Section 4
Erosion and Sediment Control Design Process

4.1 Overview of Erosion and Sediment Control Design

Erosion and sediment control has come to the forefront of roadway design and construction. Section 4 illustrates the design process to be used for erosion and sediment control plan sheets and the creation of the NOI package, including a SWPPP, in accordance with State and Federal regulations.

The first portion of section 4 describes the design activities associated with erosion and sediment control and how each of these activities are incorporated into the overall project design process. Following the description of the design activities, erosion and sediment control tools are listed to aid in the selection of BMPs.

4.2 Erosion and Sediment Control Design Activities

The MDT Project Management System (PMS) is used by the MDT to schedule, monitor, and coordinate project development and project pre-construction manpower needs. New erosion and sediment control activities have been developed to be incorporated into PMS and are listed below.

4.2.1 Preliminary Field Review (Activity 200)

In the preliminary field review activity (Activity 200) in PMS, the Erosion and Sediment Control personnel should be included in all preliminary field reviews in order to assess project's impact to receiving waters and to begin the data gathering required in the NOI package.

4.2.2 Preliminary Erosion and Sediment Control Design (New Activity)

Definition

Prepare preliminary erosion and sediment control design. The preliminary design should include the following items:

- Vicinity map,
- Delineation of potential erosion and sedimentation areas,
- Preliminary soils investigation,
- Review drainage information,
- Generate erosion and sediment control schedule,
- Identification of existing control practices, and

- Prepare preliminary NOI package, which includes a NOI form, and a SWPPP.

Output Provided

Preliminary erosion and sediment control design report summarizing the tasks listed below.

Tasks

Develop a preliminary erosion and sediment control design report for all projects where the existing conditions are disturbed. The preliminary erosion and sediment control design report should include as a minimum the following:

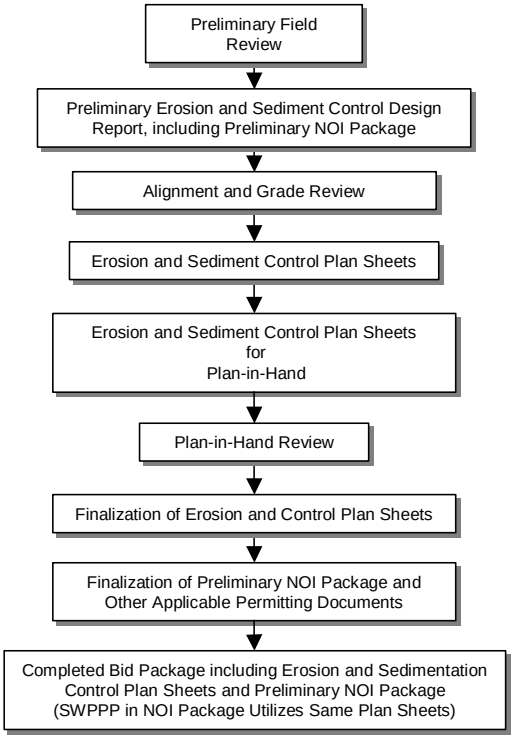
- An 8½" x 11" color copy or larger vicinity map of the project area using a USGS map or equivalent. The map shall extend approximately 0.4 km (1/2 mile) beyond the property boundaries of the construction site. Included in the vicinity map shall be the following:
  - Outline of site perimeter,
  - Clear identification of major roadways,
  - Geographic features or landmarks,
  - Water bodies within, adjacent or downstream of the construction limits,
  - Disturbance area within construction site,
  - Known wells,
  - Outline of the offsite drainage areas that discharge into the construction site,
  - Identification of anticipated construction site storm water discharge locations to a municipal storm sewer system or other water bodies,
  - Other geographic features surrounding the site, and
  - General topography.
- Delineation of potential erosion and sedimentation areas, listing all construction materials that may be used during construction activities that may have the potential to contribute to the discharge of pollutants into storm water. In addition, a list of all construction activities that may have the potential to contribute to erosion and sedimentation.
- Request for geotechnical information including a preliminary soil characterization and soil inventory. Within the characterization area, the conditions of the fill material and the soils at the construction site shall be described. Additionally, show and/or describe existing features that, as a result of known past usage, may contribute to pollution of storm water. Also, list known contaminants based on a review of the contract documents and associated environmental documents.
- Identification of existing permanent control measures. Existing permanent control measures may include any measures used to reduce erosion, sediment, or other pollutants into storm

water discharges. Existing permanent control measures may include, but not be limited to; detention basins, infiltration basins, sediment basins, oil water separators, bridge slope protections, rock slope protection, existing erosion control, existing landscaping, lined ditches, energy dissipaters, etc.

