scheduling* is critical. • Must be constructed without sharp bends or steep grades.





CROSS-SECTION A-A



CROSS-SECTION B-B

Source: Spicer Group, Inc.

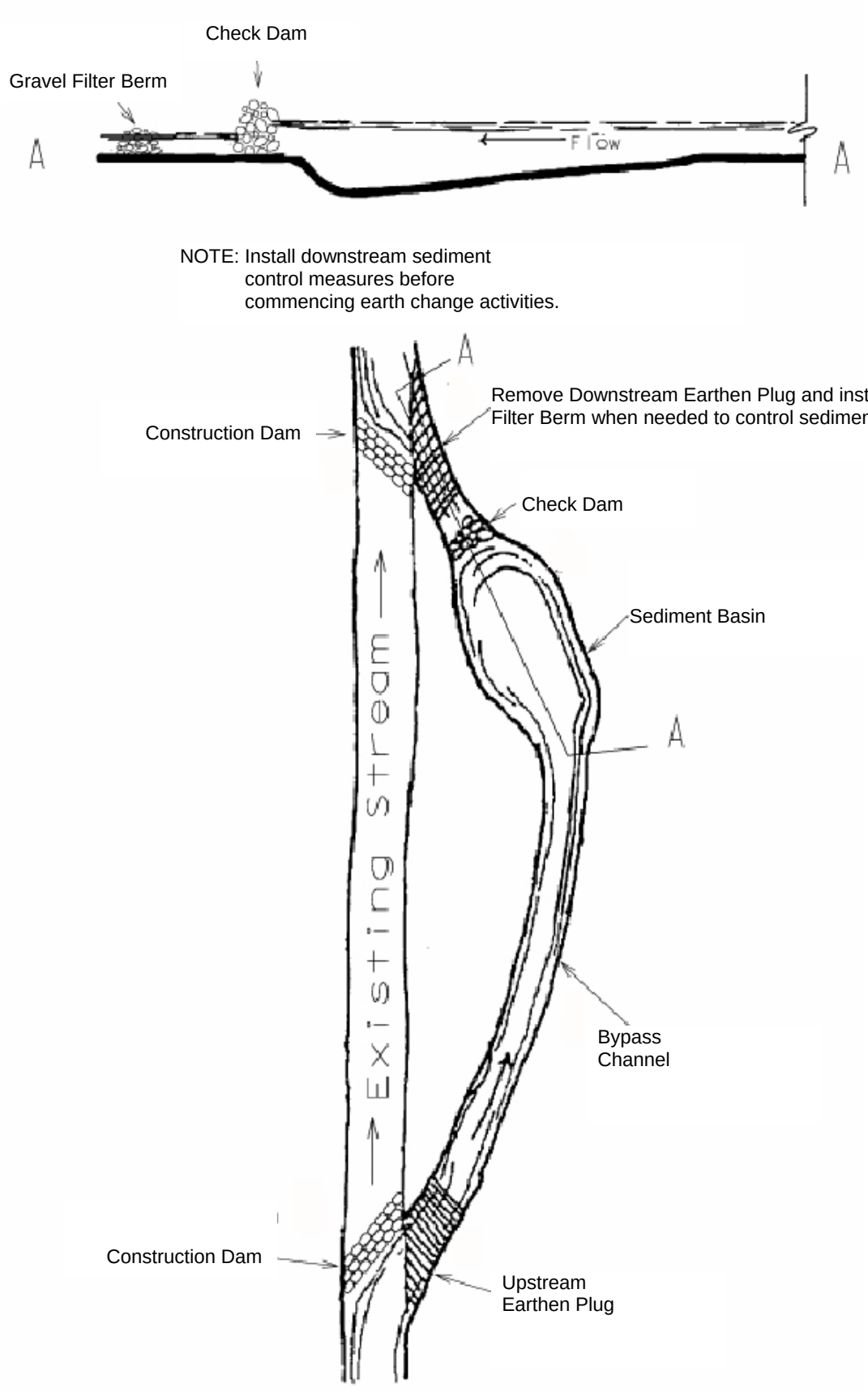
17. TOE DRAIN

When	• When a bank is eroding due to seepage and piping.
Why	• To intercept groundwater and prevent further piping and erosion.
Where	• Where piping is causing erosion.
Scheduling	• During low flow periods.
How	1. Identify groundwater seepage areas that are experiencing piping. 2. Dig a trench within the drain easement away from the drain bank to a depth below the existing groundwater elevation, or deeper if specified by the engineer. 3. Line trench with geotextile fabric. 4. Add pea stone to bottom of trench. 5. Install perforated pipe in the trench on top of the pea stone layer. 6. Cover pipe with pea stone and wrap geotextile fabric over pea stone. 7. Stabilize the perforated interceptor pipe outlet with ***riprap***. 8. Fill trench with excavated soil or sand. 9. Reshape bank and stabilize all disturbed areas.
Maintenance	• Inspect seepage area routinely and following each precipitation event that results in runoff until disturbed areas are stabilized and seepage control is confirmed.
Limitations	• Cost.

18. TEMPORARY BYPASS CHANNEL

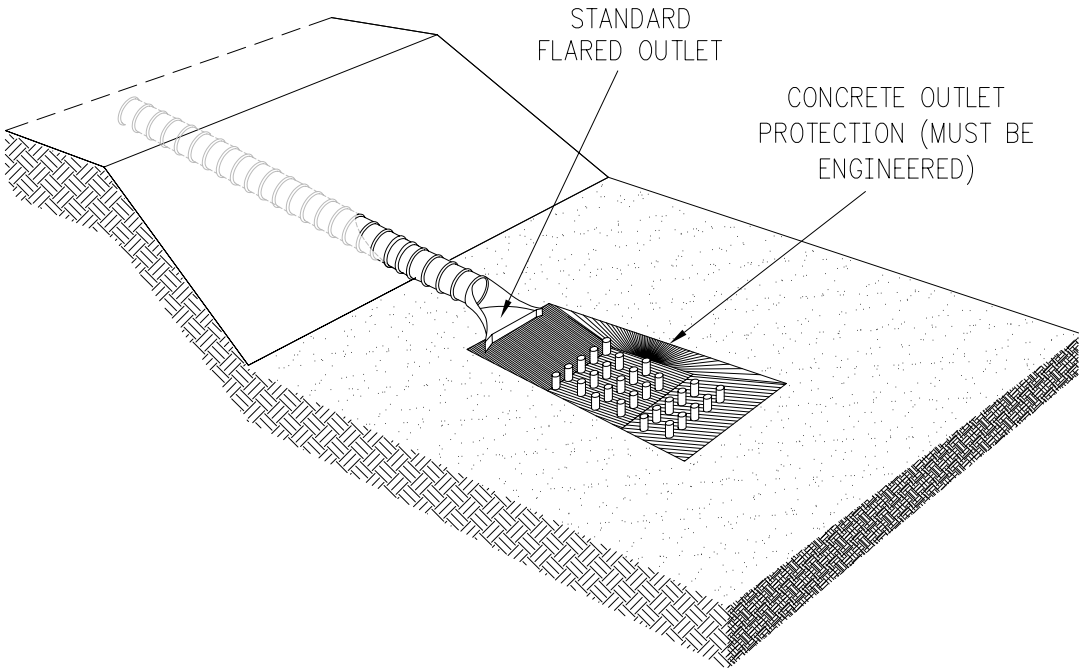
When	• Existing stream or drain must be isolated from existing or potential flow while implementing required activity.
Why	• To minimize downstream sedimentation and provide for an acceptable work site.
Where	• In and adjacent to a stream or drain.
Scheduling	• Preferably during periods of lower flow.
How	1. Design, locate, install and remove a temporary bypass channel with consideration for the topography, soils, and anticipated flow conditions and to minimize environmental disturbances. Utilize an engineer when site specific conditions warrant. Items listed below may vary based on site specific conditions. 2. Select an upland storage area near the site for excavated soil. Stabilize the stockpile and/or install ***silt fence*** around the stockpile area. 3. Install downstream sediment control measures. 4. Excavate a temporary bypass channel leaving earthen plugs at each end until entire bypass channel is graded and stabilized. 5. If site conditions warrant, construct a ***sediment basin*** within the bypass channel just upstream of the downstream limits, leaving sufficient distance between the outlet of the sediment basin and the stream to allow placement of a ***check dam***. 6. Install a ***check dam*** at the downstream limits of the bypass channel. 7. Stabilize excavated stockpile with ***seed*** and ***mulch*** or cover with ***plastic sheets*** if duration of project will exceed 5 days. 8. Stabilize bypass channel by either; toeing in geo-textile fabric and covering with stone to the anticipated high water level, or line the temporary bypass channel with ***plastic sheets***. 9. Remove downstream plug and stabilize channel from the check dam to the stream using geotextile fabric and a sturdy, non-erodible material such as riprap or other stream bed protection. 10. Remove the upstream plug, allowing water to pass through the temporary bypass channel. 11. Place a temporary dam made of erosive resistant material in the upstream end of existing channel to direct flow into temporary bypass channel. Following drainage of existing steam corridor, place a temporary dam in the downstream end of the existing channel to prevent tail water from entering desired work channel. Dewater work area if needed. 12. When construction is complete, and all areas are stabilized, remove the temporary dam from the downstream end of the natural stream followed by the upstream temporary dam. 13. Place an earthen plug at the upstream and then the downstream ends of the temporary bypass channel stabilizing earthen plugs with riprap. 14. Backfill temporary bypass channel, dewatering if necessary. 15. Stabilize all disturbed areas. 16. When necessary, remove temporary downstream sediment and sediment controls after all areas are stabilized.

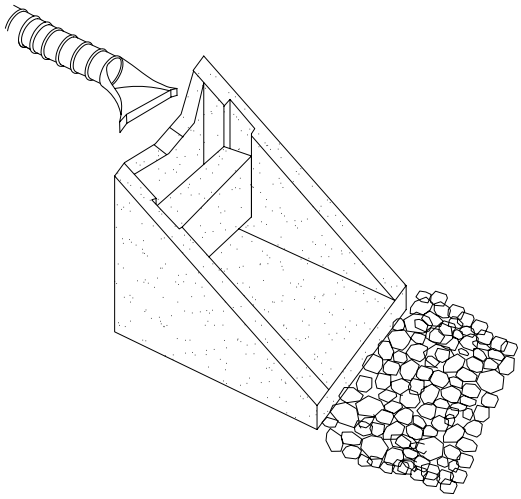
Maintenance	• Inspect bypass channel, diversion berm and drain channel routinely and following each precipitation event that results in runoff until all areas are restored and stabilized. • Check downstream sediment basin for sediment accumulation. Clean out when ½ full. Place sediment on an upland site and stabilize. • Remove diversion dams when project is complete and disturbed areas have been stabilized. Restore and stabilize temporary channel and remove temporary in stream measures as needed.
Limitations	• Difficulties increase in proportion to size of drain. • May require temporary drain easement on adjacent riparian land. • Costly to implement.


Check Dam
Gravel Filter Berm
A
Flow
A
NOTE: Install downstream sediment
control measures before
commencing earth change activities.
A
Remove Downstream Earthen Plug and install Gravel
Filter Berm when needed to control sediment
Construction Dam
Check Dam
Sediment Basin
A
Existing Stream
Bypass
Channel
Construction Dam
Upstream
Earthen Plug

19. ENERGY DISSIPATORS

When	• Discharge velocity of concentrated flow exceeds the erosive velocity of the receiving area or channel.
Why	• To dissipate energy and reduce the discharge velocity of concentrated flow preventing erosion of the receiving area or channel.
Where	• At the outlets of spillways, culverts, drainage pipes, or other conduits when concentrated flow is anticipated to exceed the erosive velocity.
Scheduling	• During low flow conditions or when flow is being diverted around construction area
How	1. Identify discharge points that are causing or are likely to cause scouring of the receiving area or channel. 2. Utilize an engineer for designing energy dissipators based on discharge volumes, flow velocities and soil type. The engineer will determine the anticipated flow velocities and tailwater elevations, size of structural device, method of placement, and extent and design of protection needed by the receiving channel. Deflector buckets, stilling basins, and plunge pools are effective energy dissipating devices used to rapidly reducing flow velocity. A wide variety of pre-constructed energy dissipators are available and should be installed per the manufactures specifications. When flow discharges from the energy dissipation devise into a channel, riprap may be required to prevent erosion and the angle of discharge should be downstream to prevent opposite bank erosion and scouring. 3. Install downstream sediment control measures before commencing earth change activities. 4. Stabilize all disturbed areas. 5. Remove temporary SESC measures after all disturbed areas are stabilized.
Maintenance	• Inspect routinely, based on flow conditions, until all disturbed areas are stabilized. • Inspect after major flood events and remove sediment and accumulated debris and confirm dissipation device is functioning as designed, making any needed adjustments.
Limitations	• Cost.





CONCRETE
DISSIPATOR

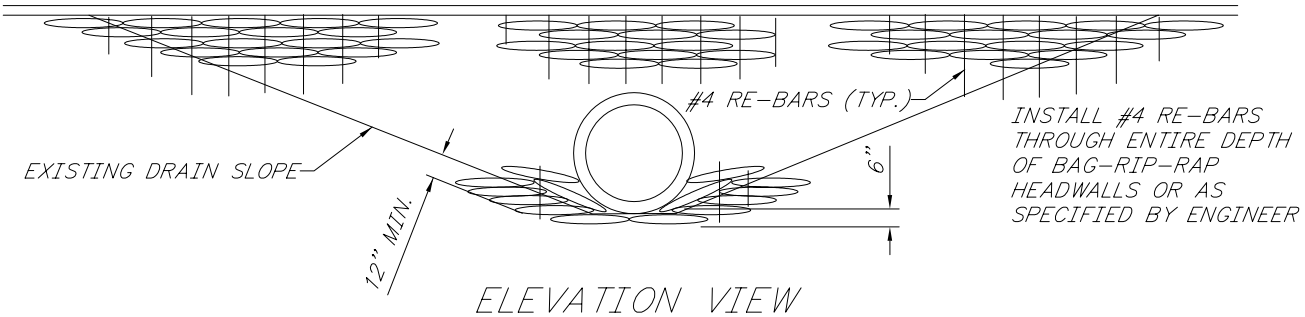
Source: State of Michigan, Department of Management and Budget, SESC Guidebook

20. CONCRETE BAG RIPRAP HEADWALL

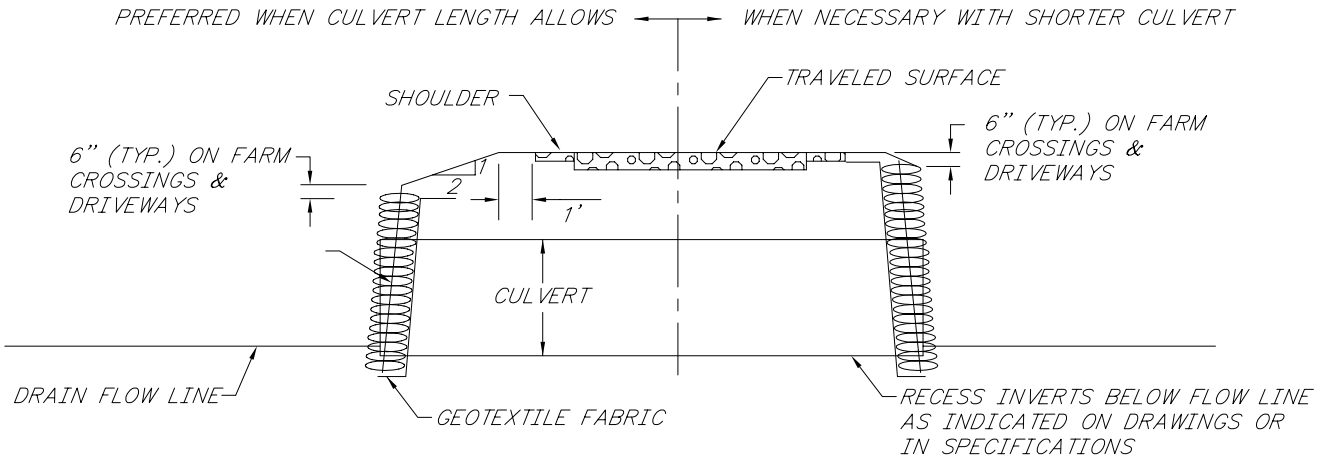
When	• Culvert backfill is eroding. • A longer culvert is impractical.
Why	• To prevent erosion of culvert backfill material and stabilize the crossing.
Where	• At culvert ends as a headwall.
Scheduling	• During low flow periods as part of the crossing installation.
How	1. Utilize an engineer for the crossing and headwall design and installation. Consideration should be given to buoyancy impacts and potential fluctuations between inlet and outlet control. 2. Excavate channel bottom and drain banks on both sides as required to key headwall into banks. 3. Install geotextile fabric behind and under headwall over compacted fill and excavated drain banks. 4. Using wet mix concrete, fill burlap bags 2/3 to 3/4 full. Never use damp or dry mix concrete or woven polyethylene sand bags. 5. Fold over remaining burlap and stack bags beginning the wall beneath the culvert ends. Overlap the bags in each successive row in a brick pattern. 6. Construct wall at a maximum slope of 1 horizontal to 8 vertical leaning the wall towards the culvert mid-span. 7. Drive lengths of rebar through bags per engineer's specifications. 8. A slightly curved wall will be less likely to tip over than a straight one 9. Keep bags wet for 48 hours. 10. A concrete cap on the top of the wall may be required to counteract buoyancy and provide additional stability.
Maintenance	• Monitor periodically headwall for tipping and piping between bags or under wall. Repair as necessary.
Limitations	• Cost. • Labor intensive. • If improperly installed walls have a tendency to tip and fail. • May be a traffic hazard if placed in a road right-of-way. • For culverts on hydraulically steep slopes (slope greater than the slope that would produce critical depth), the control may alternate between inlet control and some downstream point. The fluctuating pressures will cause a pulsating action on the pipe and vibrate the embankment. This pulsating may become so strong that structural damage to the pipe sections, joints and or headwalls may occur.

GEOTEXTILE FABRIC SHALL HAVE AN OVERLAP OF 12" MINIMUM AT JOINTS. REFER TO SPECIFICATIONS FOR PRODUCT & INSTALLATION DETAILS.

BACKFILLING BEHIND GEOTEXTILE FABRIC SHALL BE DONE IN SUCH A MANNER AS TO INSURE THAT NO CAVITIES OR VOIDS REMAIN.



ELEVATION VIEW



TOE-IN FILTER FABRIC A MINIMUM OF 12" AT ALL EDGES.

SLOPE BAG RIP-RAP 1 HOR. TO 8 VERT. TOWARDS ROAD.

PROFILE VIEW

REMOVE ALL TREES, BRUSH, AND VEGETATION WITHIN THE DITCH BANKS OR WITHIN 8' ABOVE THE DITCH BOTTOM AND WITHIN A 24' WIDE FLOW PATH, WHICHEVER IS GREATER. UNLESS OTHERWISE SPECIFIED IN THE CROSS SECTIONS.

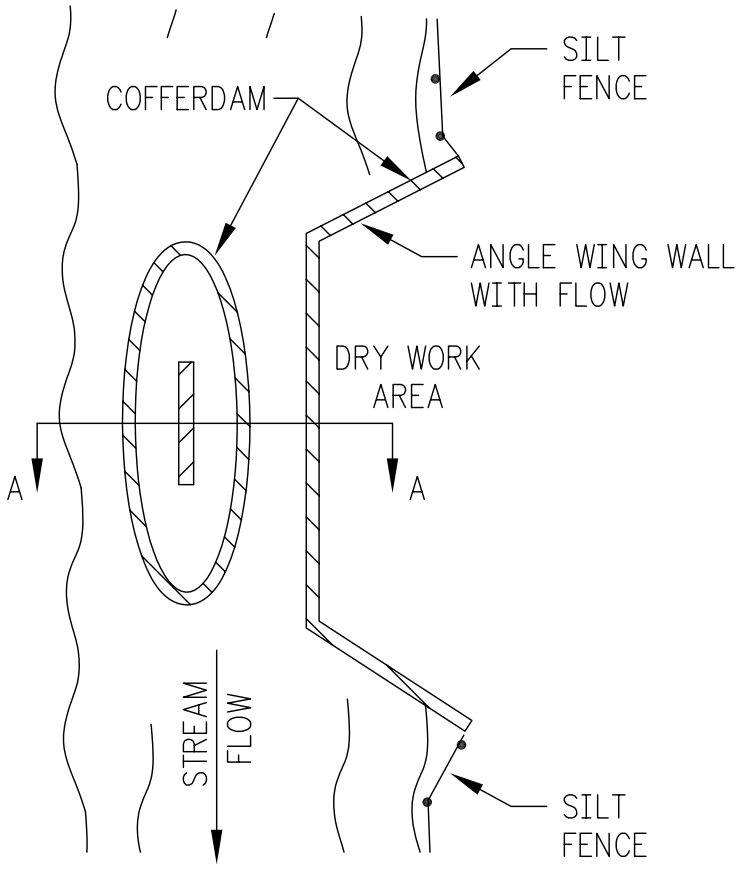
Source: Spicer Group, Inc.

21. SHEET PILING

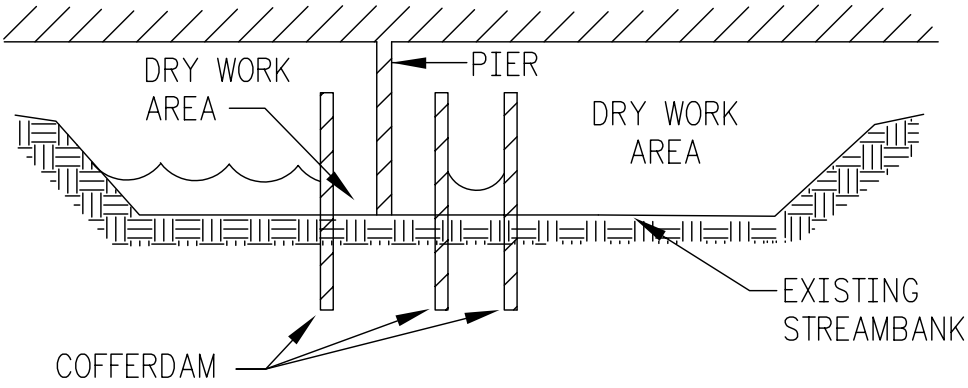
When	• Hard armor or a retaining wall is required for energy dissipation or slope protection. • As a lake level control structure weir. • As a temporary cofferdam during bridge construction or reconstruction.
Why	• Other less expensive options have failed or will fail under higher flow conditions or from ice damage. • To prevent seepage of contaminants into stream in rare circumstances. • To isolate work area from flowing drain.
Where	• In locations where a vertical bank is required. • Other permanent erosion control measures have failed. • Along or within a flowing drain or a lake.
Scheduling	• Year around.
How	1. Utilize an engineer when designing sheet piling, including the use of tie backs or deadmen. 2. When sheet piling is used as a lake level control structure always utilize an engineer for the structure design. The design must include the spillway elevation and width and the emergency spillway design, if needed. Lake level control structures must be able to pass the 100-year, 24-hour storm without flooding upstream property owners. 3. Install piling with a pile driver to the designed elevation and location. 4. Install tie backs when required to stabilize sheet piling. 5. When sheet pilling is permanent, backfill behind sheet piling, compact fill as necessary, and stabilize disturbed areas. 6. When sheet pilling is temporary, stabilize disturbed areas after installation and restore and stabilize disturbed areas after removal.
Maintenance	• Inspect routinely and following each precipitation event that results in runoff until disturbed areas are stabilized then remove temporary control measures. • Inspect sheet piling annually and repair if needed.
Limitations	• Expensive. • Natural appearance is lost. • Difficult to install during frozen ground conditions.

Sheet piling is being used to isolate a drain outlet from the Saginaw Bay during a drain reconstruction project.

Source: Sarah Pistro, Tuscola County Drain Commissioner



PLAN VIEW



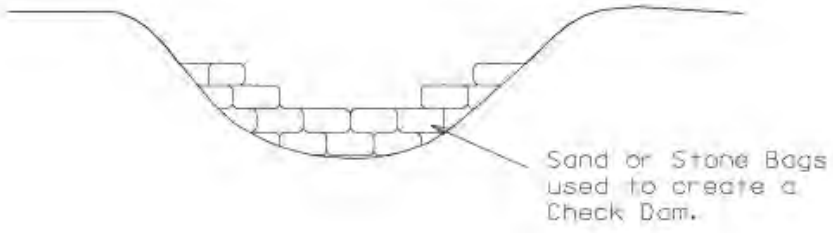
CROSS-SECTION A-A

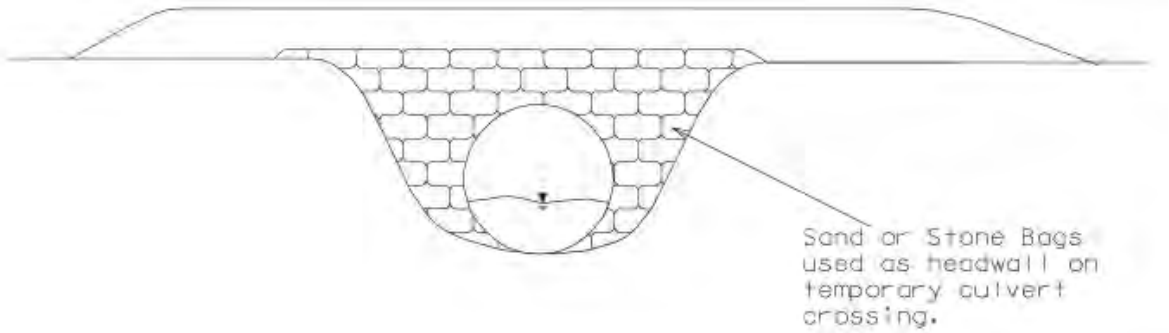
Source: Spicer Group, Inc.

22. SAND OR STONE FILLED BAGS

When	• Temporarily during construction and until all disturbed areas are stabilized.
Why	• To temporarily isolate an earth change activity from flowing water. • To divert water around a construction area. • To impound water temporarily in a stream or drain when flow is minimal and construction activities will be completed in a very short timeframe or when stream flow must be impounded and pumped around or over a crossing during construction.
Where	• Within or adjacent to a stream or drain. • At the ends of a temporary culvert crossing. • On the down gradient side of a construction area.
Scheduling	• Year around.
How	1. Fill burlap or woven polyethylene sand bags 2/3 to 3/4 full and stack in an alternating brick pattern to desired elevation. When used as a temporary check dam follow the ***check dam*** details. When used to impound water that will be pumped around the construction area follow the ***dewatering*** details. When used as a temporary diversion dike follow the ***diversion dike*** details. 2. Complete construction and earth change activities and stabilize disturbed areas. 3. Remove any accumulated sediment from behind the bags prior to removing the sand or stone filled bags.
Maintenance	• Inspect bags daily during construction activities and repair as needed.
Limitations	• Cannot be used as a filtering device because they do not allow for an adequate movement of water through the bags.

Sand or Stone Bag Check Dam



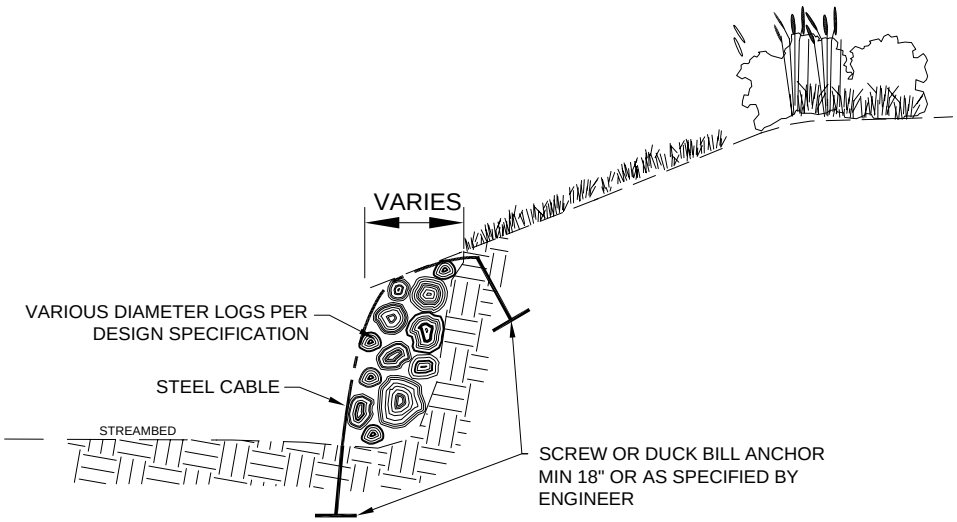


23. TREE REVETMENT

When	• Stream meandering is causing severe undercutting or drain bank erosion.
Why	• To reduce or prevent drain bank erosion by encouraging sediment deposition and deflecting current to midstream. • To prevent a drain from meandering outside the drain easement usually on outside bends where the velocity is higher.
Where	• Within the channel of a stream at the toe of slope where erosion is occurring or where sediment deposition is needed to narrow a stream.
Scheduling	• During lower flow periods.
How	1. Must be designed and installed under the direction of an engineer. 2. Place cut trees or large branches in eroding area or in an upstream location that is selected by an engineer, butt end of log pointing upstream, to divert higher velocity currents towards the center of the channel. Christmas trees may be used to supplement other materials. 3. Cable into the bank with deadhead anchors or cable to adjacent stumps or trees.
Maintenance	• Inspect routinely to ensure trees have remained in place and the drain bank is stabilizing.
Limitations	• If not designed and installed properly flow can be deflected and result in new erosion problems. • Availability of trees locally.

24. LOG REVETMENT

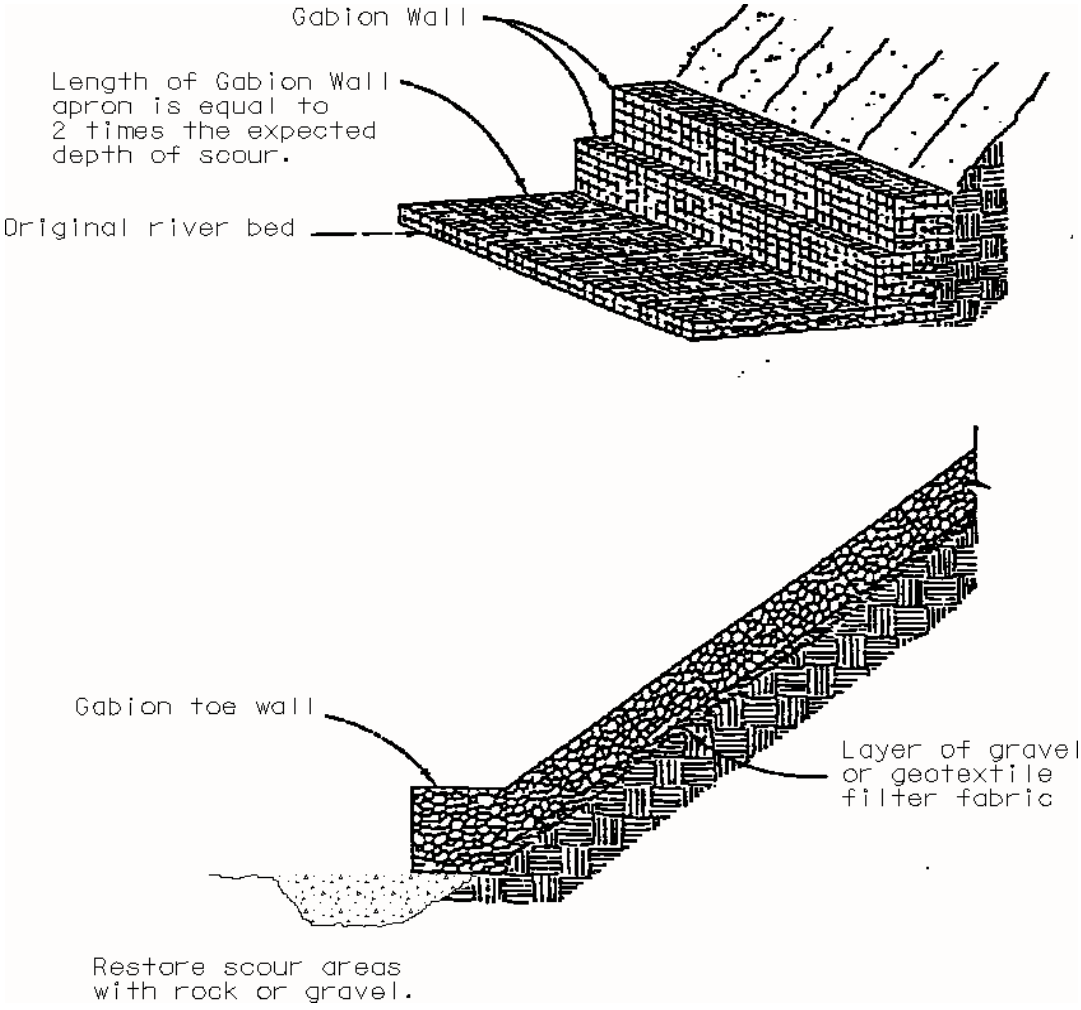
When	• During stream restoration projects to narrow a stream, create ***meanders*** and a stable ***low flow channel***. • When slumping is occurring to stabilize the drain bank preventing lateral migration and slumping.
Why	• To facilitate deposition to narrow a stream and create meanders. • To reduce drain bank erosion and re-establishment a stable drain bank. • To prevent a drain from meandering outside the drain right-of-way.
Where	• In an area of low energy, at the toe of slope within the stream channel.
Scheduling	• During lower flow periods.
How	1. Must be designed and installed under the direction of an engineer. 2. Install downstream sediment control measures. 3. Prepare streambed and banks for placement of log revetment by removing debris and necessary soil and vegetation. 4. Install anchors approximately 36 inches from the edge of bank to be protected. Anchors are to be placed at 6.0 feet on center. 5. Place logs, 6 to 8 feet in length, at the toe of slope in an overlapping pattern as directed by the engineer and stake in place. Logs should vary in diameter and should be a minimum of 6 inches in diameter. Hardwood logs are preferred where available. 6. Cable hardwood posts to anchors using cable clamps. Tighten cabling to assure that all logs will be held securely in place during high water conditions. 7. Stabilize all disturbed areas. 8. Remove temporary SESC measures after all disturbed areas are stabilized.
Maintenance	• Inspect periodically to ensure logs have remained in place and drain bank has remained stable.
Limitations	• If not designed and installed properly flow can be deflected and result in new erosion problems. • Requires access by heavy equipment



Source: Wetland and Coastal Resources, Inc

25. GABION BASKETS

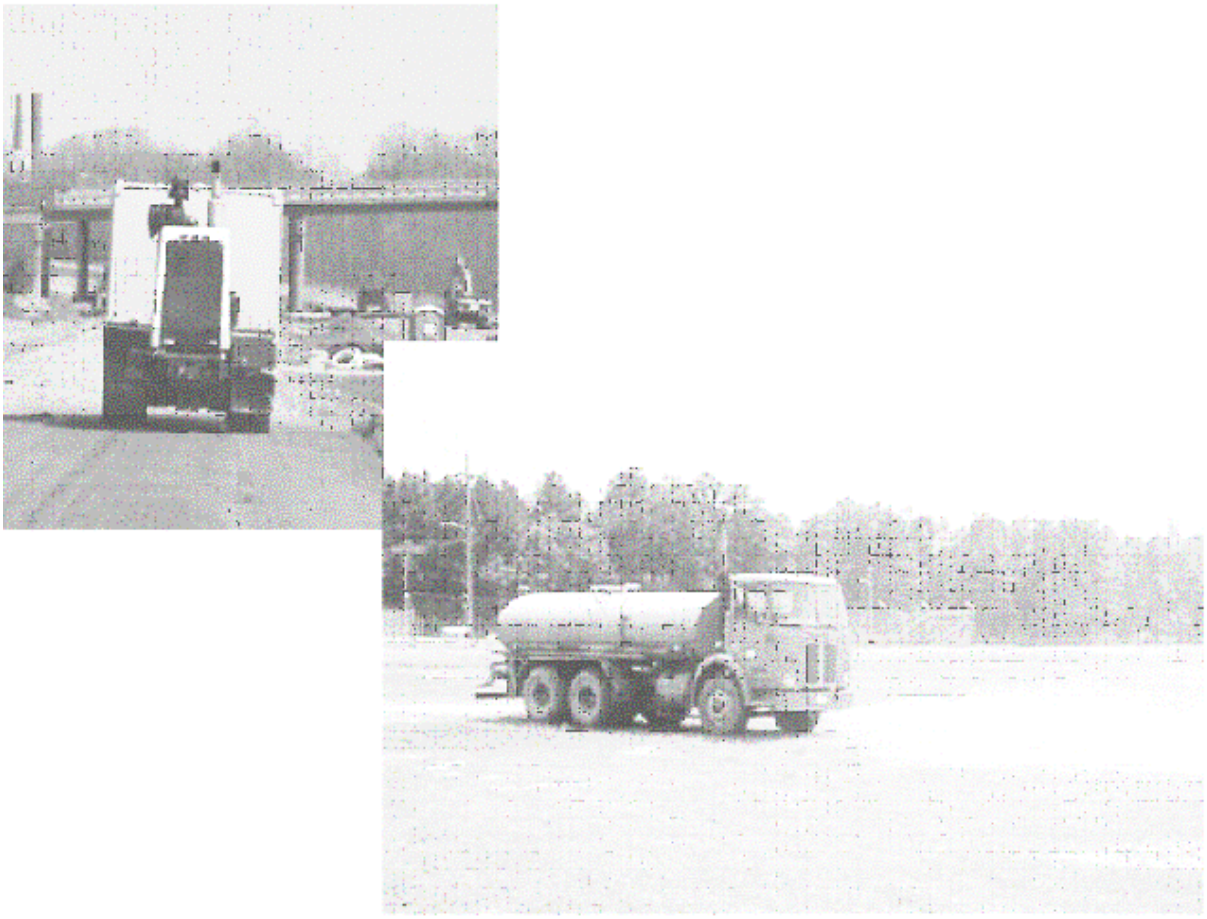
When	• Flow velocities are resulting in major drain bank or slope failure or instability and ***slope and drain bank reshaping*** with or without ***riprap*** is not practical or possible due to inadequate space within the drain easement or adjacent topography is too steep.
Why	• To protect a structure from erosion do to the lateral migration of a stream channel. • To prevent a drain from meandering outside the drain right-of-way.
Where	• At the toe of steep slopes and drain banks within or adjacent to the stream channel.
Scheduling	• During lower flow periods.
How	1. Utilize an engineer for gabion basket design. The wire mesh which makes up the gabion basket should be no smaller than 12 gauge. Mesh size will vary on rock diameter used to fill the basket. Nine gauge wire should be used for all ties and lacing. 2. Install downstream sediment control measures. 3. Excavate drain bank and toe of slope as required removing loose material to provide a stable foundation. 4. Place geotextile fabric on bank to prevent loss of fine grained soils into gabions. Secure fabric ends at least every 8 inches along seams. 5. Place bedding stone on subgrade to provide level and uniform surface for placement of first row of gabions. 6. Assemble baskets prior to placement and begin gabion basket installation at a stable bank point. Place unfilled baskets, attaching adjacent units along top and vertical edges using a minimum of 2 ties between baskets for every square foot of contract area. Each tie should loop around 2 meshes on adjacent baskets. Keep baskets stretched to assure proper filling. 7. Fill each basket with rock, close top and wire to all vertical surfaces of the gabion. 8. When installing more than one row, place assembled empty baskets on top of a completed row, and wire to the front and back of a filled row. 9. Install the number of rows shown on the design plans or to the required finished elevation. 10. Provide loose rock transition zones if necessary, restore scour areas at the base of the wall with riprap, and stabilize all disturbed areas. 11. Remove temporary SESC measures after all disturbed areas are stabilized.
Maintenance	• Inspect gabion basket locations annually following spring or peak flow periods and immediately following extreme flood events, making necessary repairs to prevent undercutting or stream bank failure.
Limitations	• High construction costs. • Gabion walls are not as aesthetically pleasing as vegetated areas. • Subject to vandalism, this can lead to loss of structural integrity.



Source: Michigan Department of Transportation

26. DUST CONTROL

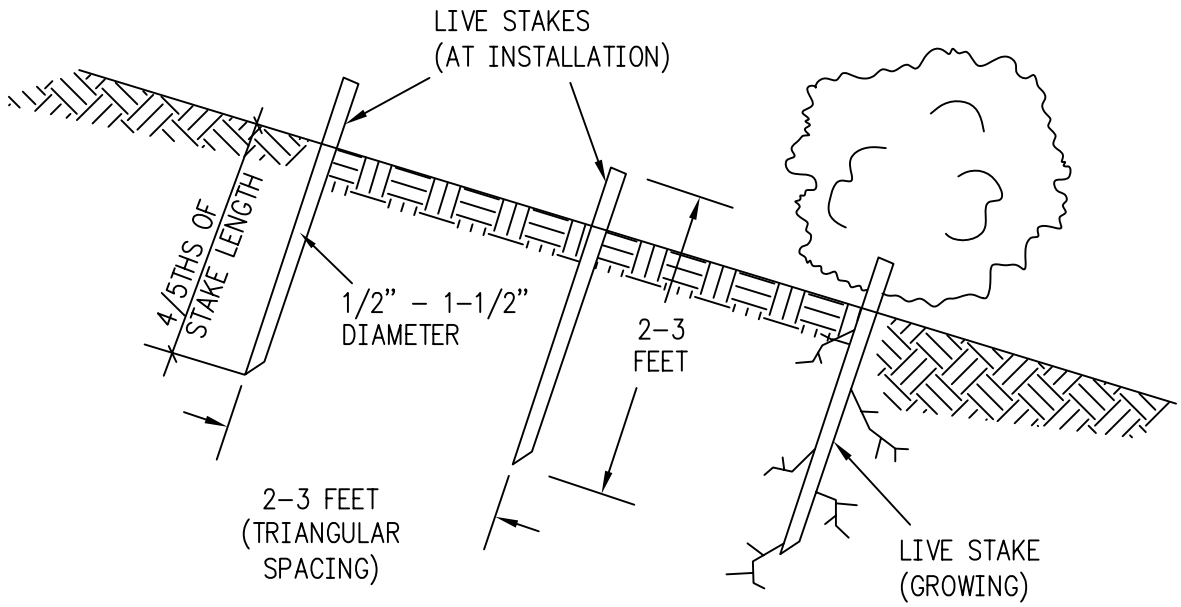
When	• Unprotected areas are being eroded by wind.
Why	• To reduce wind erosion and the resulting off site sedimentation.
Where	• On exposed and unstabilized areas.
Scheduling	• Year around, but most commonly during periods of low precipitation, low humidity and high temperatures.
How	1. Dust control applications can include watering, chemical dust suppressions, gravel or asphalt surfacing, temporary aggregate cover and haul truck covers. Oil should not be used for dust control. 2. Minimize length of time disturbed areas are left unprotected. 3. Quickly stabilize exposed soil by vegetation, mulch, soil erosion control blankets, polymers, sprinkling, or stone layering to minimize areas in need of dust control. 4. Follow manufacturer's instructions regarding application of any dust palliative. Pay particular attention to mixing details. 5. Dust suppressants can be applied using a pressure hose attached to a distributor truck. 6. Limit vehicular traffic on unprotected areas to 15 miles per hour.
Maintenance	• Frequent, even daily application may be required to increase effectiveness. • Do not over water, as over watering may cause erosion.
Limitations	• Some types of dust control may reduce infiltration and result in higher runoff rates increasing the potential for erosion. • Continued effectiveness may require repeated applications.




VATER

27. LIVE STAKING

When	• Slopes or streambanks are eroding, unvegetated, or comprised of unstable soils. • Can be used for staking down surface erosion control materials.
Why	• To promote the re-establishment of a stable slope or streambank and potentially enhance fish and wildlife habitat. • Easy to install, inexpensive method to inhibit soil movement, preserve natural drainage, and to allow native vegetation to stabilize slope. • Enhances conditions for natural colonization of plant species from adjacent areas creating enhanced wildlife habitat.
Where	• In areas requiring slope and bank protection against surface erosion and shallow mass wasting. • In wetland buffers or reservoir drawdown areas where plants may be submerged for extended periods or subject to fluctuating water levels. • In areas requiring stabilization but with limited access for equipment or when little site disturbance is required.
Scheduling	• During early spring and during the early growing season.
How	1. Identify local source of native plant species suitable for collection, based on consideration of purpose, potential hydraulic limitations, climate, soil type, and moisture regime. Obtain approval for material collection. 2. Conduct ***slope and drain bank reshaping*** as required. 3. Add topsoil if required, seed. Installation of mulch or an erosion control blanket such as straw coconut fiber mats may be necessary to stabilize live staking area. Stabilize all other disturbed areas. 4. Collect and prepare ½ to 1-½ inch diameter cuttings 2 to 3 feet in length from native vegetative community the same day as installation utilizing care to prevent over harvesting or depletion of native site vegetation. Remove side branches while leaving bark intact with buds facing upward, cut top square and bottom angled for easy installation. 5. Install live staking with a dead blow hammer, packing soil firmly around stake. Live staking is usually installed in a triangular pattern with 2 to 4 stakes per square yard and driven to a minimum depth of 2 feet.
Maintenance	• Inspect routinely and following each precipitation event that results in runoff until disturbed areas are stabilized. • Periodic pruning and replanting may be required to maintain healthy and vigorous vegetation.
Limitations	• Hand labor intensive. • Unfamiliar too many contractors. • When vegetation matures the channel flow capacity will be reduced and could result in higher flood stages on adjacent and upstream properties. • May require irrigation during vegetation establishment in dry sandy soils.