- Preliminary NOI package including NOI form and SWPPP as described in Section 4.5 – NOI Package Tools, of this manual. Incorporate all known information into the preliminary SWPPP.

Start Dependencies

Preliminary Field Review.



Distribution and Use

Distribute preliminary erosion and sediment control design report to Environmental Services Bureau, Road Design Section, Bridge Bureau, and Construction Bureau.

4.2.3 Alignment and Grade Review (Activity 216)

Incorporate the preliminary erosion and sediment control design into the alignment and grade review.

4.2.4 Erosion and Sediment Control Plan Sheets for Plan-in-Hand (New Activity)

Definition

Following the alignment and grade review, the Erosion and Sediment Control Section will prepare erosion and sediment control plan sheets for plan-in-hand review by incorporating the following tasks.

Output Provided

Complete erosion and sediment control package for plan-in-hand review, including preliminary erosion and sediment control plan sheets and preliminary NOI package.

Tasks

The Erosion and Sediment Control Section is responsible for the following tasks:

Revise and develop an erosion and sediment control package for the plan-in-hand review for all projects that will disturb existing conditions. The preliminary erosion and sediment control package should include the preliminary erosion and control plans and preliminary NOI package. For the preliminary erosion and sediment control package, as a minimum, the following task should be completed:

- Use Section 3.0 “Best Management Practices” and Section 4.4 - Erosion and Sediment Control Design Tools of this manual to select the BMPs that best apply to the reduction of erosion and sedimentation of the previously identified sources.
- Integrate geotechnical information into the preliminary erosion and sediment control plan sheets.
- Identify existing storm water control measures.
- Revise preliminary erosion and sediment control design to incorporate all modifications since alignment and grade and integrate the revisions into the erosion and sediment control plan sheets.
- Revise preliminary NOI package, including the SWPPP following Section 4.5 - NOI Package Tools of this manual. Incorporate new information since submittal of preliminary NOI package.
- Prepare any additional applicable storm water permitting documents.
- Prepare a preliminary erosion and sediment control schedule to be used during the project construction. Assumed excavation boundaries to select preliminary BMP and placement. Outline BMPs in chronological order: preconstruction, construction, and post-construction.

Start Dependencies

Alignment and grade approval.

Distribution and Use

Distribute one set of erosion and sediment control plan sheets to all Preconstruction Sections prior to plan-in-hand review. Provide Environmental Services Bureau one copy of the preliminary NOI package including the preliminary SWPPP and one copy of any other applicable preliminary storm water permitting documents.

4.2.5 Plan-in-Hand Review (Activity 220)

Incorporate erosion and sediment control plan sheets into the plan-in-hand review process. Review all erosion and sediment control plan sheets, preliminary NOI package, and any other applicable storm water permitting documents.

4.2.6 Finalize Erosion and Sediment Control Plan Sheets (New Activity)

Definition

Following plan-in-hand, revise, and finalize the erosion and sediment control plan sheets.

Output Provided

Finalized erosion and sediment control plan sheets.

Tasks

The Erosion and Sediment Control Section is responsible for the following task:

- Finalize all erosion and sediment control plan sheets to incorporate any changes based on the plan-in-hand review.

Start Dependencies

Finalization of plan-in-hand report.

Distribution and Use

Distribute one copy of erosion and sediment control plan sheets to all Preconstruction sections.

4.2.7 Finalize Preliminary NOI Package and Other Applicable Permitting Documents (New Activity)

Definition

Following plan-in-hand, revise NOI package and any other applicable permitting document.

Output Provided

Finalized NOI package including NOI form and SWPPP and any other applicable permitting documents.

Tasks

The Erosion and Sediment Control Section is responsible for the following task:

- Finalize the preliminary NOI package including the NOI form and the SWPPP, and any other applicable permitting documents to incorporate any changes based upon the plan-in hand review.

Start Dependencies

Finalization of plan-in-hand report, preliminary NOI package, and any other applicable permitting documents.

Distribution and Use

Distribute one copy of the finalized NOI package and the any other permitting documents to the Environmental Services Bureau.