MICHIGAN SPECIES SUITABLE FOR LIVE STAKING BY SOIL TYPE

SAND

Acer negundo	Box Elder	*Robinia pseudacacia*	Black Locust
Cornus ammomum	Silky Dogwood	*Rubus strigosus*	Red Raspberry
Cornus racemosa	Gray Dogwood	*Salix exigua*	Sandbar Willow
Cornus rugosa	Round–leaf Dogwood	*Salix spp.*	Willow spp.
Cornus sericea	Red Osier Dogwood	*Sambucus canadensis*	American Elderberry
Physocarpus opulifolius	Common Ninebark	*Spirea alba*	Meadowsweet
Populus deltoides	Eastern Cottonwood	*Viburnum lentago*	Nannyberry Viburnum

LOAM

Acer negundo	Box Elder	*Robinia pseudacacia*	Black Locust
Cornus ammomum	Silky Dogwood	*Rubus strigosus*	Red Raspberry
Cornus racemosa	Gray Dogwood	*Salix exigua*	Sandbar Willow
Cornus sericea	Red Osier Dogwood	*Salix spp.*	Willow spp.
Populus deltoides	Eastern Cottonwood	*Viburnum lentago*	Nannyberry Viburnum
Populus tremuloides	Quaking Aspen		

CLAY

Acer negundo	Box Elder	*Rubus strigosus*	Red Raspberry
Cornus racemosa	Gray Dogwood	*Viburnum dentatum*	Arrowwood Viburnam
Cornus sericea	Red Osier Dogwood	*Viburnum lentago*	Nannyberry Viburnum
Populus deltoides	Eastern Cottonwood		

MUCK

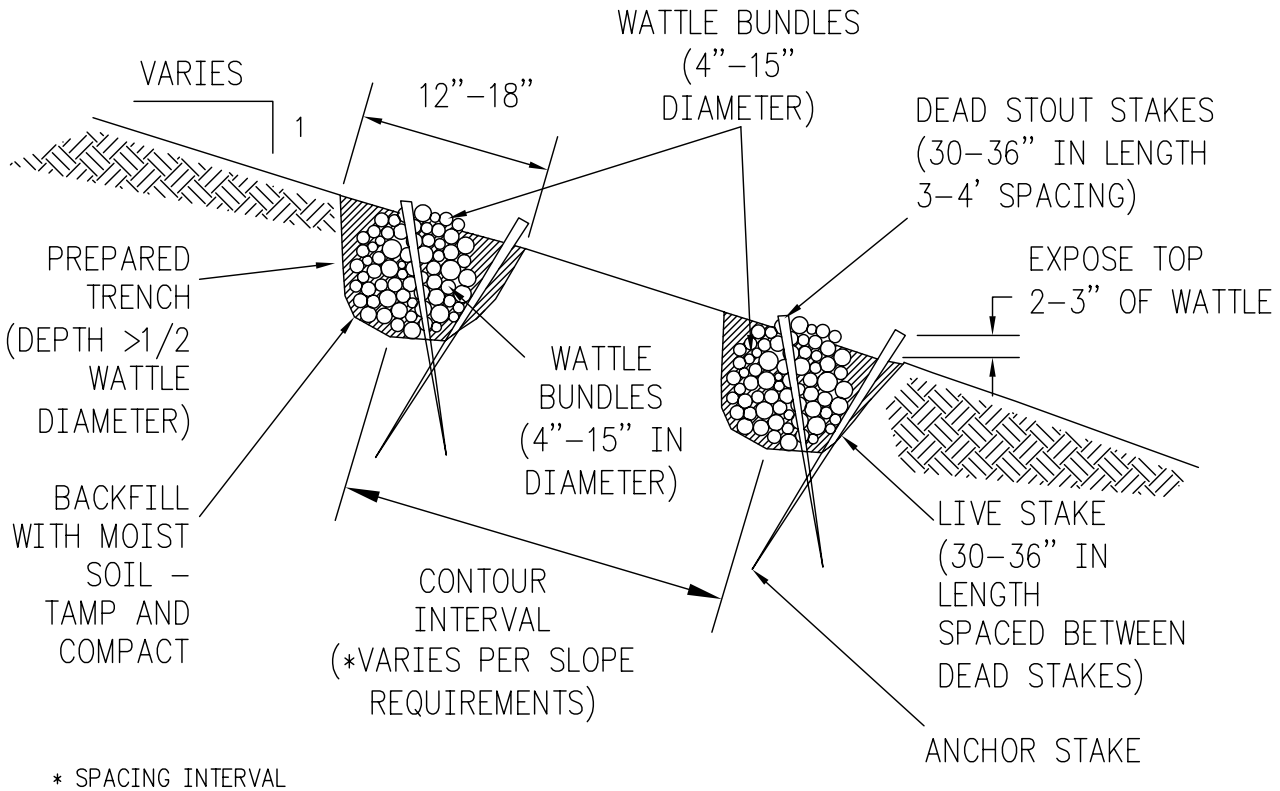
Cornus ammomum	Silky Dogwood	*Sambucus canadensis*	American Elderberry
Cornus sericea	Red Osier Dogwood	*Spirea alba*	Meadowsweet
Physocarpus opulifolius	Common Ninebark		

Source: State of Michigan, Department of Management and Budget, SESC Guidebook

28. WATTLES

When	• Slopes or streambanks are eroding, unvegetated, comprised of unstable soils or are susceptible to gully formation.
Why	• To provide immediate protection of slopes and banks against erosion and gully formation by inhibiting soil movement and gully formation.
Where	• In areas requiring stabilization but with limited access for equipment or when relatively little site disturbance is preferred or required. • On cut and fill slopes and banks requiring stabilization, including dunes, shorelines, or streambanks. • In wetland buffers or reservoir drawdown areas where plants may be submerged for extended periods.
Scheduling	• Collect live plant material while dormant (late fall up to early spring). Install in the early spring during the early growing season.
How	1. Review slope steepness to determine necessary spacing interval (see following table), trench length, and material needs. 2. Identify local source of native plant species suitable for collection, based on consideration of purpose, potential hydraulic limitations, climate, soil type, and moisture regime (refer to ***live staking*** details for suitable species). Obtain approval for material collection. 3. Layout contour interval on slope. 4. Prepare stakes, for use during wattle installation, from 30 to 36 inch long 2x4s by diagonally cutting them on an angle lengthwise on the 4 inch face to make two dead stout stakes. 5. Collect and prepare ½ to 1-½ inch diameter cuttings from native vegetative utilizing care to prevent over harvesting or depletion of native site vegetation. Remove side branches while leaving bark intact. 6. Transport live material to installation site and assemble wattles. Wattles are usually between 5 and 30 feet in length, 4 to 15 inches in diameter, have tapered ends, and are bound with twine every 12 to 15 inches. 7. Starting at the slope base, hand dig trench 12-18 inches wide along a level contour, deep enough to accommodate at least half of the wattle diameter. 8. Place wattle in trench and drive dead stout stakes into slope through wattle every 2 to 3 feet along the entire wattle length. 9. Prepare live stakes that are 30 to 36 inches long by removing side branches while leaving bark intact with buds facing upward, cut top square and bottom angled for easy installation. Install live stakes, with dead blow hammer, between dead stakes on down slope side of bundles leaving live stakes protruding 2 to 3 inches above wattles. 10. Backfill trench with moist soil along sides of wattle leaving top 2 to 3 inches of wattle exposed. Compact soil to eliminate air pockets around buried wattles. 11. Move upslope to the next contour interval and repeat preceding steps. 12. Mulch between stakes if required to control erosion. Mulch blankets may be needed on slopes steeper than 2 horizontal to 1 vertical.

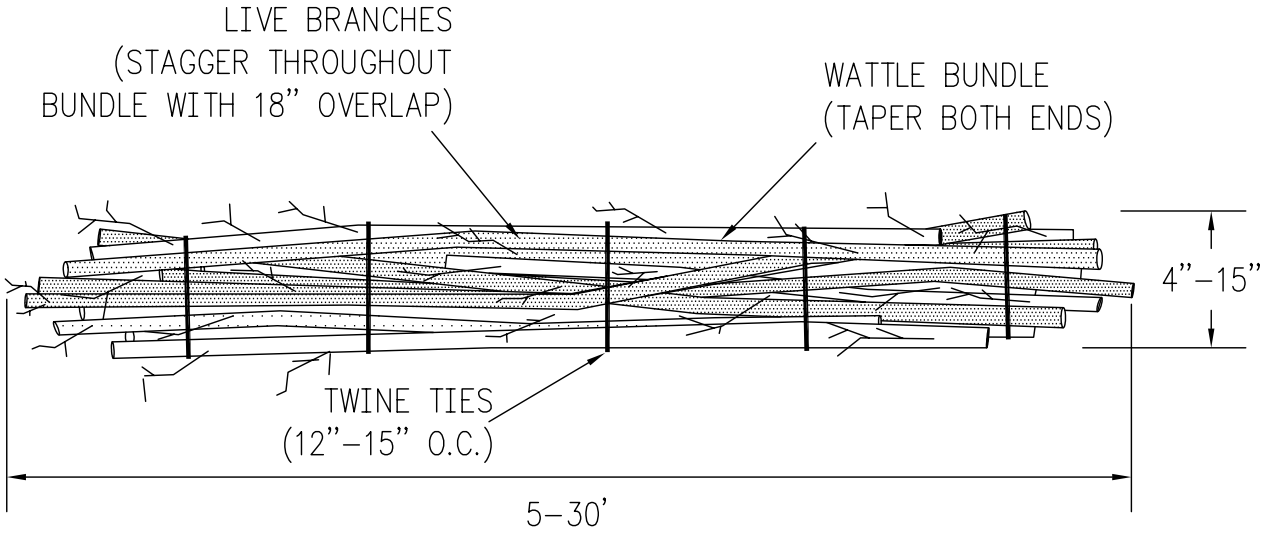
Maintenance	• Inspect routinely and following each precipitation event that results in runoff until vegetative growth has established making needed repairs promptly. • Periodic pruning and replanting of live stakes may be required to maintain healthy and vigorous vegetation.
Limitations	• Labor intensive.



* SPACING INTERVAL

SLOPE	1:1	1:2	1:3	1:4	1:6
CONTOUR INTERVAL	3'	4'	5'	6'	8'

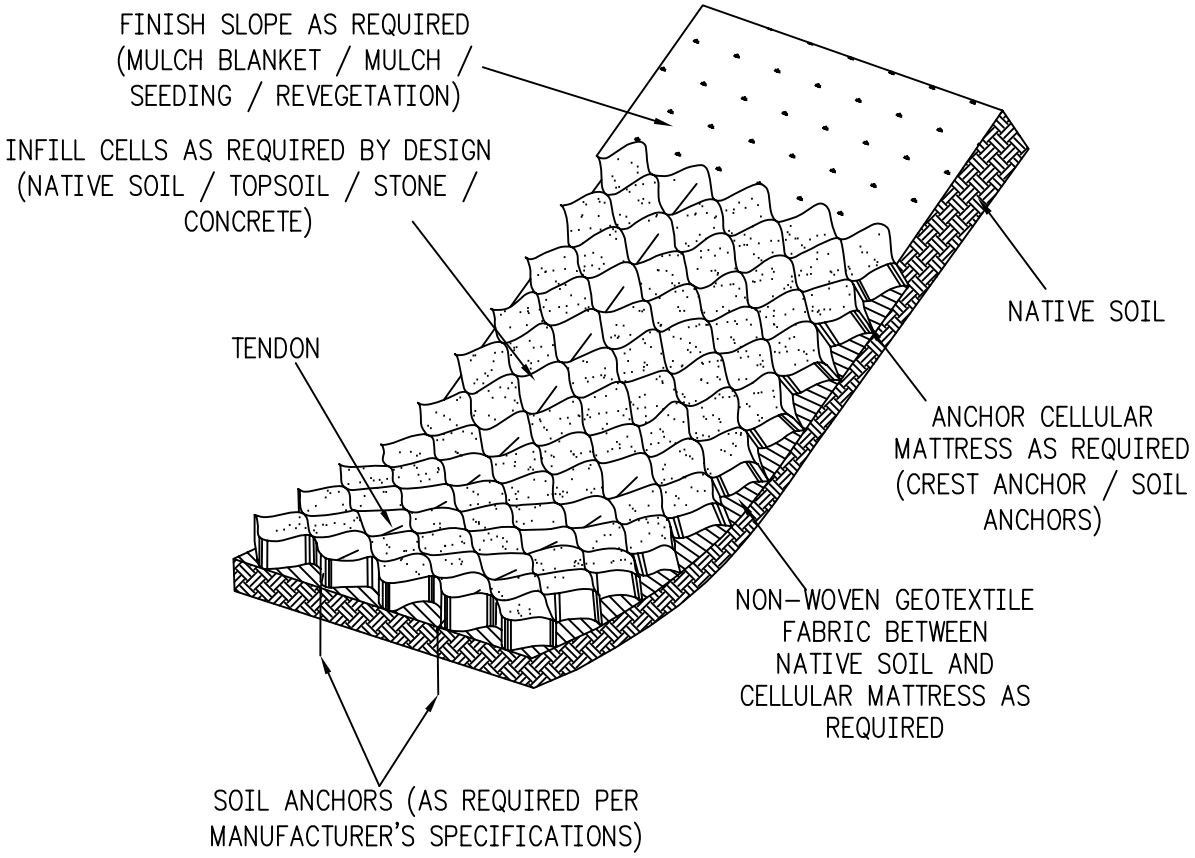
ADAPTED FROM NRCS, SOMERSET, NJ



Source: State of Michigan, Department of Management and Budget, SESC Guidebook

29. CELLULAR CONFINEMENT SYSTEMS

When	• Permanent slope or channel protection must be protected from erosive velocities.
Why	• To inhibit soil movement and preserve natural drainage. Allows for use of native fill and revegetation.
Where	• In areas requiring permanent stabilization of steep grades within a narrow area of impact. • In channels with flow velocities that exceed 5 or 6 feet per second. Consider the soil type when determining the controlling flow velocity. • As an alternative to wood, steel, concrete, or block retaining walls, particularly when the availability to support vegetation and maintain drainage is a factor. • In applications where it is necessary to distribute concentrated loads over a wide area.
Scheduling	• During lower flow periods or when emergency repairs are required.
How	1. Utilize a qualified professional for the design of earth retention applications including site specific construction materials, design details, and selection of infill material that is suitable for anticipated hydraulic conditions. 2. Install downstream sediment control measures. 3. Grade and shape slopes per design. 4. Confinement system sections must be anchored as necessary using stakes, tendons, and/or restraint pins as specified in the site specific design details. 5. Install geotextile fabric along all areas with ground contact with ends buried in trenches. 6. Install confinement system referring to product vendor for additional guidelines for specific site installation details. 7. Fill confinement system with suitable material to support vegetation. 8. Establish vegetation within the confinement system as soon as the fill has been placed and stabilize all disturbed areas. 9. Remove temporary SESC measures after all disturbed areas are stabilized.
Maintenance	• Confinement systems should be checked periodically after installation for settling at the base or indications of lateral movement. Individual cells may need additional fill due to consolidation of fill materials. • Slopes should be inspected after each rainfall event that produces runoff and at least monthly during the first year of establishment to identify and address erosion problems as they occur. Complete identified repairs promptly.
Limitations	• Cost limits use to problem areas. • Seed germination may be delayed due to reduced soil temperature.



Source: State of Michigan, Department of Management and Budget, SESC Guidebook

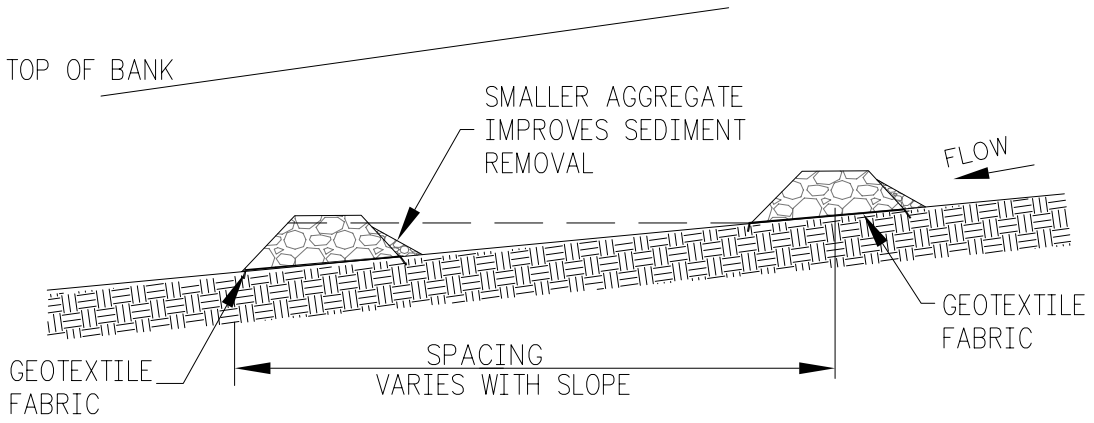
SECTION 4

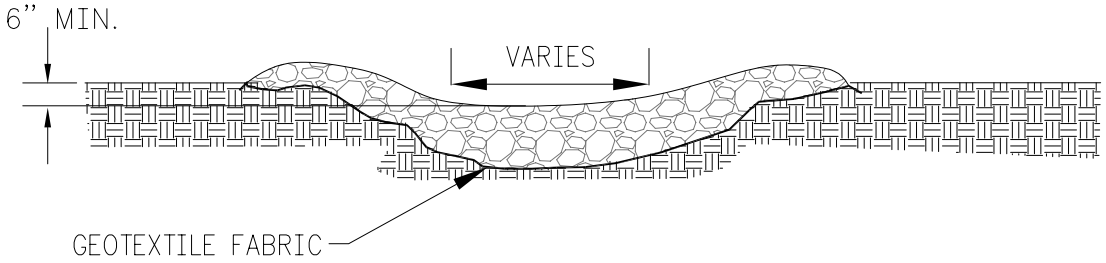
Erosion and Sediment Control Measures

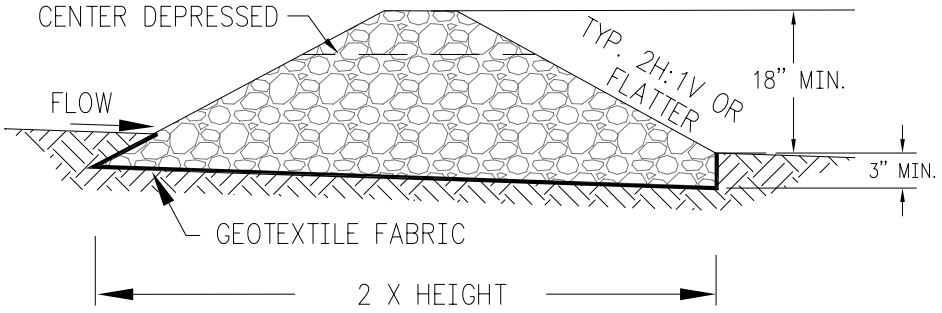
40. CHECK DAM

When	• To stabilize constructed and existing flow corridors when flow is anticipated to exceed the erosive velocity. • To control sediment in a stream in conjunction with a ***sediment sump***.
Why	• To reduce water velocity minimizing erosion in flow corridors and channels. • To temporarily protect vegetation during early stages of growth or permanently to reduce flow velocities.
Where	• Within and across an existing or constructed flow corridor.
Scheduling	• Year around.
How	1. Configure check dams to site specific conditions. Utilize an engineer as necessary to determine the notched center dimensions and spacing between check dams based on channel slope, flow length, discharge, flow velocity, and soil type. Permanent check dams should be designed to pass, at a minimum, a 10-year, 24-hour storm at non-erosive velocity. 2. Permanent check dams should be constructed of clean rock placed on geo-textile fabric which has been toed in a minimum of 3 inches. Ninety percent of the rock should range between 2 to 4 inches for slopes less than 2 percent and 3 to 12 inches for steeper grades. The rock size should be large enough to stay in place during anticipated flows. When larger rock is used, place smaller aggregate immediately upstream to filter sediment and improve efficiency. 3. Temporary check dams that will experience low flow conditions can utilize pea-stone or gravel filled bags instead of rock over geotextile fabric. New commercially available technologies include prefabricated check dams that are effective and sometimes reusable. 4. When not engineered but used in series, the toe of the upstream check dam should be set at the same elevation as lowest point in the top of the downstream check dam. 5. The side slopes of the check dam should be 2 horizontal to 1 vertical or flatter or equivalent to the existing streambank slopes. 6. The middle of the dam should be a minimum of 9 inches lower than the outer edges, allowing flow to go over the depression in the center as opposed to around the sides where it could erode the banks. 7. The outer edges should be keyed into adjacent banks and extend to an elevation above the anticipated flow depth to prevent washouts. 8. ***Sediment sumps*** should be used upstream of check dams when working in sandy soils when excessive amounts of sediment is expected to accumulate. 9. Riprap should be placed immediately below the check dam to help dissipate the energy of the water flowing over the dam. In areas of higher velocities energy dissipation may be needed downstream of the check dam to prevent undercutting. 10. Temporary check dams should be constructed to handle the anticipated flow and sediment load until the site is stabilized. Aggregate filled bags are easier to remove than a rock check dam and the aggregate can usually be spread along the channel bottom when the check dam is removed. Aggregate meeting the gradation requirements of 6A is recommended; use nothing finer than pea-stone.

Maintenance	• Inspect check dams following each runoff event to ensure there is no piping under the structure or around the banks until the flow corridor has been stabilized. • Initiate identified repair needs as soon as possible following inspection. • Remove and properly dispose of sediment when it accumulates to 1/2 the check dam height. Spread sediment in an upland area and seed immediately. • In some instances clogged stone must be cleaned to remain effective. • Inspect downstream structures to ensure they have not been damaged or clogged with displaced rock or stone. • After flow corridor or channel has stabilized remove accumulated sediment from behind the check dam. If check dam is temporary, remove check dam and then stabilize the area.
Limitations	• Check dams greater than two feet in depth at the center may seriously impact the flow characteristics of the flow corridor or channel and should not be used. • Removal of rock check dams is labor intensive and expensive. • Does not remove suspended clay and silt, therefore polymers may be needed.







NOTE: BASE WIDTH SHOULD BE AT LEAST 2X THE HEIGHT

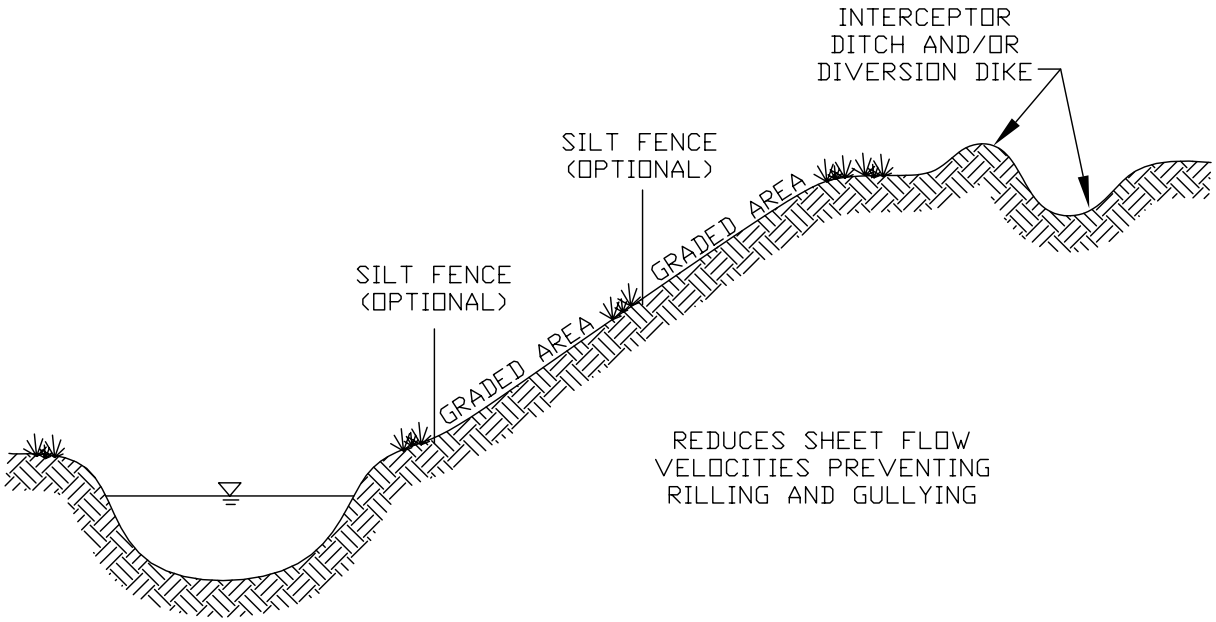
Source: Adapted from State of Michigan, Department of Management and Budget, SESC Guidebook

41. CATCH BASIN

When	• To provide a stable inlet to an enclosed storm drain, open drain or stream.
Why	• On enclosed drains to provide a stable inlet and to collect sediment. • On open drains with steep slopes or erodible soils to prevent erosion of the inlet and to collect sediment.
Where	• Where surface water accumulates and needs an outlet. • Within an enclosed drain system to provide a storm drain inlet and a sump. • Where an open drain discharges to a stream or drain at erosive velocities.
Scheduling	• Year around.
How	1. Excavate to install catch basin with an adequate sump and a positive discharge to the storm system. Design considerations include inlet size, outlet pipe capacity, inlet and outlet elevations, pipe slope, and sump depth. 2. Backfill to grade, adding topsoil and seed, fertilize with a low or no phosphorus fertilizer if necessary. 3. Install soil erosion and sediment control measures to protect inlet.
Maintenance	• Inspect routinely and following each precipitation event that results in runoff until disturbed areas are stabilized. • Remove temporary control measures and clean sediment from sump after site is stabilized. • Routinely remove sediment accumulation by hand or with a vacuum truck and haul to an upland site and stabilize. Contaminated sediments must be disposed of at an approved landfill. • Repair structure as needed.
Limitations	• Disposal cost.

42. VEGETATED BUFFER STRIPS

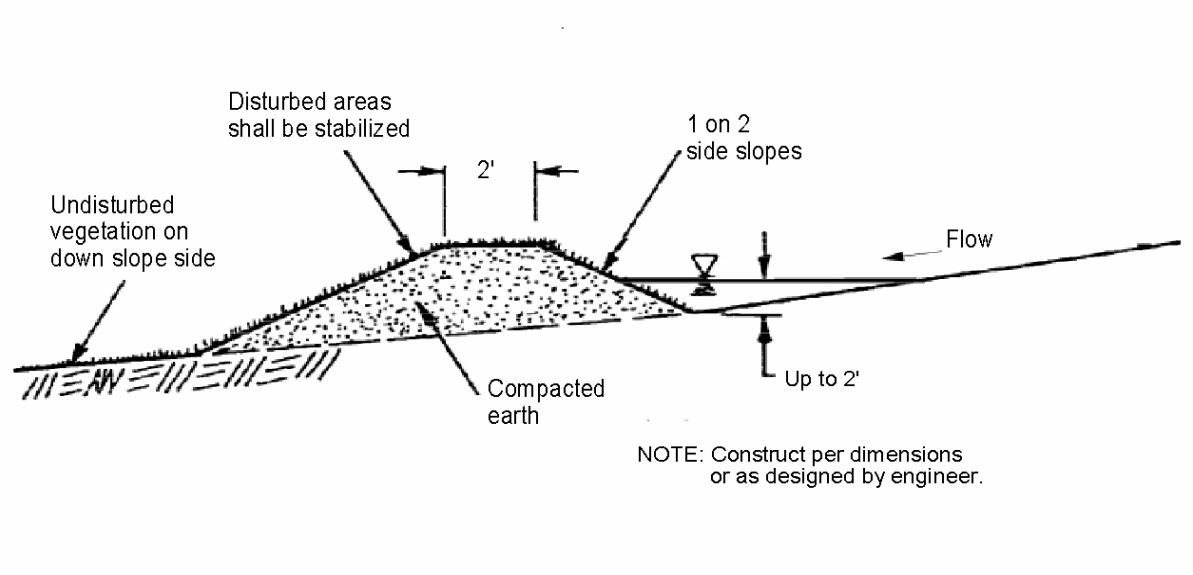
When	• Existing vegetation buffer strip can be maintained during a drain maintenance or improvement project. • A permanent vegetated buffer strip is being established to stabilize an eroding bank or drain easement area.
Why	• Reduces sheet flow velocities preventing rilling and gullying. • Filters sediment laden runoff and reduces the potential for wind erosion. • The vegetation roots hold and stabilize soils. • To protect waterbody from adjacent agriculture and urban development impacts.
Where	• Along stream and drain corridors, sensitive areas, and shorelines.
Scheduling	• Maintain existing buffer strips whenever possible. • Establish new permanent vegetation during the growing season or when dormant ***seeding*** can be used.
How	1. Where possible, maintain or establish at least a 20 foot wide buffer strip beyond the top of the slope. On steep slopes with highly erodible soils a wider buffer strip is required to attain full benefit of the buffer strip. 2. When reshaping and vegetating a slope, place a ***diversion ditch and dike*** at the top of the slope to prevent water from running over the graded area. 3. Follow the ***seeding, mulching,*** pre-vegetated erosion control blankets or other appropriate SESC measures when establishing temporary or permanent vegetation.
Maintenance	• Reestablish vegetation in disturbed areas. Inspect routinely until disturbed areas are stabilized. • If mowing will be used to prevent establishment of woody vegetation, mow annually no closer than 6 inches ideally between August 1 and August 20 to avoid peak nesting seasons and reduced winter cover for wildlife. • Unwanted competing vegetation should be removed in the first year. Herbicides may be used to eliminate unwanted vegetation and to assist in the establishment of native species. • When burning vegetated buffer strips avoid peak nesting seasons.
Limitations	• Width of drain easements. • Plowing, tilling and construction activities can damage buffer strips. • Property owner's cooperation.



Source: Adapted from Michigan Department of Transportation

43. DIVERSION DIKE

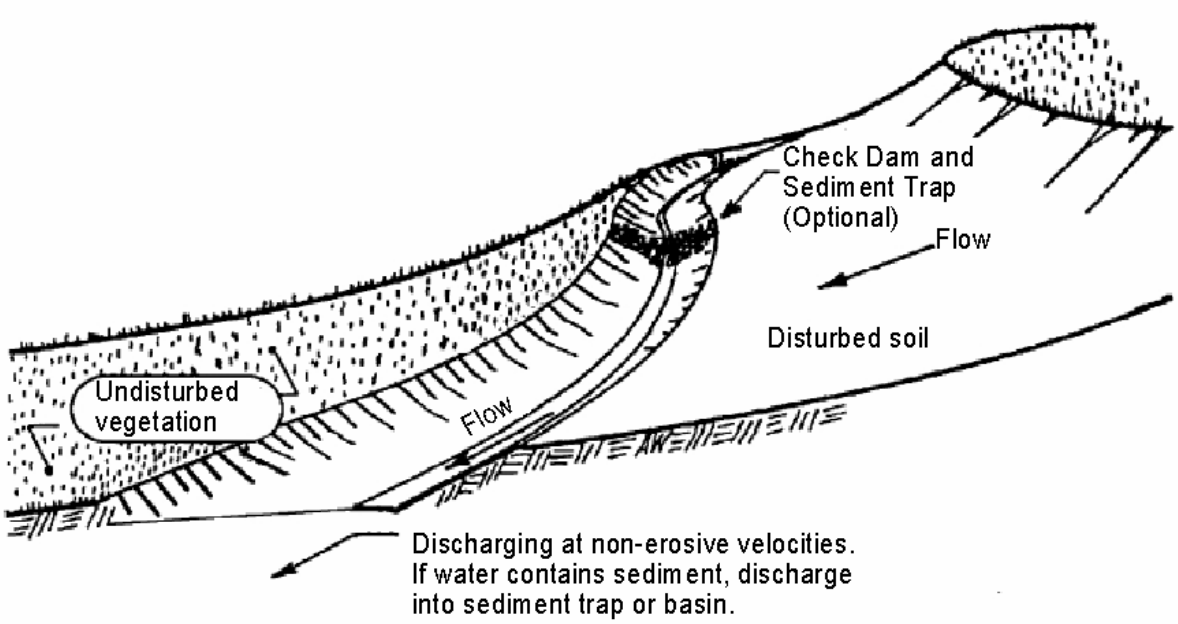
When	• Runoff needs to be diverted around sensitive areas, unstable or easily eroded soils, bare soils, away from steep banks, or around earth change activities.
Why	• Temporarily to divert runoff around earth change activities while vegetation is being established. • To divert runoff to a stable outlet or sediment control device. • To stabilize existing flow corridors and prevent bank blowouts, gullying, and subsurface seepage failures.
Where	• Just beyond top of bank. • Adjacent to in-channel construction area. • On the upgradient side of earth change activities. • Downgradient side of earth change activities to collect sediment laden waters.
Scheduling	• As part of construction activities as necessary. • During an emergency condition.
How	1. Evaluate existing topography and identify flow paths and potential diversion dike and stable outlet locations. 2. Permanent diversion dikes should be designed to divert a 10-year, 24-hour storm. Utilize an engineer when designing a diversion dike based on discharge volume, ditch slope, flow velocity and soil type. 3. Temporary dikes must be constructed with appropriate soils and compacted. 4. Stabilize the diversion dike with vegetation or erosion control blankets prior to use. 5. Provide a stable outlet using SESC control measures such as ***riprap***, ***vegetated spillway***, ***armored spillway***, ***sloped pipe spillway***, or ***pipe drop spillway***. 6. Stabilize all disturbed areas prior to removing diversion dikes that must be removed.
Maintenance	• Inspect routinely and following each precipitation event that results in runoff until stabilized making any necessary repairs until all areas are stabilized.
Limitations	• Must be stabilized prior to use. • May require additional temporary or permanent drain easements.

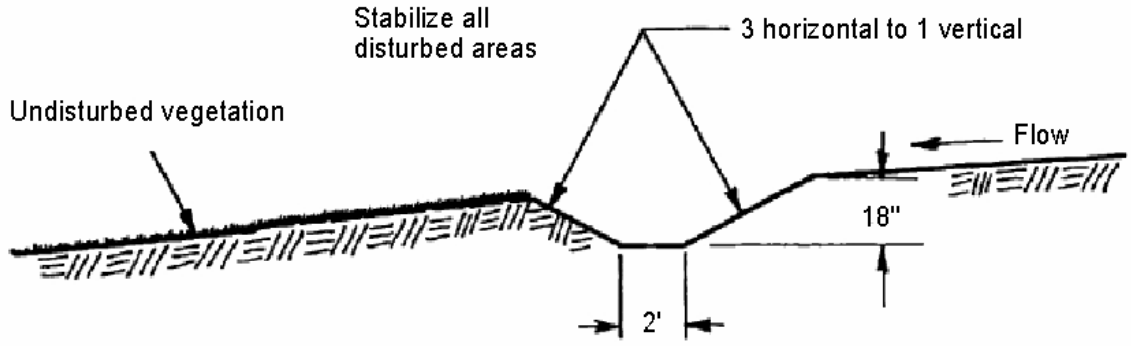


Source: Adapted from Michigan Department of Transportation

44. DIVERSION DITCH

When	• Runoff needs to be intercepted and or diverted around sensitive areas, unstable or easily eroded soils, bare soils, away from steep banks, or around earth change activities.
Why	• Temporarily to divert runoff around earth change activities while vegetation is being established. • To divert runoff to a stable outlet or sediment control device. • To stabilize existing flow corridors and prevent bank blowouts, gullying, and subsurface seepage failures.
Where	• Just beyond top of bank. • Adjacent to in-channel construction area. • On the upgradient side of earth change activities. • Downgradient side of earth change activities to collect sediment laden waters.
Scheduling	• As part of construction activities as necessary. • During an emergency condition.
How	1. Evaluate existing topography and identify flow paths and potential diversion ditch and stable outlet locations. 2. Permanent diversion ditches should be designed to convey a 10-year, 24-hour storm at non erosive velocity. Utilize an engineer when designing a diversion ditch based on discharge volume, ditch slope, flow velocity and soil type. ***Check dams*** may be necessary to reduce runoff velocity within the ditch. 3. Temporary diversion ditches can range from a shallow swale to a deeper constructed ditch. 4. Stabilize the diversion ditch with vegetation or erosion control blankets prior to use. 5. Provide a stable outlet using SESC control measures such as ***riprap***, ***vegetated spillway***, ***armored spillway***, ***sloped pipe spillway***, or ***pipe drop spillway***. 6. Stabilize all disturbed areas prior to restoring diversion ditch areas that must be removed.
Maintenance	• Inspect routinely and following each precipitation event that results in runoff until stabilized. • Routinely remove debris and repair ditch as needed.
Limitations	• Top of bank diversion ditches are limited to small flows and shallow ditch depths not exceeding 3 feet. • Must be stabilized prior to use. • May require additional temporary or permanent drain easements.



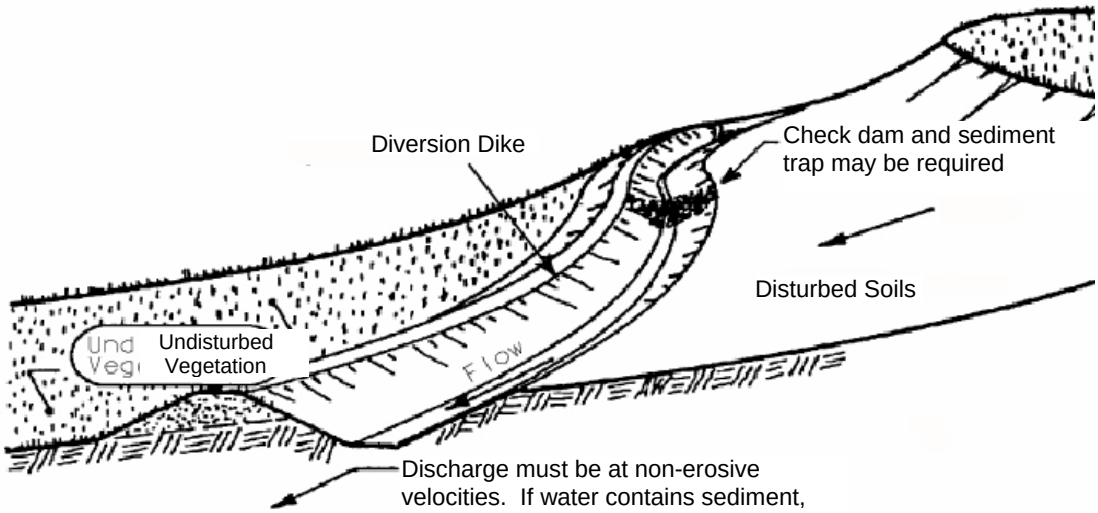


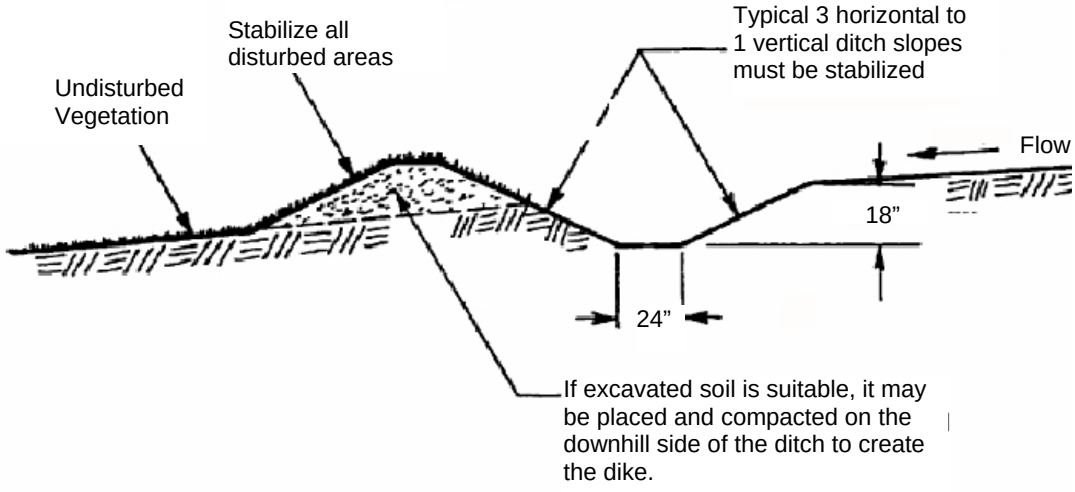
NOTE: Construct per dimensions
or as designed by engineer.

Source: Adapted from Michigan Department of Transportation

45. DIVERSION DITCH AND DIKE

When	• Runoff needs to be diverted around sensitive areas, unstable or easily eroded soils, bare soils, away from steep banks, or around earth change activities.
Why	• To divert runoff around earth change activities while vegetation is being established. • To divert runoff to prevent bank blowouts, gullying, and subsurface seepage failures. • To stabilize existing flow corridors.
Where	• Just beyond top of bank. • Adjacent to in-channel construction area. • On the upgradient side of earth change activities. • Downgradient side of earth change activities to collect sediment laden waters.
Scheduling	• As part of construction activities as necessary. • During an emergency condition.
How	1. Evaluate existing topography and identify flow paths and potential diversion ditch and/or dike, and stable outlet locations. 2. Permanent diversion ditches should be designed to convey a 10-year, 24-hour storm at non erosive velocity. Utilize an engineer when designing a diversion ditch and/or dike based on discharge volume, ditch slope, flow velocity and soil type. ***Check dams*** may be necessary to reduce runoff velocity within ditch. 3. Temporary diversion ditches can range from a shallow swale to a deeper constructed ditch. Temporary dikes must be constructed with appropriate soils and compacted. 4. Stabilize the diversion ditch and/or dikes with vegetation or erosion control blankets prior to use. 5. Provide a stable outlet using SESC control measures such as ***riprap***, ***vegetated spillway***, ***armored spillway***, ***sloped pipe spillway***, or ***pipe drop spillway***. 6. Stabilize all disturbed areas prior to restoring diversion ditch and dike areas that must be removed.
Maintenance	• Inspect routinely and following each precipitation event that results in runoff until stabilized. • Routinely remove debris and repair ditch and dike as needed.
Limitations	• Top of bank diversions are limited to small flows and shallow ditch depths not exceeding 3 feet. • Must be stabilized prior to use. • May require additional temporary or permanent drain easements.





NOTE: Construct per dimensions or as designed by engineer.

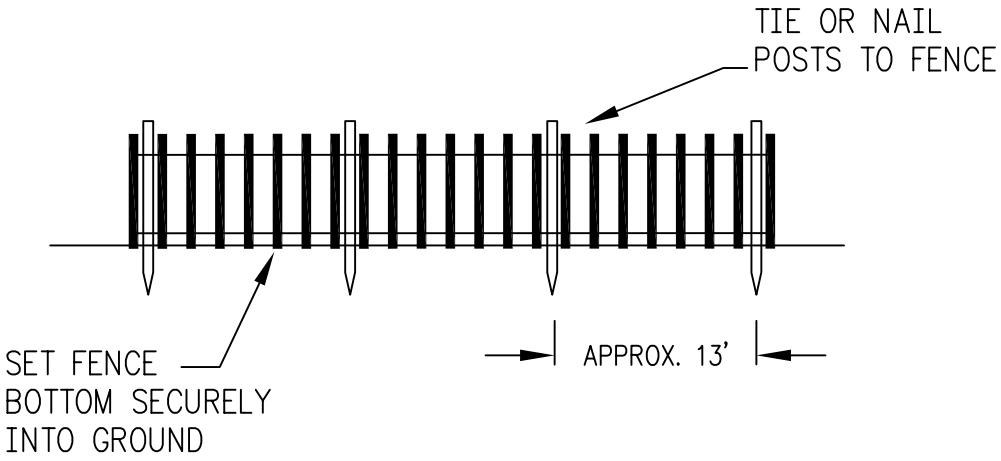
Source: Adapted from Michigan Department of Transportation

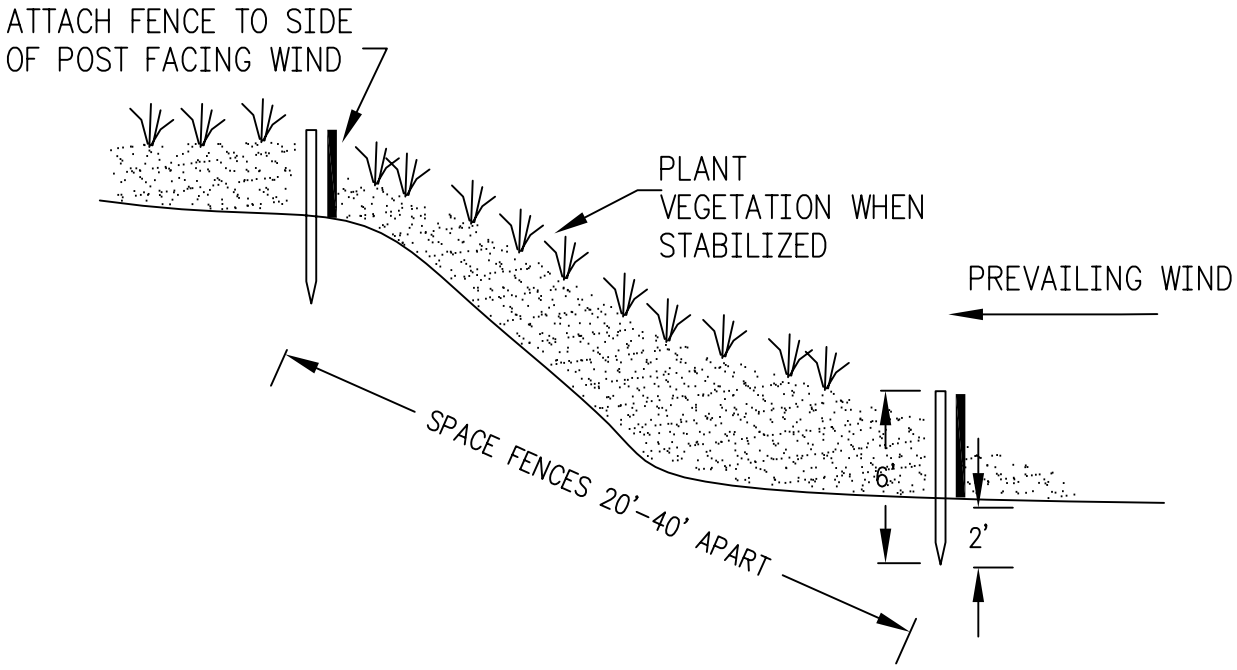
46. STONE FILTER BERM

When	• Runoff from disturbed areas requires filtering before leaving a construction site.
Why	• To reduce the flow velocity and filter sediment from runoff.
Where	• In areas where sheet flow or rill flow occurs from small drainage areas. • In drainage ways where intermittent concentrated flow will not exceed 2 feet per second. • Along a site perimeter. • Across construction site access roads. • Around temporary spoil areas. • Along segments of a stream or drain.
Scheduling	• Year around.
How	1. Use 3/4 to 3 inch size stone in areas of sheet flow and 3 to 5 inch stone in areas with concentrated flow. 2. Construct a sump area large enough to detain runoff volume on the upslope side of the berm where runoff can pond and sediment can settle. If drainage area is large a sediment basin may be needed. 3. Allow ample room in to allow equipment access for sediment removal and maintenance of the berm.
Maintenance	• Inspect routinely and following each precipitation event that results in runoff, to assure filter berm has not plugged. Remove accumulated sediment and repair and replace gravel as needed to maintain adequate filtering and prevent berm overtopping and ultimate failure.
Limitations	• Should not be used in place of a check dam in a flowing ditch because they are unable to withstand velocities in excess of 2 feet per second. • Not for use in concentrated, continuous flow areas. • Not for use in areas intended for mowing.