4.3 Erosion and Sediment Control Reference Literature

This section provides information and references that the erosion and sediment control designer can use to create erosion and sediment control plan sheets, NOI packages, and any other applicable storm water permitting documents. The reference literature listed below can be used to assist the designer in the erosion and sediment control design process. Sections 4.3.1 through 4.3.5 provide an overview of some of the available references. These references are subject to change; therefore, the designer should review updated versions prior to beginning the design process.

4.3.1 MDT Hydraulics Manual

The MDT Hydraulics Manual is a modified version of the AASHTO Drainage Manual. This manual contains guidelines for hydrology, culverts, bridges, and storm drain systems. Within this reference there are several example problems for each section including rainfall intensity tables, design requirements, and rainfall curves. This reference should be used whenever the designer is evaluating rainfall intensities and their effects on flow throughout Montana.

4.3.2 MDT Road Design Manual

The MDT Road Design Manual is an integral part of the MDT road design process. This manual should be referenced to determine adequate cut and fill slopes for different geometric design variables. In addition, this manual contains information on basic design controls, horizontal alignments, vertical alignments, cross section, at-grade intersections, roadway safety, temporary traffic control, drainage/irrigation, and special design elements.

4.3.3 MDT Detail Drawings

The MDT Detail Drawings includes English and metric versions of detail drawings of construction designs. These drawings should be referenced to ensure that all designs meet the Departments standards. The Detail Drawings coincide with the MDT Standard Specifications for Roads and Bridges. The Detail Drawings provide the designer with dimensions and materials to be used for a multitude of different designs and procedures.

4.3.4 MDT Standard Specifications for Roads and Bridges

The MDT Standard Specifications for Roads and Bridges is a compilation of construction standards used on MDT projects. The Standard Specifications should be referenced to ensure that BMPs are specified correctly and that they are integrated into the design following the correct guidelines. Special provisions may need to be written to address specific applications if the standard specifications do not outline the desired approach.

4.3.5 Federal Regulations

The specific requirements for storm water controls on construction activities will be defined by the NPDES permitting authority. For construction sites not located on Tribal lands the NPDES authority is the DEQ. For construction sites located on Tribal land, the permitting authority is the EPA. In the state of Montana, a MPDES permit will be required. For construction sites located on Tribal lands, an NPDES permit will be required. Application processes in both cases are similar. Section 4.5 included contract information and ways to access a blank form.

4.3.5.1 MPDES Storm Water Discharge General Permit

The basic principle of the General Permit under NPDES/MPDES is to identify areas or activities that may contribute pollutants to surface waters and to consider practical methods to reduce such pollutants from entering the surface water discharges. A General Permit must be obtained from regulatory authority if storm water associated with construction activity will discharge to surface water.

4.3.5.2 Notice of Intent Package

If a construction activity requires a General Permit, a NOI package including a NOI form and a SWPPP must be completed and submitted to DEQ or EPA (for Tribal lands). To be compliant with the regulations, a complete NOI package must be received and approved by the regulatory agency prior to construction. If the NOI package has not been completed or is considered not complete by the regulatory agency, storm water discharge associated with construction activity will not be in compliance with the law. Refer to Section 4.5 for NOI packages for the DEQ and EPA.

4.3.6 Soil Survey Information

Each county throughout Montana has a published survey of soils classifications. The county soil classification survey contains a large amount of information that is useful in any land planning program. Of prime importance are the predictions of soil behavior for selected land uses. Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may also be shallow to bedrock. With this information, the designer will be able to select the BMP for the appropriate soil type.

The MDT Hydraulics Manual lists soils surveys that have been completed by the U.S Department of Agriculture, National Resource Conservation Service. The list of surveys can be found in Appendix C of Section 7 of the MDT Hydraulics Manual.

Soil surveys are being completed and published on a continuing schedule. For information on areas not listed and for ordering or obtaining information on reference copies, contact:

State Conservationist
Federal Building, Room 443
10 East Babcock Street
Bozeman, MT 59715-4704

Phone: 406-587-6813
FAX: 406-587-6761

4.3.7 Erosion and Sediment Control Cost Estimating

Erosion and sediment control BMP cost estimates can be found in MDT's Erosion and Sediment Control BMP Unit Cost Rate Schedule. This schedule will be updated periodically as the unit costs are refined and to account for inflation. An example BMP Unit Cost Rate Schedule is provided in Appendix A.