47. SAND FENCE

When	• In areas susceptible to wind erosion, particularly where soil has not yet been stabilized through other means.
Why	• To reduce wind velocities, reducing erosion. • To trap blowing sand, reducing off-site sedimentation. • To assist in stabilizing or re-building a slope.
Where	• Along coastal dunes, open areas subject to frequent wind, along roads, work areas, and adjacent to agricultural fields.
Scheduling	• Year around.
How	1. Sand fences are generally made from wooden slats spaced approximately 1.5 inches apart or consist of plastic web material. 2. Place sand fence perpendicular to the prevailing wind direction. 3. Anchor fence with sturdy posts at least 6 feet long. Drive posts into the ground approximately 2 feet. 4. Space the posts approximately 13 feet apart. Spacing may be altered to ensure posts are placed at low points. 5. Securely attach sand fence to posts on the windward side. Tying or nailing fence material to each post is often the method used. 6. The bottom of the fence must be set securely into the ground. 7. To continue effectiveness when needed, add another row of fence when the first row has accumulated sand up to 2/3 its height. 8. When sand fence is used to re-build a slope, plant vegetation to stabilize the sand when sand accumulation has slowed significantly. 9. When sand fence is used to reduce wind erosion, remove fence after disturbed areas have stabilized.
Maintenance	• Inspect routinely and add or maintain fence until all disturbed areas are stabilized.
Limitations	• Removal of fence may disturb established vegetation in stabilized areas unless adequate equipment access routes are planned.

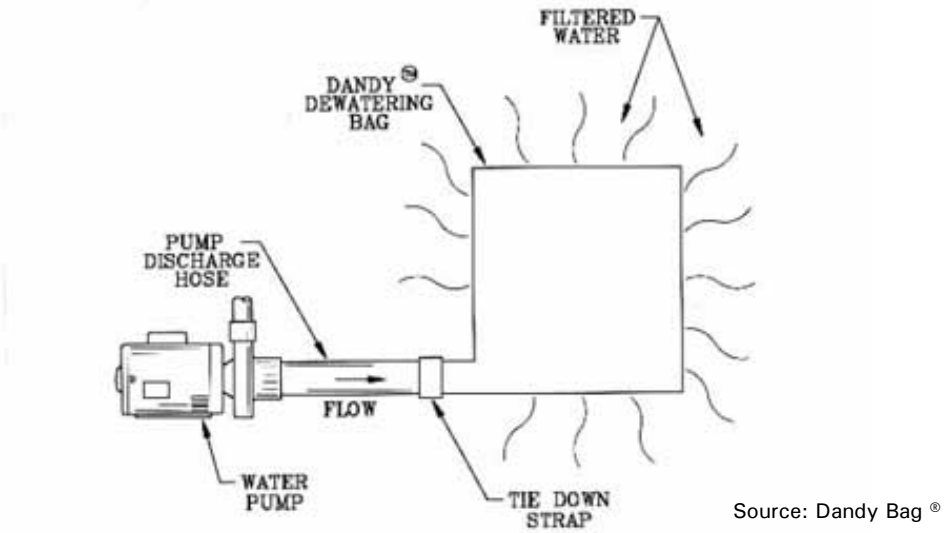




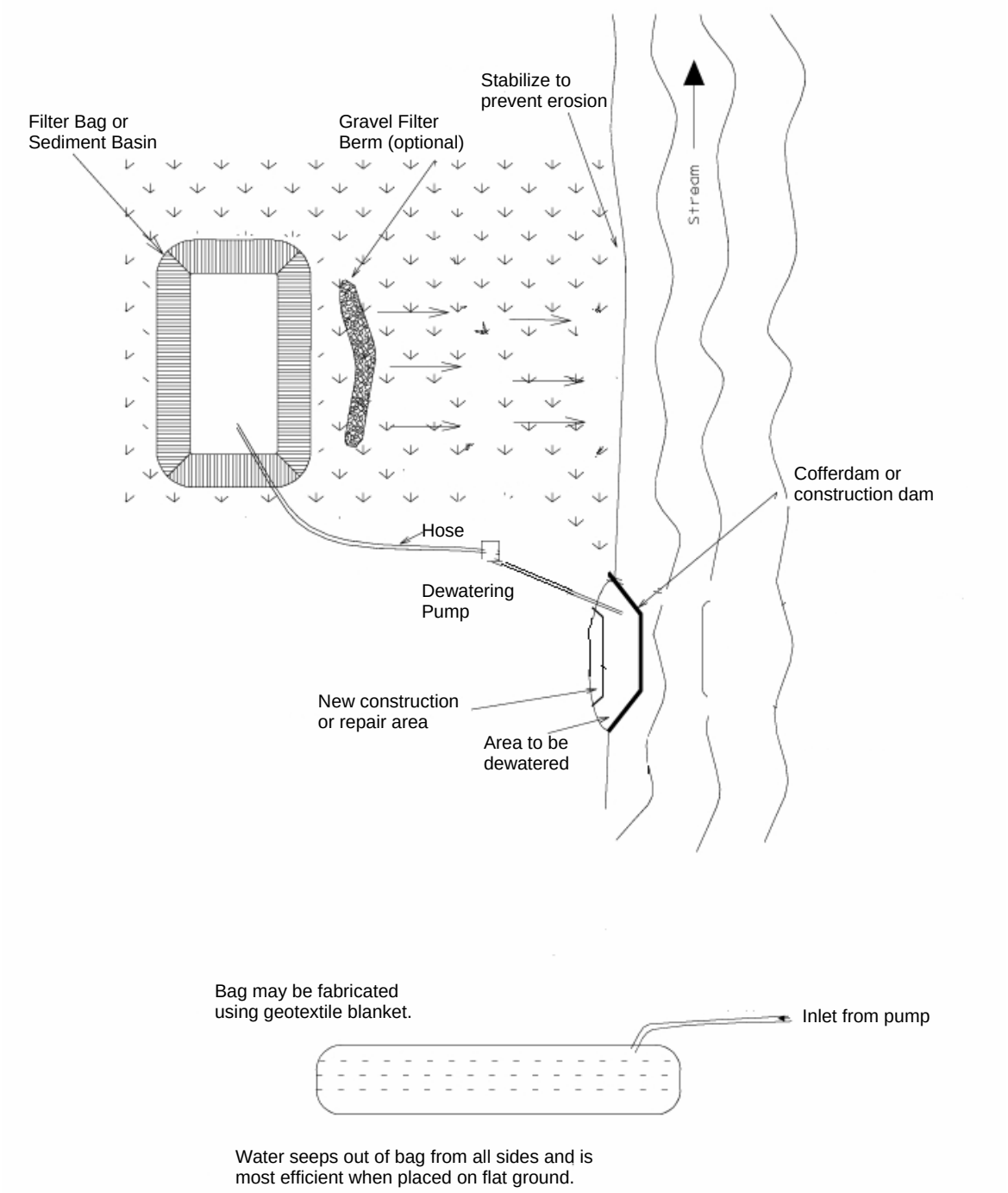
Source: State of Michigan, Department of Management and Budget, SESC Guidebook

48. DEWATERING

When	• Construction activities are limited by the presence of water and a dry work area is required. • Maintenance activities require lower water levels. • Accumulated stormwater must be discharged.
Why	• To remove groundwater or surface water to facilitate construction activities.
Where	• A high groundwater table limits construction activities. • Within or adjacent to a stream or drain. • In stormwater basins.
Scheduling	• Year around.
How	1. Utilize an engineer to design a dewatering system with sufficient size and capacity to maintain a dry condition without delays during construction or maintenance operations and to provide an adequate sediment basin when needed. 2. Design and stabilize dewatering system discharge point to prevent scouring of the receiving waters. 3. If sediment filtration is required, water should be filtered through a stone filter near dewatering pump inlet or released through a filter, designed for this purpose, prior to discharge. 4. Sediment accumulated with a filtering system must be either spread and stabilized within the drain easement or properly disposed of off site.
Maintenance	• Maintain sediment controls and filters in good working order. • Inspect dewatering discharge points daily for signs of scour and erosion. • Repair any problems immediately.
Limitations	• Does not provide filtration of contaminated water. • Requires adequate sediment settling area or filtration system to remove sediment. • Freezing temperature may limit the use of filter bags.



Source: Dandy Bag ®



Source: Adapted from Michigan Department of Transportation

49. STRAW BALES

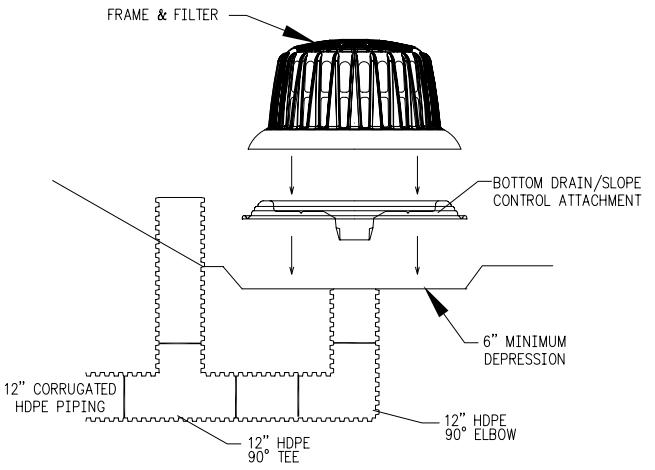
When	• As a temporary diversion structure. • Occasionally as an alternative to silt fence for projects that will be completed within a very short time period (less than one month).
Why	• To divert flow to a protected area during soil disturbance preventing suspended sediments from leaving the drain easement or entering a drain. • Effective when used during minor soil disturbance activities. Very effective for short time periods and create little disturbance when installed and removed. Additionally, straw may be used as mulch when removed.
Where	• Adjacent to critical areas, such as wetlands, and along drain easement boundaries.
Scheduling	• Year around if ground is not frozen.
How	1. Trench in a minimum of 4 inches and butt the bales tightly together to prevent water and sediment from passing between them and stake.
Maintenance	• Routinely inspect bales following each precipitation event that results in runoff. • On extended projects straw bales may require replacement. • Remove straw bales when vegetation has been established.
Limitations	• Trenching the straw bales is time consuming. • Straw bales deteriorate rapidly, often in 60 to 90 days. • The straw swells when becoming wet so very little if any water will pass through, often resulting in overtopping or failure of the bail barrier. • Straw bales are ineffective in areas of concentrated flow, such as in the drain, or directly downstream of outlets.

SECTION 5

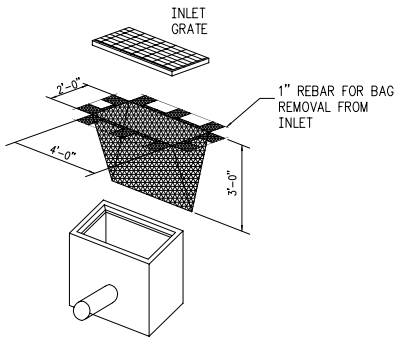
Sediment Control Measures

60. STORM DRAIN INLET PROTECTION

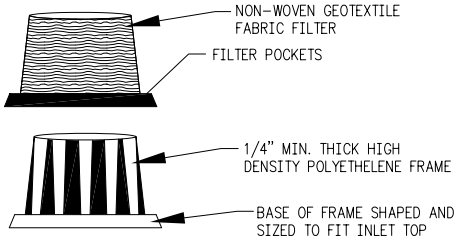
When	• Runoff from earth change activities will discharge to a catch basin or storm drain inlet. • A newly constructed catch basin or storm drain inlet needs protection until surrounding area is stabilized.
Why	• To prevent sediment from entering a stormwater system.
Where	• Around the entrance to a catch basin or storm drain inlet.
Scheduling	• Year around.
How	1. For catchbasins and storm drain inlets in lawns: install silt fence around the catch basin or inlet perimeter and overlap fence 1-2 feet; wrap catchbasin cover with geotextile fabric or use a prefabricated inlet protection device sized for the inlet. 2. For catchbasins in curb lines wrap catchbasin cover with geotextile fabric or use a prefabricated inlet protection device sized for the inlet. A curb silt dam may also be used for added protection. 3. Provide for secondary bypass to prevent flooding during high runoff conditions. 4. Remove temporary sediment controls when project is complete and all areas are stabilized.
Maintenance	• Inspect routinely and following a precipitation event that results in runoff until sediment filter is removed. • Routinely remove sediment accumulation. • Repair and or replace control measures as needed.
Limitations	• May cause temporary flooding. • Plug easily and require repeated routine maintenance. • Catch basin covers and silt sacks should not be used during freezing weather because they become impermeable.



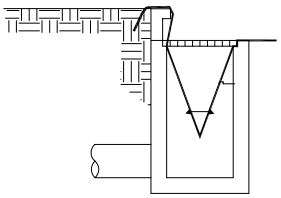
INSTALLATION PROFILE



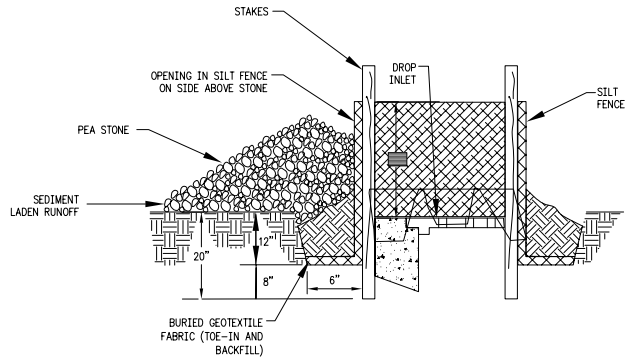
ISOMETRIC VIEW



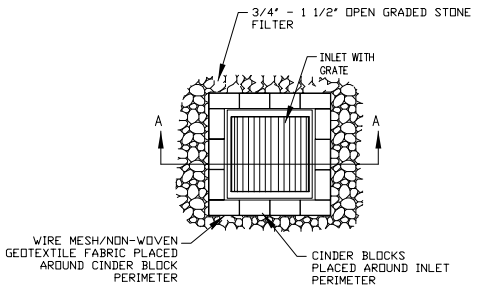
FILTER & FRAME PROFILE



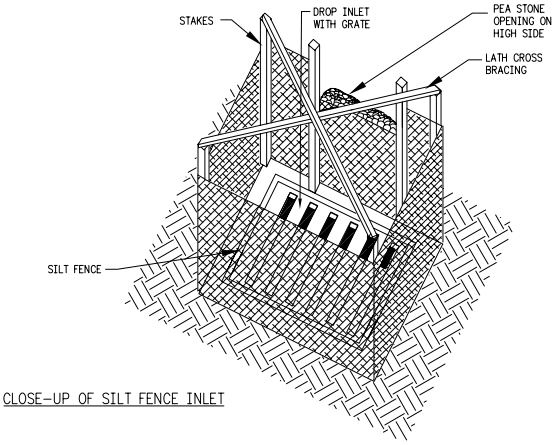
INSTALLATION DETAIL



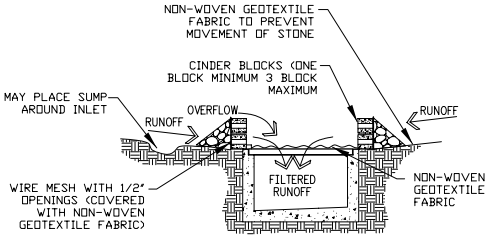
CROSS-SECTION OF SILT FENCE INLET FILTER



PLAN VIEW



CLOSE-UP OF SILT FENCE INLET



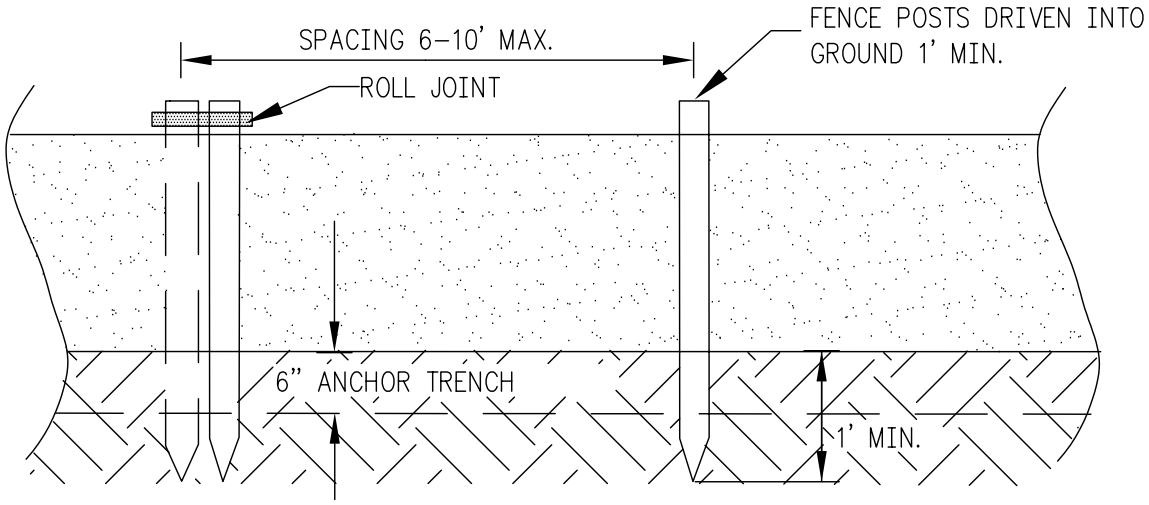
CROSS SECTION A-A

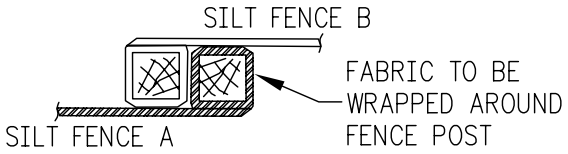
DROP INLET BLOCK AND STONE FILTER

Source: State of Michigan, Department of Management and Budget, SESC Guidebook

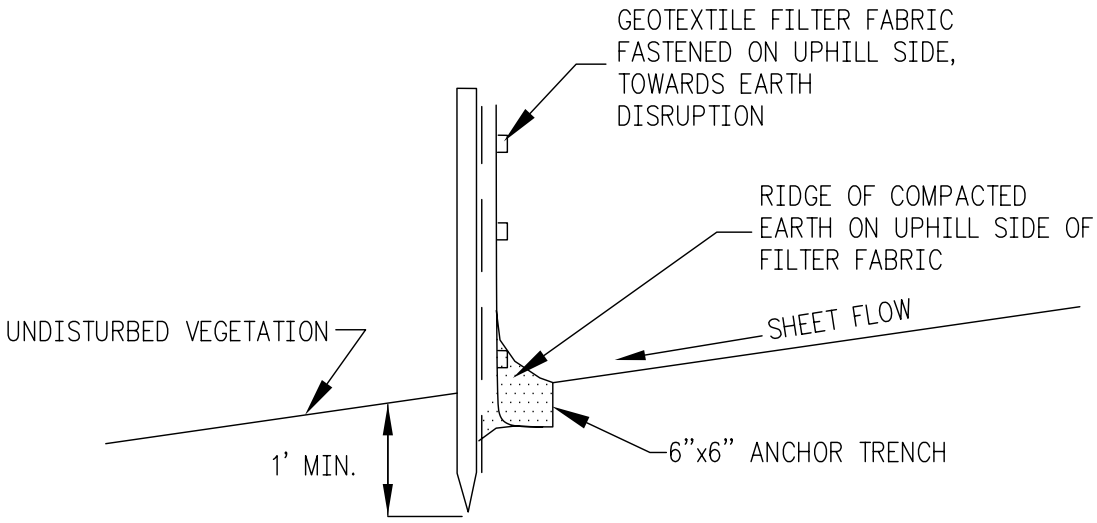
61. SILT FENCE

When	• As a temporary measure used to capture sediment from sheet flow. May also divert small volumes of sheet flow to protected outlets.
Why	• The permeable barrier prevents suspended sediments from leaving the work area minimizing downstream sedimentation.
Where	• Between earth disturbance and drain, on drain easement boundaries and adjacent to sensitive areas, such as wetlands. • In shallow standing water to confine sediment during sediment removal.
Scheduling	• Year around except during frozen ground conditions.
How	1. Trench in at the bottom a minimum of 6 inches, stretch and support by wooden posts on the downstream side of the silt fence. The wooden stakes should be driven to a depth of 12 inches below the ground surface and the trench should be backfilled and compacted. It may be necessary to add additional staples in the wooden posts to adequately anchor the silt fence. 2. Install along an elevation contour across the slope overlapping and rolling joints. 3. Drainage from no more than 1/2 acre should be passed through 100 feet of silt fence. 4. In areas where water ponds behind the silt fence, a stone filter berm may be needed to provide an outlet and prevent failure of the silt fence. 5. As an extra precautionary measure when the disturbed area is adjacent to a watercourse or on steep slopes two rows of silt fence may be necessary. They should be placed 3 feet apart and at least 3 feet from the edge of the water. 6. All excavated or surplus soils shall be removed to an upland site, disposed of outside of regulated wetlands or on an existing spoil bank and stabilized to prevent erosion in a manner that will not impair flood flows.
Maintenance	• Inspect the silt fence routinely to assure it has not been knocked down and following a precipitation event that results in runoff. Remove all sediment when it reaches 50 percent of its capacity and make repairs promptly. • Maintain the silt fence until the disturbed area is completely stabilized with an effective vegetative cover. • Remove accumulated sediment and silt fence and vegetate the disturbed areas. • Silt fence may be reused.
Limitations	• Labor intensive to install correctly, however improperly installed silt fence will not contain sediment and will be undercut, overtopped or will collapse. • Costly for linear projects however less expensive than removing off-site sediment. • A very limited amount of water can pass through silt fence therefore it may fail during larger storm events. • Stable outlets must be provided to prevent silt fence failure. • Silt fence is ineffective in areas of concentrated flow, such as in the drain, or directly downstream of outlets.





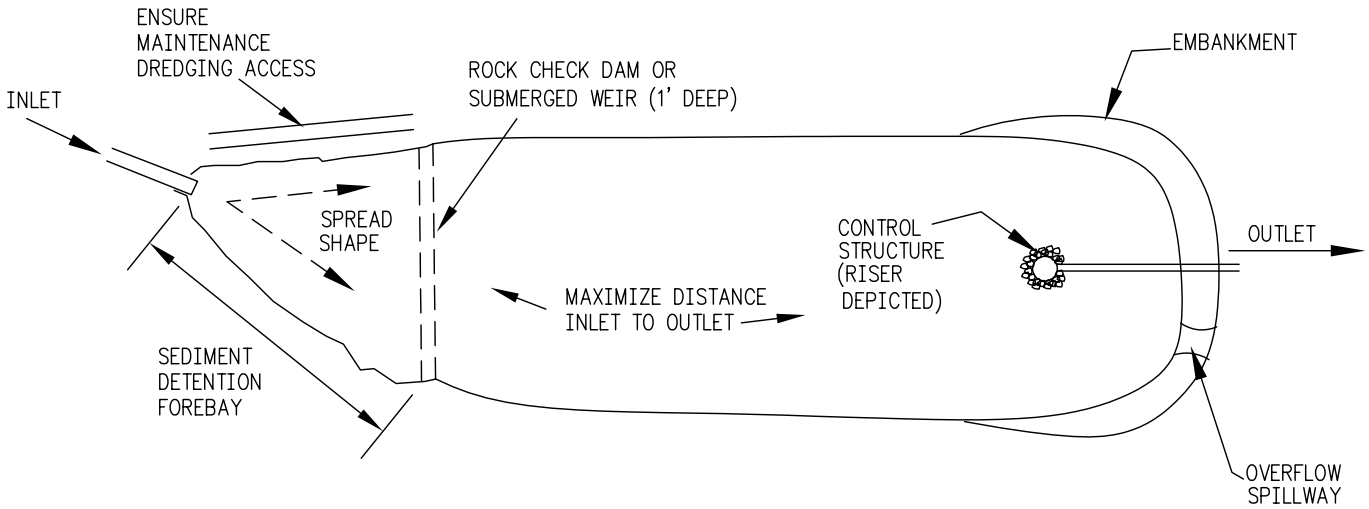
ROLL JOINTS



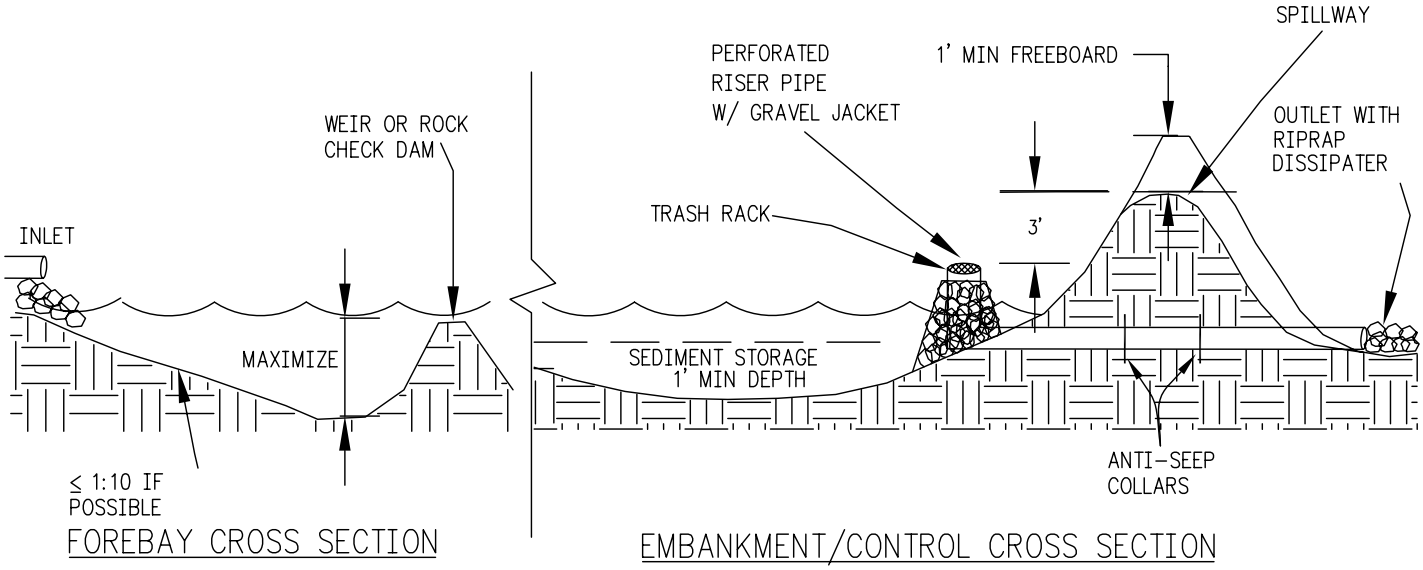
Source: State of Michigan, Department of Management and Budget, SESC Guidebook

62. SEDIMENT BASIN

When	• Earth change activities will result in sediment release. • Sediment accumulates in a drain from natural bed load, unstable areas, unregulated activities or construction projects. • Potential sediment from upstream projects is anticipated and ***sediment sumps*** are inadequate.
Why	• To provide an accessible location for sediment deposition, basin maintenance, and sediment removal.
Where	• In drains downstream of sediment sources. • At upstream end of stormwater basins.
Scheduling	• Year around.
How	1. Sediment basin specifications should be designed by an engineer with consideration for the soil type, drainage area, desired sediment removal efficiency, stream flow and velocity, the extent of work area, and project duration from initial soil disturbance to final stabilization. The design should include a forebay to trap the initial sediment slug and must be located where equipment can access the basin for maintenance and cleanout. 2. When using an impermeable berm with a riser pipe(s) or permeable rock check dam(s) provide an emergency auxiliary spillway for major events. 3. Install sediment basin according to the engineer's design and stabilize all disturbed areas prior to commencing upstream work.
Maintenance	• Inspect weekly and following a precipitation event that results in runoff during active work and until all disturbed areas are stabilized. Continue routine inspections for permanent sediment basins. • Check the accumulated sediment depth to ensure remaining storage capacity is adequate for storm water and sediment deposition. • Sediment shall be removed and the basin restored to its original dimensions when the sediment has accumulated to ½ the design depth of the basin. Removed sediment shall be deposited in the drain easement, leveled and adequately stabilized or removed to an appropriate off site location.
Limitations	• Cost. • May require additional drain easement. • Liability concerns based on failure of the basin, flooding of adjacent properties, and discharge of sediment. • May become an attractive nuisance to children and waterfowl. • Effective in removing sediment down to the medium silt size fraction, however, not effective with fine silt and clay without extending detention time or when ***polymer*** or biopolymer flocculants are employed.



PLAN VIEW



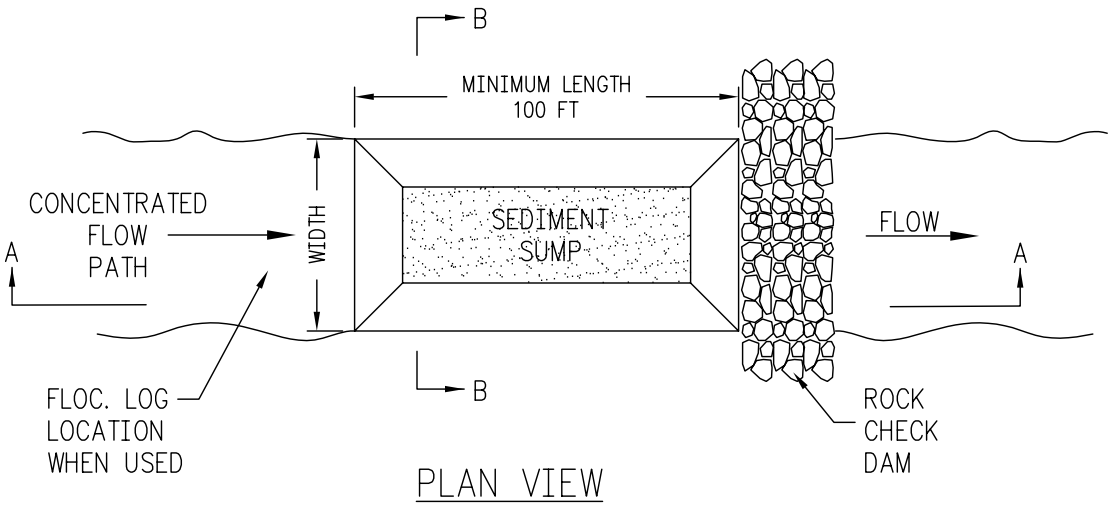
FOREBAY CROSS SECTION

EMBANKMENT/CONTROL CROSS SECTION

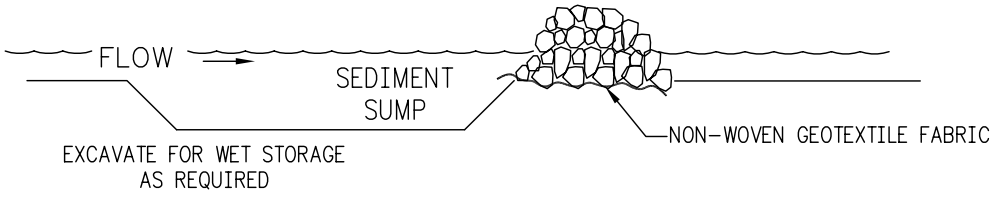
Source: State of Michigan, Department of Management and Budget, SESC Guidebook

63. SEDIMENT SUMP (TRAP)

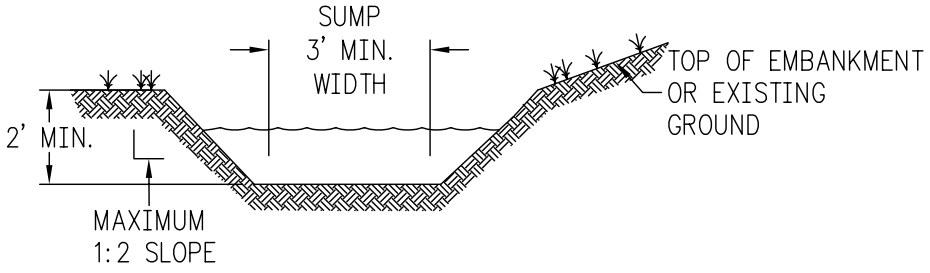
When	• Earth change activities will result in sediment release. • A stream has a large sediment load.
Why	• To trap, collect and store sediment. • To provide a location to remove accumulated sediment.
Where	• Downstream of earth change activities that will result in sediment release. • The stream or drain slope flattens and sediment will accumulate.
Scheduling	• Year around.
How	1. Sediment sump (trap) specifications should be designed by an engineer, with consideration for the soil type, drainage area, desired sediment removal efficiency, stream flow and velocity, the extent of work area, and project duration from initial soil disturbance to final stabilization. A series of sediment sumps may be required. For large projects, the sediment sump should have a minimum length of 100 feet, a minimum depth of 2 feet, and a minimum bottom width of 3 feet, or as recommended by the design engineer. Smaller sediment sumps are often used behind check dams during small, short duration, projects. 2. The sediment sump location must provide a suitable access for maintenance and sediment removal, if needed, and be located in an area where sediment will accumulate. 3. Prior to earth change activities, including clearing and grubbing and sediment removal, install a check dam downstream of the sediment sump location prior to digging the sediment sump.
Maintenance	• When a sediment load is expected to continue and will exceed the sump capacity, remove sediment and restore sump to its original dimensions when the sump is ½ full. Removed sediment shall be deposited within the drain easement, leveled and stabilized or moved to an appropriate off site location. • Inspect routinely and following a precipitation event that results in runoff during active work and until all disturbed areas are stabilized. Continue routine inspections and maintenance of permanent sediment sumps. • Remove temporary rock check dams and stabilize area when the project is complete and the disturbed area stabilized.
Limitations	• Removes coarse sediment only (medium silt size or larger) unless sump area is sized similar to a sediment basin with extended residence time or polymers are employed. Sediment sumps are not effective in capturing clay and smaller sized silts.



PLAN VIEW



CROSS-SECTION A-A



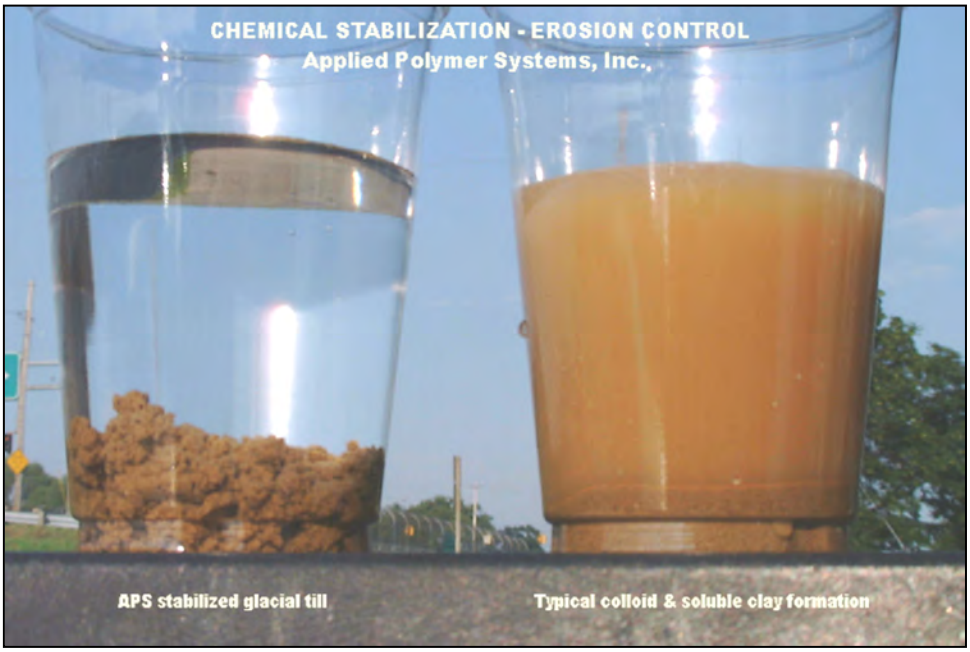
CROSS-SECTION B-B

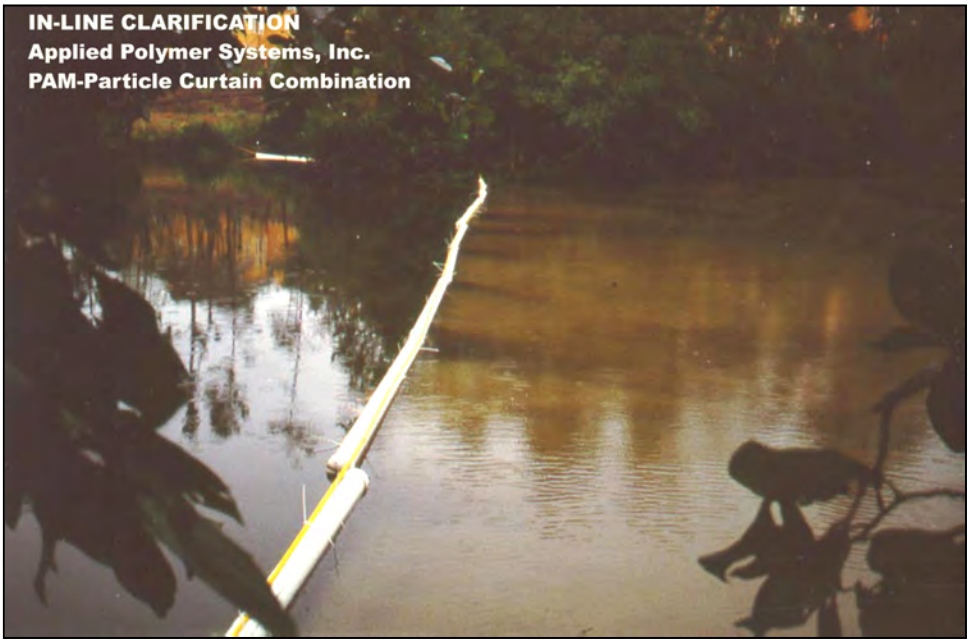
Source: State of Michigan, Department of Management and Budget, SESC Guidebook

64. POLYMER OR BIOPOLYMER FLOCCULANTS

When	• Suspended sediments must be removed from flowing water.
Why	• To clarify turbid water by removing sediments and other suspended solids, reducing detrimental effects to wildlife, receiving waters, wetlands or adjacent land. • Application provides immediate effect.
Where	• Turbid water can be collected prior to discharging to a lake, stream, drain, or a wetland. • Any flow situation where the flocculated sediment can be managed including within a stream or drain at the downstream end of an earth change.
Scheduling	• Include in the planning and design phases. • Prior authorization from the DEQ is required when polyacrylamides (PAMs) or biopolymers will be used as a water additive to remove suspended particles from runoff that that will enter surface waters of the state. Requests for use should be submitted to Mr. Gerald Saalfeld, Water Division, PO Box 30273, Lansing, Michigan 48909-7773 at least two weeks prior to anticipated use. See MDEQ's Technical Guidance for the Use of Polyacrylamides for Soil Erosion Control below.
How	1. Include polymer or biopolymer flocculants in the project planning and design phases by seeking the advice of a knowledgeable expert. Contact your local polymer supplier for additional information regarding polymers and their related application technologies. 2. When using polymers, select only anionic polyacrylamides or anionic polyacrylamide blends in aqueous emulsion, granulated or partially hydrated form. All polymers must be on both the ANSI/NSF 60 and MDEQ's Water Treatment Additive lists. 3. Polymer selection is site-specific and can take many forms, but must incorporate all of the following: a. Select an appropriate polymer, through bench testing, based on the site water and soil chemistries, b. Add polymer to turbid water, c. Mix polymer with turbid water to form floc and chelates, and d. Allow precipitation of floc and/or chelates prior to off-site discharge. 4. Biopolymers are not soil specific and are available in several forms. a. Select biopolymer form and determine biopolymer quantity based on the water turbidity and quantity. b. Add biopolymer to water. c. Mix biopolymer with turbid water to form flocs. d. Allow precipitation of flocs prior to off-site discharge.
Maintenance	• Inspect and maintain flocculant sump. • Observe polymer or biopolymer reserve following each significant rainfall event and prior to any forecasted rain event. Replace polymer or biopolymer in reserve as needed. • Observe receiving water following each significant rainfall event and prior to any forecasted rain event. If excess turbidity exists, adjust system to render proper storm water quality. • After all contributory areas of the project site are stabilized remove polymer

	or biopolymer reserve and all related system devices. • When needed, remove accumulated sediments.
Limitations	• Polymer performance is subject to the chemical matching between the site soil and waters and the polymer, i.e., one polymer will not provide suitable performance for all soil or water types. • Biopolymers perform best in turbid water with a pH between 6.5 and 8.5.

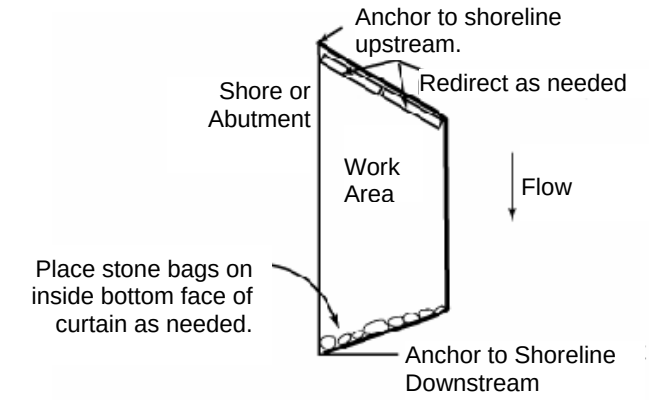




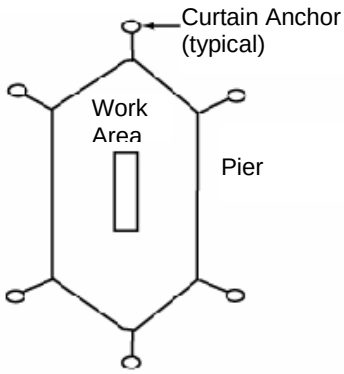
Source: Price and Company, Inc.

65. TURBIDITY CURTAIN

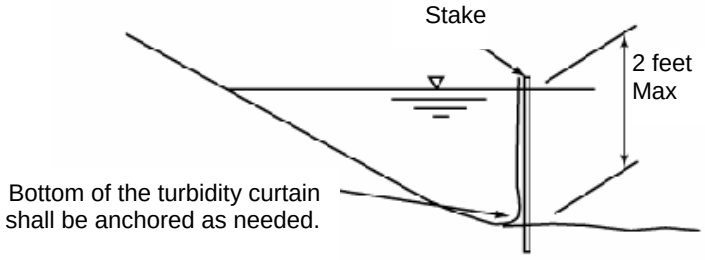
When	• Slack water area is necessary to isolate construction activities from a lake or channel.
Why	• To provide isolation of a work area from a waterbody and contain sediment.
Where	• Parallel to flow. A re-directional barrier on the upstream end of the work area may be required to direct the stream flow away from the construction area.
Scheduling	• During summer or early fall when flow is low.
How	1. Install a turbidity curtain at the location shown on the plans and according to the manufactures guidelines or as directed by the engineer. The curtain must be designed to handle site specific drainage or flow patterns. 2. Install a re-directional barrier on the upstream end of the work area if required. 3. Place the turbidity curtain parallel to the direction of flow. Install sufficient anchors, tie-downs, or other mechanisms to ensure proper position and performance of the curtain.
Maintenance	• Inspect curtain daily and make required adjustments to insure that anchors, tie-downs, or other mechanisms are sufficiently isolating construction activities from the waterbody.
Limitations	• Maintenance especially during large precipitation events and within waterbodies.



Shoreline Construction

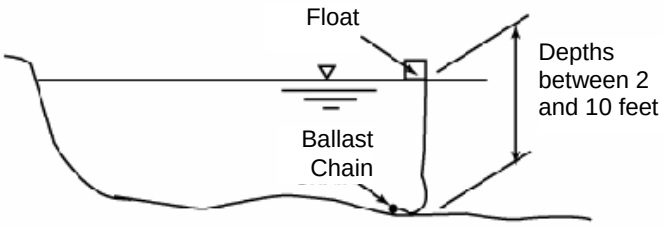


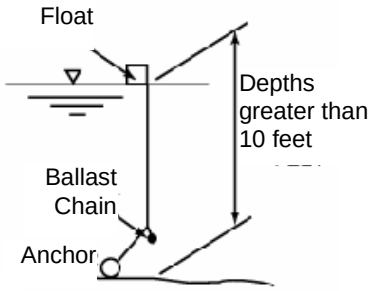
In-Stream Construction



When water is less than 2 feet deep and has low flow, a shallow turbidity curtain may be used. Curtain shall be securely fastened to stakes.

Shallow Turbidity Curtain





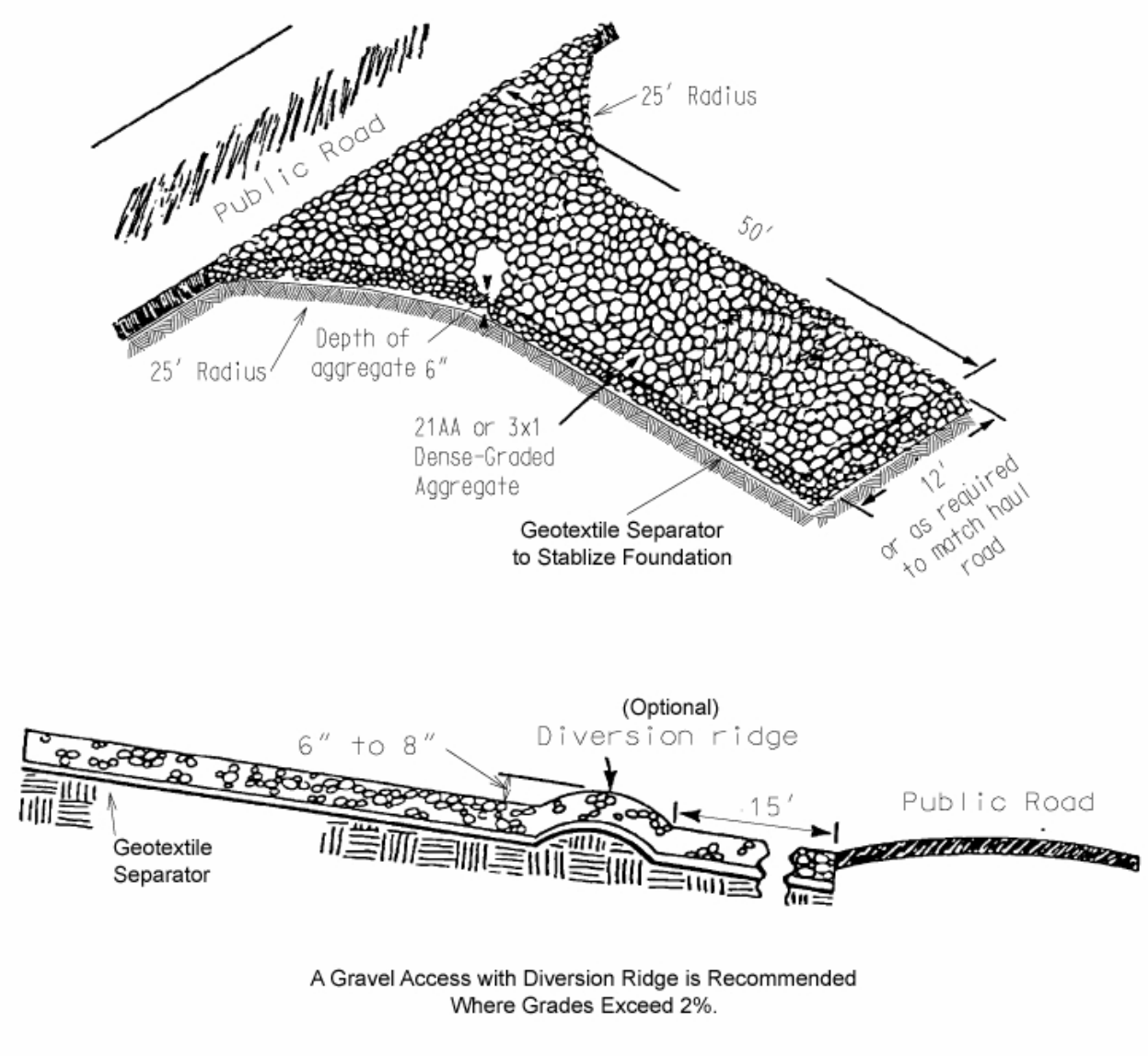
Deep Turbidity Curtain

NOTE: The turbidity curtain shall be anchored upstream, downstream and to the streambed to maximize protection of the watercourse.

Source: Adapted from Michigan Department of Transportation

66. STABILIZED CONSTRUCTION ACCESS

When	• Prior to initiating major earth change activities when construction equipment is expected to transport soil onto public roads. The project duration and anticipated frequency of use shall be considered when determining if a gravel construction exit is warranted.
Why	• Minimize fugitive dust and tracking of soil onto a roadway.
Where	• At locations that construction equipment will enter and exit the drain easement and tracking of soil is anticipated.
Scheduling	• Year around.
How	1. When conducting earth change activities adjacent to public roads locate in accordance with traffic and safety guidelines. 2. Location should consider potential use as a foundation for a permanent access by the landowner or for drain maintenance. 3. Remove vegetation and other objectionable material such as trees, stumps boulders, etc. from the foundation area. 4. Install a culvert and a ***sediment sump*** on the downstream end of the culvert whenever gravel construction exit will block surface runoff. 5. Place geotextile fabric beneath the aggregate to stabilize the foundation. 6. The gravel construction exit approach should be a minimum of 50 feet long, 12 feet wide, 6-8 inches deep, and crowned for positive drainage. The aggregate should consist of 2-3 inch diameter crushed rock, gravel or reconstituted concrete. 7. If the gravel construction exit approach slopes toward a road or off of a drain easement, or up gradient of a culvert, install linear ***sediment sumps*** on one or both sides of the gravel construction exit. 8. If the gravel construction exit approach slopes toward a roadway or off of a drain easement, at a 2 percent grade or more, construct a ridge transversely 6 to 8 inches high approximately 15 feet from the road or drain easement boundary to divert runoff into ***sediment sumps*** on one or both sides of the gravel construction exit. 9. When access is temporary, aggregate and geotextile fabric must be removed and area restored and re-vegetated.
Maintenance	• To prevent premature failure, large quantities of soil on equipment tires should be removed prior to driving across the gravel construction exit. • Inspect gravel construction access routinely and when it becomes ineffective scrape the top layer and add a 2 inch layer of aggregate. • Remove materials tracked onto roadways daily and outside of drain easement as soon as possible.
Limitations	• Effectiveness can be limited; sediment may be tracked onto roads requiring street sweeping.



A Gravel Access with Diversion Ridge is Recommended
Where Grades Exceed 2%.

NOTE: Construct per dimensions and materials or as designed by engineer.

Source: Adapted from Michigan Department of Transportation

SECTION 6

Routine Maintenance Activity Details

80. DEBRIS REMOVAL

When	• Deadfall, and other objects, such as shopping carts, tires, appliances, and mattresses have accumulated in the drain.
Why	• To prevent flooding. • To prevent or remove blockages and safety hazards. • To prevent bottom scour and drain bank erosion.
Where	• In county drains.
Scheduling	• Preferably during lower flow periods. • Some locations require routine debris removal. • During an emergency.
How	1. Remove debris minimizing channel bottom and bank disturbance. 2. When trees are uprooted and fall into a drain, cut tree off above root ball and cut tree into manageable lengths and remove from the drain. If possible reposition root ball back into its original position anchoring appropriately or remove the root ball and fill and stabilize area.
Maintenance	• Inspect disturbed areas routinely and following each precipitation event that results in runoff until stabilized.
Limitations	• Access. • Cost of retrieval and disposal. • Equipment availability. • Safety concerns.

81. SEDIMENT REMOVAL

When	• When sediment has accumulated above the dimensions of the drain as legally established or constructed and the drain is not providing adequate drainage.
Why	• Remove sediment accumulation restoring proper drain function.
Where	• Sediment has accumulated in reaches of a drain preventing the drain from functioning as legally established or constructed.
Scheduling	• During low flow or frozen ground conditions. • Avoid sediment removal and spreading of spoil piles during spring thaw due to soil instability and when crops will be damaged.
How	1. Inspect drain and document eroding outfalls, obstructions, and areas of sediment accumulation. Prioritize maintenance activities and identify needed equipment. Seek engineering support when needed to analyze the drain profile in identifying reaches that need to be dredged and/or to design SESC measures taking into account the soil type, flow conditions and length of time from initial earth disturbance to project completion. 2. **Develop a SESC plan prior to the initial earth disturbance when the project differs from these specifications or when removing sediment from a drain reach that exceeds 100 linear feet.** 3. Prioritize and schedule maintenance, taking into account adjacent land use activities. 4. Prepare access along bank. When practical clear north and east banks to maintain shading of the stream. 5. Install downstream sediment control measures such as sediment sumps and check dams or sheet pilling prior to commencing earth change activities. 6. Install all other necessary SESC measures. 7. When practical, begin sediment removal downstream and work upstream. 8. Deposit spoils along the edge of the drain easement as far away from the drain as possible maintaining a natural buffer strip and leaving openings for natural drainage to occur. Do not place spoils in a regulated wetland unless it is a historic spoil area without a wetlands permit. 9. Seed, apply mulch when necessary, or otherwise stabilize disturbed drain banks daily and stabilize disturbed areas, either temporarily or permanently, within 5 days. 10. Spread spoils to prevent erosion and ditch bank surcharge and seed or otherwise stabilize spread spoils within 5 days. If spoils will be spread at a later date, seed, apply mulch when necessary, or otherwise stabilize spoil piles within 5 days except where spoil piles will interfere with plowing tilling or the harvesting of crops. If spoil piles will be left slope spoils toward agricultural fields and away from the stream or drain. 11. When removing sediment in the winter during freezing temperatures, dormant seed spoil piles daily using additional erosion control measures as required to prevent erosion.
Maintenance	• Inspect erosion and sediment controls routinely and following a precipitation event that results in runoff until disturbed areas are stabilized.

Limitations	• Cost. • Access is limited by the drain easement dimensions. • The cost of frequent sediment removal resulting from unregulated sediment sources such as plowing and tilling, and urban land uses. • Additional SESC measures may be needed during the non growing season.

Maintenance of a natural buffer strip between spoils
and reconstructed drain prior to drain bank stabilization.

Excavated sediment and soils being trucked off-site during a drain reconstruction project.

Source: Sarah Pistro, Tuscola County Drain Commissioner

82. STORMWATER BASIN MAINTENANCE

When	• Sediment has accumulated and is limiting storage volume. • Excessive vegetation or brush accumulates in the bottom or along the banks. • Structural components require maintenance. • Wetland vegetation is being negatively impacted.
Why	• To maintain the design capacity and control sediment and other pollutants.
Where	• In constructed stormwater basins.
Scheduling	• When the basin water level is low and rainfall is not anticipated. • Brush removal during times of frozen ground, ice cover, or drought conditions will minimize soil disturbance.
How	1. In wet basins, dewater basin if outlet structure can be adjusted for dewatering; and pump or divert incoming flow around basin until sediment removal is complete and vegetation is reestablished. Vegetation can be controlled by hand cutting or by applying an aquatic labeled herbicide by a certified applicator. 2. In dry basins, remove vegetation during low flow or dry periods by brushing or by applying an aquatic labeled herbicide by a certified applicator. Stabilize disturbed areas. 3. Remove brush to an upland area within the drain easement or haul offsite. 4. Test spoils, if required, to determine appropriate locations for disposal. 5. Spread sediment spoils in an upland area within the drain easement or haul to an appropriate offsite area and stabilize.
Maintenance	• Inspect spoil deposition and disturbed areas routinely until stabilized. • Monitor basin for future sediment and vegetation accumulation. • Establish a maintenance schedule for mowing of dry basins.
Limitations	• Herbicides must be applied by a certified applicator. • If an herbicide is used in water it must be labeled for aquatic use.

83. VEGETATION REMOVAL WITHOUT GRUBBING

When	• Vegetation limits flow capacity. • Vegetation poses a threat to channel and bank stability. • Access is required.
Why	• Brushing without grubbing reduces sheet flow velocities preventing rilling and gullying, maintaining slope stability. • Trees and/or stumps located below the ordinary high water mark may cause channel restrictions, stream bottom scour, and drain bank erosion unless removed.
Where	• In drain easements, stream or drain banks and within the channel.
Scheduling	• Year around; consider nesting and spawning seasons and critical habitat.
How	1. Identify areas which need to be sprayed or brushed. If possible, maintain vegetation on south and west drain banks. 2. Chemical applicators, heavy equipment, light machinery, and hand tools, may be needed. 3. Cut vegetation within a few inches of the ground surface, leave root zone intact and do not grade area. Stump treatments may be applied to prevent re-sprouting. 4. Remove cut vegetation and pile within drain easement. 5. If a tree must be cut from within the channel, cut during low flow conditions.
Maintenance	• Where vegetation growth hinders flow capacity mow or chemically spray as needed.
Limitations	• Stumps and other woody remnants inhibit mowing. • May temporarily disrupt habitat.

84. VEGETATION REMOVAL WITH SELECTIVE GRUBBING

When	• Vegetation roots pose a threat to channel and bank stability. • Access is required.
Why	• Selective grubbing maintains selective vegetation to reduce sheet flow velocities preventing rilling and gullying, maintaining slope stability. • Trees and/or stumps located below the ordinary high water mark may cause channel restrictions, stream bottom scour, and drain bank erosion unless removed.
Where	• In drain easements, drain banks, or within the channel, and grubbing is isolated to less than 100 linear feet at any one location.
Scheduling	• Year around; consider nesting and spawning seasons and critical habitat.
How	1. Selectively identify areas which must be grubbed leaving intermittent vegetation where feasible to reduce sheet flow velocities and assist in the reestablishment of vegetation (See Vegetation Removal without Grubbing). When possible, avoid the south and west drain banks. 2. **Develop a SESC plan prior to the initial earth disturbance when the project differs from these specifications or when isolated areas of grubbing exceed 100 linear feet.** 3. Place appropriate downstream sediment control measures, such as a check dam, when working in the channel. 4. Heavy equipment, light machinery, and hand tools, may be needed. 5. Flush cut trees wherever possible, to leave roots in place for bank stabilization. 6. In areas where grubbing is required, remove vegetation, minimizing the disturbance of surrounding vegetation. 7. Grade soil surface as required, fill in voids, compact soil, and seed. 8. Apply mulch and/or erosion control blankets during the non-growing season. (Mulch is optional during the growing season.) 9. Remove any accumulated sediment from behind downstream erosion control device(s). Place sediment in vegetation on the right of way, as far from the drain as possible. 10. Remove sediment control measures after disturbed area is covered with mulch and/or erosion control blanket, or after the disturbed area is stabilized. 11. If a tree must be removed from the channel bottom when the stream is flowing, install downstream temporary sediment controls, cut tree and pile within drain easement, pull stump, allow channel bottom to stabilize, and then remove downstream sediment control measures as described above.
Maintenance	• Inspect routinely and following each precipitation event that results in runoff until stabilized.
Limitations	• May temporarily disrupt habitat.

85. SLOPE AND STREAMBANK STABILIZATION

When	• Existing slope or drain bank is failing and erosion is occurring. • Runoff inflows must be redirected within the drain easements.
Why	• To reduce flow to non erosive velocities, prevent erosion, and stabilize the slope or drain bank.
Where	• Isolated locations where total corrective action(s) will disturb less than 100 linear feet.
Scheduling	• During low flow conditions, often concurrently with sediment removal, ditch reconstruction or maintenance activities.
How	1. Identify areas where slope flattening or other corrective measures would stabilize bank 2. **Develop a SESC plan prior to the initial earth disturbance when the project differs from these specifications or when isolated corrective actions will disturb more than 100 linear feet.** 3. Determine the cause of the problem and necessary corrective actions. 4. Determine the appropriate start date and scheduling for the project. 5. Define construction work and staging limits. 6. Place appropriate downstream sediment control measures such as check dam and sediment sump. 7. Divert off site concentrated sources of runoff (if present) away from earthwork area. 8. Remove selected trees, if necessary, minimizing the disturbance of existing vegetation. 9. Salvage topsoil and temporarily store in drain easement leaving a natural buffer of vegetation between the spoils and the drain. 10. Reshape slopes and bottom to design dimensions or to match upstream and downstream slopes and bottom contours. 11. In areas requiring filling, place fill material and compact it with excavator bucket. (Note: if using geogrids, live fascines, or wattles of native vegetation, they should be placed prior to, or in conjunction with, the fill material.) 12. Replace topsoil and pack it in with excavator bucket. 13. Place seed and the appropriate mulch/BMP on the repaired and stockpile areas. Hydroseeding may be used in lieu of seed and mulch. 14. Place and stake erosion control blanket from top of slope to the bottom of the channel. 15. Install appropriate BMP at the toe of the reshaped bank to protect it from erosive velocities. 16. Remove any accumulated sediment from behind the check dam and place sediment in vegetation on the right of way, as far from the drain as possible. 17. Remove downstream sediment control measure(s). 18. Hydroseeding may be used in lieu of ***seed*** and ***mulch.***
Maintenance	• Inspect routinely and following each significant precipitation event that results in runoff until stabilized then remove temporary control measures.
Limitations	• During hot, dry summer conditions and/or in sandy soil conditions where stabilization is difficult.

86. DRAIN CROSSING MAINTENANCE

When	• Flow is restricted due to sediment and debris accumulation in a culvert or bridge opening.
Why	• To maintain proper flow capacity.
Where	• Inside and adjacent to a culvert or bridge.
Scheduling	• During lower flow conditions. • When an emergency occurs as a result of blockage.
How	1. When sediments are removed by hand; or with an auger machine, pressurized water jet, or excavator, temporary sediment controls, such as a ***sediment sump, check dam****, or* ***polymer flocculent****,* shall be installed downstream within 100 feet of the structure outlet prior to cleanout. Remove sediment and downstream temporary control measures when cleanout is complete. 2. Use a vacuum truck.
Maintenance	• Monitor culvert or bridge to assure maintenance of flow capacity. • If sediment accumulation is a continued maintenance problem and erosion problems have been resolved, utilize an engineer to evaluate if the crossing should be replaced with an alternative design configuration. This may include placing the culvert or bridge at a different elevation, realigning the structure, or replacing the culvert, multiple culverts, or a bridge with an alternate design.
Limitations	• Cost. • Access. • Equipment availability.

87. ENCLOSED DRAIN MAINTENANCE

When	• When sink (blow) holes are observed above tile or a tile blockage is evident. • When tile has deteriorated and needs to be replaced or lined.
Why	• To maintain drainage.
Where	• In enclosed tile drainage systems.
Scheduling	• When the drain is dry or at a low flow if possible. • When an emergency blockage has occurred. • Immediately upon notification or discovery of a sink hole.
How	1. If flow is present, water diversion may be required and sediment must be controlled. 2. Excavate existing tile as necessary. If possible bulkhead downstream end of existing tile during repair. 3. Install tile, sealing joints when necessary, or follow manufacturer's recommendations for new pipe installation. 4. Backfill with appropriate material, compacting bedding to provide adequate support for tile. 5. When tile is in a road right-of-way compact in lifts adequate to prevent settling of the road surface. Contact MDOT or County Road Commission for guidance. 6. Check tile outlet to assure it is operating properly and is not blocked. 7. Stabilize disturbed areas. 8. Install downstream SESC measures prior to using an auger machine or water jet to remove sediment or a blockage from an enclosed drain.
Maintenance	• Inspect disturbed areas routinely and following each precipitation event that results in runoff until disturbed areas are stabilized. • Remove trapped sediment and temporary control measures after the area has stabilized.
Limitations	• Soil must be properly compacted to prevent road failure. • Equipment availability. • Flow conditions. • Cost.

SECTION 7

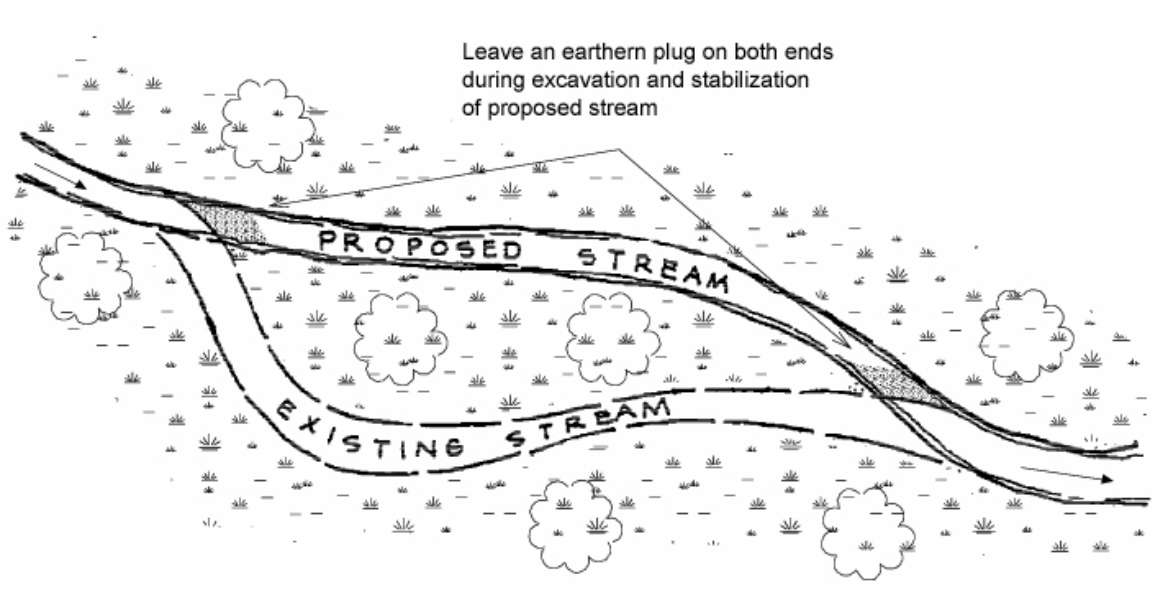
Construction & Restoration Activity Details

100. STORMWATER BASIN CONSTRUCTION

When	• Land development will permanently increase runoff volumes, discharge rates and flow velocities. • Existing runoff conditions cause stream channel degradation.
Why	• To provide additional storage for runoff volumes. • To reduce peak discharges to pre development conditions. • To prevent erosive velocities. • To improve water quality by removing sediments and other pollutants; especially when a forebay or sediment basin is constructed as part of the stormwater basin.
Where	• Within a drainage system where flow detention or retention is necessary. • In developments.
Scheduling	• Year around if adequate erosion and sediment controls are provided.
How	1. Obtain a temporary construction drain easement and a permanent drain easement for long term maintenance and spoils deposition. 2. An engineer shall be retained to design the stormwater basin and develop a long term maintenance plan.
Maintenance	• Inspect temporary erosion and sediment controls routinely; and following each precipitation event that results in runoff until permanent control measures are installed and disturbed areas are stabilized. • Remove temporary control measures after all areas are stabilized. • See *Stormwater Basin Maintenance*.
Limitations	• Cost. • May require land/drain easement acquisition.

101. DRAIN RELOCATION

When	• When petitioned to relocate a drain.
Why	• To prevent or control drain bank erosion. • When a drain has meandered outside of the drain easement and must be relocated to its original location. • To accommodate construction or improvement, including safety, of a roadway or other structural action.
Where	• In a new location with consideration for the topography and to minimize environmental disturbances.
Scheduling	• Year around, during lower flow periods.
How	1. Utilize a qualified engineer for the drain relocation design with consideration for the topography and to minimize environmental disturbances. 2. Construct in-stream ***sediment sumps, check dams***, and other required downstream sediment measures. 3. If excavated soils will be used to fill abandoned channel, stockpile soil near site in an upland area and stabilize stockpile with ***seed***, mulching if necessary, or cover with ***plastic sheets***. Otherwise, level soils within drain easement and stabilize. 4. Do not plug or fill in old channel until relocated channel has been stabilized. If plugging or filling old channel, stabilization at both ends may be appropriate. 5. Excavate new channel leaving earthen plugs at each end until entire relocated channel is graded and stabilized. 6. Remove earthen plugs, beginning with the downstream plug first. 7. Fill in abandoned channel, compacting as required. 8. Stabilize all disturbed areas.
Maintenance	• Inspect relocated channel routinely and following each precipitation event that results in runoff until stabilized. • Inspect routinely downstream ***sediment sump***s and catchbasins for sediment accumulation and clean when needed. When all areas are stabilized, remove temporary sediment controls. • After flow is diverted through the stabilized relocated channel, watch for bank erosion, formation of sediment islands, or channel down cutting near ends of relocation and make necessary repairs.
Limitations	• New or additional drain easement may be required. • May decrease stream gradient if longer flow path is required, perhaps resulting in increased sedimentation. • Conversely, may increase stream gradient if shorter flow path is proposed increasing flow velocity and potential channel down cutting.



Source: Michigan Department of Transportation

102. DRAIN ENCLOSURE

When	• Petitioned to tile, or enclose, an existing open drain, or extend or add a branch to an existing drain. • A road or driveway access is required.
Why	• To provide drainage benefits to a property. • Increased use of a property, usually when an open channel drain bisects property that is being developed or when there has been an encroachment. • To increase road safety. • To eliminate severe, chronic erosion problems.
Where	• An open drain bisects a yard or development. • Along a road. • An encroachment has occurred. • Drain flows through unstable soils or a seepage area. • Through chronic high erosion areas (i.e. sand hill).
Scheduling	• Year around, during low flow periods.
How	1. Utilize a qualified engineer for the drain enclosure design and installation specifications which include: tile size, design elevations, slope, and alignment; catchbasins; and materials, bedding, backfill, and compaction requirements. 2. Install downstream sediment measures. 3. Provide a stabilized inlet and outlet. 4. Prior to construction, install and maintain adequate temporary and permanent SESC measures upstream and downstream of the enclosure. 5. Install a temporary bypass channel or a temporary dam and a by pass pump, if necessary. 6. Stabilize all disturbed areas. 7. Remove temporary sediment control measures after all disturbed areas are stabilized.
Maintenance	• Clean catchbasin sumps as needed. • Clean tile if sediment accumulates over time.
Limitations	• Cost. • Subject to root intrusion and sediment blockage over time. • Enclosures may limit the drain capacity.

103. DRAIN CROSSINGS

When	• A new crossing is required under petition. • Bridge or culvert is not of sufficient capacity and is obstructing a drain. • Bridge or culvert has deteriorated or failed. • Bridge or culvert was previously improperly installed.
Why	• To provide a safe drain crossing. • To provide sufficient hydraulic capacity. • To correct improper grade, size, or alignment problems. • To replace a failing structure.
Where	• At locations requiring access to the other side of a drain. • At existing drain crossings.
Scheduling	• Year around, preferably during low flow periods. • Additional SESC measures are required during the winter.
How	1. Utilize an engineer to design an adequate crossing for the anticipated loads and flow conditions that will not cause harmful upstream flooding conditions. 2. Install downstream sediment control measures. 3. When stream flow cannot be interrupted install a ***temporary bypass channel*** or a temporary dam and pipe it around or over the crossing to provide a dry work area. Use an earthen plug upstream of crossing if stream flow is minimal and can be interrupted during crossing installation. 4. Install drain crossing per engineer's and manufacturer's specifications. 5. Construct non-erosive end treatments such as: headwalls; riprap; end sections or wing walls; ***seed*** and ***mulch***; or mulch blankets. 6. Restore disturbed areas and ***seed***, ***mulch*** if necessary. 7. If a temporary dam, dike, or earthen plug was used to block or divert flow during construction, remove constriction and stabilize disturbed areas. If a bypass channel or diversion ditch was used, restore and stabilize main channel before removing temporary by-pass channel or diversion ditch. 8. Remove temporary sediment control measures after all disturbed areas are stabilized.
Maintenance	• Inspect routinely and following each precipitation event that results in runoff, checking for downstream scour, erosion at culvert ends, and establishment of seeded and/or mulched areas until entire site is stabilized.
Limitations	• Minimum cover must be maintained over some crossing types. • Soil types and high stream flows.

104. BEAVER DAM REMOVAL

When	• Beaver dams can provide positive functions by serving as a sediment sump and reducing stream velocities and therefore should not always be removed. Under spill structures can be installed to provide passage of flow without causing erosive velocities, bottom scour, and drain bank erosion. • A beaver dam is discovered to be causing a problem. • Routinely in locations where beaver dams are a continual problem and bypass structures are not feasible.
Why	• To prevent flooding. • To prevent or remove a blockage that is causing a problem or safety hazard. • To prevent erosive velocities, bottom scour and drain bank erosion.
Where	• Beavers have constructed dams in county drains.
Scheduling	• As soon as the beavers have been removed from area. • Immediately during an emergency situation.
How	1. Obtain a Damage and Nuisance Animal Control Permit from the local Conservation Officer, Law Enforcement and Wildlife Division, Department of Natural Resources. Permits can be issued on an annual basis when routine beaver dam removal is required. 2. Request the services of a licensed trapper and require the trapper to notify affected landowners prior to removal of beavers from drain easements. 3. Install downstream sediment control measures. 4. Manual removal is preferred. Stage the removal by removing higher elevation debris first and allowing the water level to recede gradually to prevent downstream flooding and erosive velocities. Continue staging the removal until the entire beaver dam is removed. A hydro hose or other equipment may be needed when manual removal is impractical or unsafe. 5. Stabilize disturbed areas. 6. Remove temporary sediment control measures after all disturbed areas are stabilized.
Maintenance	• Inspect disturbed areas routinely and following each precipitation event that results in runoff until stabilized then remove temporary control measures.
Limitations	• Access. • Manual labor and equipment availability. • Safety concerns. • Staging removal to prevent downstream flooding and damage. • Safety of manual labor.

105. WEIR CONSTRUCTION

When	• To stabilize constructed or existing channels when flow is anticipated to exceed the erosive velocity. • To rapidly adjust the gradient of a channel.
Why	• To reduce water velocity minimizing erosion in the channel.
Where	• Within and across an existing or constructed channel.
Scheduling	• Year around, preferably during low flow conditions.
How	1. Configure structure to site specific conditions. 2. Utilize an engineer as necessary to design the structure to pass a 25-year, 24-hour storm and to withstand the hydraulic pressures on the structure components. 3. Install downstream sediment control measures. 4. Interlock weir and wing wall components. 5. Key wing wall and weir into adjacent channel banks and below channel bottom. 6. Dissipate energy with 4 to 18 inch angular riprap immediately below the weir. The angular riprap should be a mix of sizes large enough to dissipate energy and stay in place, with smaller riprap to fill voids. 7. Stabilize all disturbed areas. 8. Remove temporary sediment control measures after all disturbed areas are stabilized.
Maintenance	• Inspect for piping around and through the wing walls and weir wall. • Reposition riprap as necessary or replace with larger rock.
Limitations	• Weir structures with a height greater than 4 feet should not be used without extensive engineering analysis. • Undercutting of the structure below the weir can weaken the structure.

Concrete waste-block structure with weir and wing walls.

Sheet metal piling structure with weir and wing walls.

Source: Tom Doyle, Barry County Drain Commissioner

106. LOW FLOW CHANNEL

When	• When the original designed dimensions create capacity that exceeds the ability of a watershed to supply base flow in the channel at a desired depth that allows the drain to reach equilibrium. • When removing sediment from a drain. • During a drain restoration project.
Why	• To provide a meandering base flow channel and a bench for sediment deposition without reducing flow capacity. A meandering low flow channel is preferred because the flow velocities will be lower than a straight low flow channel. • To stabilize the drain reducing the required maintenance frequency.
Where	• Within the streambed of an open drain.
Scheduling	• During lower flow conditions when vegetation can be established.
How	1. Utilize an engineer who specializes in stream restoration for the required sediment controls and the floodway shelf design. Design considerations for a floodway shelf include geology, channel slope and sinuosity, contributing drainage area, flow velocity, discharge, sediment transport, sediment particle distribution, and channel geometry 2. Install downstream sediment control measures. 3. Dredge a narrow meandering low flow channel within the existing channel bottom leaving some of the accumulated sediments to serve as a ***floodway shelf***. 4. Seed shelf with a waterway seed mix. 5. Remove sediment controls after ***floodway shelf*** and low flow channel have stabilized.
Maintenance	• Inspect routinely and following significant precipitation events until ***floodway shelf*** and low flow channel are stable. • Inspect every other year and remove woody vegetation from the ***floodway shelf*** and banks to maintain flow capacity and drain bank stability.
Limitations	• Dredge operator must be knowledgeable of geomorphology and fluvial processes.

107. FLOODWAY SHELF

When	• When installing a ***low flow channel***. • When bankfull capacity of a drain is exceeded at a frequency that results in drain bank erosion.
Why	• To provide a place for sediment to drop out when flow returns to base flow. • To stabilize a ***low flow channel***. • To provide floodplain storage in flashy streams or drains.
Where	• Above the base flow elevation of a drain.
Scheduling	• During summer or early fall when flow is low.
How	1. Utilize an engineer and/or a qualified professional who specialists in stream restoration for the required sediment controls and the floodway shelf design. Design considerations for a floodway shelf include geology, channel slope and sinuosity, contributing drainage area, flow velocity, discharge, sediment transport, sediment particle distribution, and channel geometry 2. Install downstream sediment control measures. 3. Construct floodway shelf as designed by an engineer under the direction of the engineer's representative. 4. Stabilize all disturbed areas and seed shelf with a waterway seed mix. 5. Remove temporary sediment controls after shelf has stabilized.
Maintenance	• Inspect routinely and following each significant precipitation event until disturbed areas are stabilized.
Limitations	• May require redistribution of a large amount of soil within the drain easement.

108. RIFFLE ZONES

When	• During a drain maintenance or improvement project ***floodway shelves, low flow channels***, ***pools, riffle zones, J-hook vanes, cross-vanes,*** and ***meanders*** can be created as an alternative to maintaining a straight channel.
Why	• Adds oxygen and maintains a cooler water temperature providing improved water quality and habitat. • At normal flow, flow velocities increase atop riffle zones due to the increased bed slope between the riffle crest and the subsequent ***pool***. • Used as a grade control structure and to centralize flow.
Where	• Within the channel where the stream bottom is higher relative to streambed elevation immediately upstream or downstream.
Scheduling	• During summer or early fall when flow is low.
How	1. Utilize an engineer and/or qualified professional for the required sediment controls and the riffle zone design. Design consideration must include the range of anticipated discharges and flow velocities, angle of flow, and streambed and drain bank materials. 2. Prepare streambed and drain banks by removing all soil and debris to meet the grading requirements for placement of the stone to create the riffle. 3. Place stone as shown on engineering details. Usually placing stone face to face, using a stone diameter of 18-24 inches, and spaced 1.0 foot apart is required.
Maintenance	• Inspect routinely and following each significant precipitation event and adjust as needed until disturbed areas and riffle zones are stable.
Limitations	• Riffle zones must be designed by an engineer to fit the natural gradient and sinuosity of each individual watercourse.

Riffle Zone installation in Carrier Creek, Eaton County

Source: Wetland and Coastal Resources and the Eaton County Drain Commissioner, Brady Harrington

109. POOLS

When	• A drain has very shallow base flow and poor water quality that would be improved by the creation of a ***floodway shelves, low flow channels***, ***pools, riffle zones, J-hook vanes, cross-vanes,*** and ***meanders***
Why	• At normal flow, flow velocities decrease in pool areas, allowing fine grained deposition to occur, and increase atop riffle zones due to the increased bed slope between the riffle crest and the subsequent pool. • Maintains a cooler water temperature providing improved water quality and habitat.
Where	• Within the channel of a drain.
Scheduling	• During summer or early fall when flow is low.
How	1. Utilize an engineer and/or a qualified professional for the required sediment controls and the pool designs. Design consideration must include the range of anticipated discharges and flow velocities, angle of flow, and streambed and drain bank materials. 2. Excavate pool areas under the guidance of the engineer's representative as shown on the engineering plans. 3. Use suitable excavated materials for construction of meanders and as fill around point bars under the direction of the engineer's representative as called for on engineering plans or remove to an upland site and stabilize.
Maintenance	• Inspect routinely and following each significant precipitation event and adjust as needed until pools and meanders are stable.
Limitations	• Pools and meanders must be designed by an engineer to fit the natural gradient and sinuosity of each individual watercourse. • Construction must be overseen by an engineer's representative to assure construction is accomplished per engineering plans.

110. MEANDERS

When	• A drain has very shallow base flow and poor water quality that would be improved by the creation of a ***floodway shelves, low flow channels***, ***pools, riffle zones, J-hook vanes, cross-vanes,*** and ***meanders***
Why	• To restore the stream's sinuosity reducing the flow velocity necessary to help maintain channel stability. • To create a deeper, narrower base flow channel minimizing the need for routine sediment removal.
Where	• Within the channel of a drain.
Scheduling	• During summer or early fall when flow is low.
How	1. Utilize an engineer and/or a qualified professional who specializes in stream restoration for the required sediment controls and the meander design. Design consideration must include the range of anticipated discharges and flow velocities, angle of flow, and streambed and drain bank materials. 2. Prepare streambed and drain banks for installing gravel point bar as shown on the engineering plans under the direction of the engineer's representative. 3. If also installing pools, consult engineer's representative to determine if excavated pool material is suitable to construct meander and fill around point bar. If pool material is suitable for construction of meander, place spoil in identified fill section as show on engineering plans. If not, dispose of excavated pool material in an upland area or off site and stabilize. Consult engineer's representative with the identification of local native material to be used. Construct meander and fill around point bar using identified materials per engineering plans.
Maintenance	• Inspect routinely and following each significant precipitation event and adjust as needed until meanders are stabilized.
Limitations	• Meanders must be designed by an engineer to fit the natural gradient and sinuosity of each individual watercourse. • Construction must be overseen by an engineer's representative to assure construction is accomplished per engineering plans.

Carrier Creek prior to installation of meanders.

Meander installation in Carrier Creek, Eaton County.

Source: Wetland and Coastal Resources and the Eaton County Drain Commissioner, Brady Harrington

111. CROSS-VANES

When	• During a drain maintenance or improvement project ***floodway shelves, low flow channels***, ***pools, riffle zones, J-hook vanes, cross-vanes,*** and ***meanders*** can be created as an alternative to maintaining a straight channel.
Why	• Reduces near bank shear stress, centralizes flow, grade control and stabilizes eroding banks. • Adds oxygen and maintains a cooler water temperature providing improved water quality and habitat. • At normal flow, flow velocities increase atop cross-vanes and riffle zones due to the increased bed slope between the cross vane and riffle crest and the subsequent ***pool***.
Where	• Within the channel where the stream bottom is higher relative to streambed elevation immediately upstream or downstream.
Scheduling	• During summer or early fall when flow is low.
How	1. Utilize an engineer and/or a qualified professional who specializes in stream restoration for the required sediment controls and the cross vane design. Design consideration must include the range of anticipated discharges and flow velocities, angle of flow, and streambed and drain bank materials. 2. Prepare streambed and drain banks by removing all soil and debris to meet the grading requirements for placement of cross vane. 3. Place stone as shown on engineering details.
Maintenance	• Inspect routinely and following each significant precipitation event and adjust as needed until disturbed areas and cross vane are stable.
Limitations	• Cross-vanes must be designed by an engineer to fit the natural gradient and sinuosity of each individual watercourse.

Cross-Vane in Carrier Creek, Eaton County

Source: Wetland and Coastal Resources and the Eaton County Drain Commissioner, Brady Harrington

112. J-HOOK VANES

When	• During a drain maintenance or improvement project ***floodway shelves, low flow channels***, ***pools, riffle zones, J-hook vanes, cross-vanes,*** and ***meanders*** can be created as an alternative to maintaining a straight channel.
Why	• Reduces near bank shear stress, centralizes flow, grade control and stabilizes eroding banks on the outer bend of meanders. • Adds oxygen and maintains a cooler water temperature providing improved water quality and habitat. • At normal flow, flow velocities increase atop cross-vanes and riffle zones due to the increased bed slope between the J-hook vanes and riffle crest and the subsequent ***pool***.
Where	• Within the channel where the stream bottom is higher relative to streambed elevation immediately upstream or downstream.
Scheduling	• During summer or early fall when flow is low.
How	1. Utilize an engineer and/or qualified professional who specializes in stream restoration for the required sediment controls and the J-hook vanes design. Design consideration must include the range of anticipated discharges and flow velocities, angle of flow, and streambed and drain bank materials. 2. Prepare streambed and drain banks by removing all soil and debris to meet the grading requirements for placement of J-hook vanes. 3. Place stone as shown on the engineering details.
Maintenance	• Inspect routinely and following each significant precipitation event and adjust as needed until disturbed areas and J-hook vanes are stabilized.
Limitations	• J-hook vanes must be designed by an engineer to fit the natural gradient and sinuosity of each individual watercourse.

J-hook-Vane in Carrier Creek, Eaton County

Source: Wetland and Coastal Resources and the Eaton County Drain Commissioner, Brady Harrington

SECTION 8

Part 91 and Administrative Rules

Please go the following websites to print the most current version of Part 91 and the Administrative Rules:

PART 91, Soil Erosion and Sedimentation Control, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended

For a printer friendly version of the statute all in one document, go to the following link and click on the printer icon on the upper right hand corner of the screen. A new window will appear—click on the "PDF Version" icon.

www.legislature.mi.gov/(5cwjy0u0cpxld2u0prdn5pvy)/mileg.aspx?page=GetMCLDocument&objectname=mcl-451-1994-II-2-Soil-Conservation-Erosion-and-sedimentation-Control-91

ADMINISTRATIVE RULES

http://www.state.mi.us/orr/emi/admincode.asp?AdminCode=Single&Admin_Num=32301701

For additional information visit the DEQ Soil Erosion and Sedimentation Control Program Website at:

http://www.mi.gov/deq/0,1607,7-135-3311_4113---,00.html

SECTION 9

Glossary

GLOSSARY

Accelerated soil erosion means the increased loss of the land surface that occurs as a result of human activities.

Agricultural Practices means all land farming operations except plowing or tilling of land for the purpose of crop production or the harvesting of crops.

APA is an acronym for Authorized Public Agency

Authorized Public Agency (APA) means a state agency or an agency of a local unit of government authorized by the MDEQ under Section 9110 of Part 91 to implement soil erosion and sedimentation control procedures with regard to earth changes undertaken by it.

Backwater means the increased depth of water upstream of a restriction or obstruction, such as a dam, bridge or culvert.

Base Flow means the portion of stream flow that is not due to runoff from precipitation, usually supported by water seepage from natural storage areas such as groundwater, a waterbody or wetlands.

Bulkhead means a plug installed in a sewer pipe constructed of concrete, brick, or masonry to block to prevent flow into or out of a conveyance system.

Certified Storm Water Operator means a person who has a valid Storm Water Operator for Construction Sites Certification from the MDEQ.

Conservation District (CD) means a conservation district authorized under Part 93, Soil Conservation Districts, of the Natural Resources and Environmental Protection Act, 1994 PA 451, being 324.9301 *et seq.* of the Michigan Compiled Laws.

County Enforcing Agency (CEA) means the county agency, designated by the County Board of Commissioners under Section 9105 of Part 91 that is responsible for administration and enforcement of Part 91 and the Rules.

Discharge means the volume of water passing a point in a given time and is often expressed as cubic feet per second.

Earth Change means a human-made change in the natural cover or topography of land, including cut and fill activities, which may result in or contribute to soil erosion or sedimentation of the Waters of the State. Earth change does not include the practice of plowing and tilling soil for the purpose of crop production. Earth change does include digging in the ditch, grubbing, leveling spoils, stump removal, deposition of spoils, laying back slopes, culvert replacement, placement of riprap, armoring a drain bank.

Earth Change Permit or **Permit** means an earth change permit issued by a County Enforcing Agency or a Municipal Enforcing Agency authorizing work to be performed under the provisions of Part 91, the Rules, or a local SESC ordinance.

Engineer means a person, firm or corporation providing professional engineering design expertise to the County Drain Commissioner.

Forebay means a small, separate storage area near the inlet to a stormwater or sediment basin, used to trap and settle incoming sediments before they enter the basin.

Geotextile fabric means non-woven geotextile filter fabric.

Grading means any leveling, stripping, excavating, filling, stockpiling or any combination thereof and shall include the land in its excavated or filled condition.

Grubbing means the removal of tree stumps and roots from below ground.

Harmful Interference means causing an unnaturally high stage or unnatural direction of flow on a river or stream that causes, or may cause, damage to property, a threat to life, a threat of personal injury, or a threat to water resources.

Lake means the Great Lakes and all natural and artificial inland lakes or impounds that have definite banks, a bed, visible evidence of continued occurrence of water, and a surface area of water that is equal to, or greater than 1 acre. Lake does not include sediment basins and basins constructed for the sole purpose of storm water retention, cooling water, or treating polluted water.

Landowner means the person who owns or holds a recorded easement on the property or who is engaged in construction in a public right-of-way in accordance with sections 13, 14, 15, and 16 of Highway Obstructions and Encroachments; use of Highway by Public Utilities, 1925 PA 368, as amended, being 247.183, 247.184, 247.185, and 247.186 of the Michigan Compiled Laws.

Live stake means a stake made from acceptable species; live, rootable, vegetative cuttings inserted into the ground.

MDEQ is an acronym for the Michigan Department of Environmental Quality.

Timber means trees having a stump diameter of 6 inches or more.

Municipal Enforcing Agency (MEA) means an agency designated by a municipality under Section 9106 of Part 91 to enforce a Local Ordinance that has been approved by the MDEQ.

Municipality means any of the following:

a. A city.
b. A village.
c. A charter township.
d. A general law township that is located in a county with a population of 200,000 or more.

Non-erosive velocity means a speed of water movement that is not conducive to the development of accelerated soil erosion.

NPDES is an acronym for the National Pollutant Discharge Elimination System.

Ordinary High-Water Mark means the line between upland and bottomland that persists through successive changes in water levels, below which the presence and action of the water is so common or recurrent that the character of the land is marked distinctly from the upland and is apparent in the soil itself, the configuration of the surface of the soil, and the vegetation. On an inland lake that has a level established by law, it means the established high (summer) level. Where water returns to its natural level as the result of the permanent removal or abandonment of a dam, it means the natural ordinary high-water mark.

Part 91 means Part 91, Soil Erosion and Sedimentation Control, of the Michigan Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, being 324.9101 *et seq.* of the Michigan Compiled Laws.

Permanent Soil Erosion and Sedimentation Control Measures means those control measures, which are installed or constructed to control soil erosion and sedimentation and which are maintained after project completion.

Piping is when seepage is transporting soil.

Plunge pool means a deep pool into which water falls that is provided for energy dissipation.

Point bars means ridges of deposited material located in the streambed.

Rules means the rules promulgated pursuant to the Administrative Procedures Act of 1969, 1969 PA 306, being 24.201 to 24.328 of the Michigan Compiled Laws for the administration of Part 91.

Runoff means the excess portion of precipitation that does not infiltrate into the ground, but runs off and reaches a stream, waterbody, or storm sewer.

Sediment means solid particulate matter, including both mineral and organic matter that is in suspension in water, is being transported, or has been removed from its site of origin by the actions of wind, water, or gravity and has been deposited elsewhere.

Sediment Basin means a naturally occurring or constructed depression used for the sole purpose of capturing sediment during and after an earth change activity.

Sheet Flow means runoff which flows over the ground surface as a thin, even layer, and not concentrated in a channel.

Site means the location at which the work is to be performed.

Soft armor means installation of a vegetated erosion protection by such methods as live staking or brush blankets.

Soil Erosion means the wearing away of land by the action of wind, water, or gravity; or a combination of wind, water, or gravity.

Stabilization means the establishment of vegetation or the proper placement, grading, or covering of soil to ensure its resistance to soil erosion, sliding, or other earth movement.

State Agency means a principal state department or a state public university.

Stilling Basin means a short length of paved channel generally placed at the foot of a spillway to dissipate energy before the flow reaches the exposed and unpaved riverbed downstream.

Storm Water Retention Basin means an area which is constructed to capture surface water runoff and which does not discharge directly to a lake or stream through an outlet. Water leaves the basin by infiltration and evaporation.

Stream as defined by Part 301, Inland Lakes and Streams of the NREPA, means a natural or artificial river, stream, or creek which may or may not be serving as a drain as defined by the drain code of 1956, 1956 PA 40, that has definite banks, a bed, and visible evidence of a continued flow or continued occurrence of water (intermittent flow), including the St. Marys, St. Clair, and Detroit Rivers.

Stream as defined by Part 91, Soil Erosion and Sedimentation Control, of the NREPA, means a river, creek, or other surface watercourse which may or may not be serving as a drain as defined in The Drain Code of 1956, 1956 PA 40, as amended, being 280.1 *et seq*. of the Michigan Compiled Laws, and which has definite banks, a bed, and visible evidence of the continued flow or continued occurrence of water, including the connecting waters of the Great Lakes.

Swale means a natural depression or wide shallow ditch used to temporarily or permanently convey, store, or filter runoff.

Tailwater means the depth or elevation of water at the downstream end of a structure, such as a bridge, culvert or dam.

Temporary Soil Erosion and Sedimentation Control Measures means interim control measures which are installed or constructed to control soil erosion and sedimentation and which are not maintained after project completion.

Violation of Part 91 or **Violates Part 91** means a violation of Part 91, or the Rules.

Waters of the State means the Great Lakes and their connecting waters, inland lakes and streams, as defined in the Rules, and wetlands regulated under Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, being 324.30301 *et seq.* of the Michigan Compiled Laws.

Weather Resistant Stone means stone that will not absorb water that would freeze and then crack the stone.

Weir means a structure that extends across the width of a channel, and is used to impound, measure, or in some way alter the channel flow. Weirs are often constructed of concrete or sheet piling.