4.3.8 Erosion and Sediment Control CADD Standards

In an attempt to standardize plan preparation, MDT has created CADD Standards that are followed on all design projects. The following erosion and sediment control CADD standards will be incorporated into the MDT CADD Standards Manual.

4.3.8.1 File Naming

Reserved

4.3.8.2 Levels

Reserved

4.3.8.3 Reference Files

Reserved

4.3.8.4 Symbols

Reserved

4.3.8.5 Cells

Reserved

4.3.8.6 Custom Line Styles

Reserved

4.3.8.7 Macros

Reserved

4.4 Erosion and Sediment Control Design Tools

The following are design tools that should be used when creating erosion and sediment control plan sheets. The tools consist of BMP selection guidelines and rules of thumb.

4.4.1 BMP Selection Guidelines

As previously described, BMPs are tools used to reduce the amount of erosion and subsequent sediment discharge from construction sites. To most effectively prevent the erosion and sedimentation processes, the designer should first identify if erosion is likely to occur, the areas of potential erosion, and the type of erosion and sedimentation that could occur on the construction site. Once these items are identified, the designer should select the best BMP for the conditions. As an example, mulching reduces the detachment of soil particles from raindrop impact. Therefore, mulching would be used in disturbed bare areas where rainfall

could cause significant erosion. Mulching should not be used to reduce erosion in a channel or ditch where the primary erosion mechanism is the concentrated flow of water.

Assess if Erosion is Likely to Occur at the Site

The main mechanisms of erosion are water and wind. In order for the designer to determine if erosion will occur on a particular site due to water, the designer can correlate the soil type with the erodibility potential for different slopes or use the Revised Universal Soil Loss Equation (RUSLE) to calculate the average annual soil loss. To determine if a site has the potential for wind erosion, the designer can use the wind erodibility equation listed in this section.

Erosion by Water

Several states highway departments, like Alaska, developed charts to easily determine the level of erodibility of construction sites. The table below illustrates the relationship between the erodibility of the different soil types and the slope dimensions (Alaska Highway Drainage Manual, 2001).

CLASSIFICATION		ERODIBILITY				
GEOLOGICAL DESCRIPTION	USCS CLASSIFICATION (ASTM D-2487)	GENERAL	SLOPE ANGLE < 45 degrees (1:1 slope)	SLOPE ANGLE > 45 degrees (1:1 slope)	SLOPE LENGTH < 30 feet	SLOPE LENGTH > 30 feet
ALLUVIAL						
High Energy	GW, GP,GM	Low	Low-Med	Med	Low-Med	Med
Low Energy		Med-High	Med-High	High	Med-High	High
COLLUVIAL	Various	Low-High	Low-High	Low-High	Low-High	Low-High
EOLIAN						
Dune Sand	SP	High	High	Very High	High	Very High
Loess	ML, SM	High- Very High	High- Very High	Very High	High-Very High	Very High
GLACIAL						
Till	GM, SM ,ML	Low-Med	Low-Med	Low-Med	Low-Med	Med
Outwash	GW, GP, GM, SW, SP,SM	Low-Med	Low-Med	Med	Low-Med	Med
Glaciolacustrine	ML, SM, SP	Med-High	Med	High	Med	High
LACUSTRIAN	ML, SM, MH, OL, CL, CH, OH, PT	High	High	High-Very High	High	High-Very High

Another method to predict the level of erodibility is to use the RUSLE. RUSLE provides numerical empirical estimates of the average annual soil loss. RUSLE calculates the soil loss from slopes due to raindrops and overland flow (interrill erosion), or rill erosion. The RUSLE does not describe other types of erosion, like gully or stream bank erosion.

The RUSLE is defined as:

$$A=RKLSCP$$

Where:

A - Average annual soil loss.

R - Rainfall-runoff erosivity factor – Rainfall intensity and duration, and snow accumulation and melting are directly related to erosion. As intensity of rainfall increases, erosion increases. As duration increases (assuming the same intensity), erosion increases.

K - Soil erodibility factor – This is the propensity for soil particles to become detached by actions of water or wind. Silty soils are typically the most erodable soils.

L, S - Slope factors – The length of the flow path and the slope angle have a direct effect on erosion.

Length (L): Top of slope to closest waterway, diversion, or design point.

Slope (S): The ratio of the horizontal to vertical distance of travel.

C - Cover-management factor – The rate of erosion is directly proportional to the amount of permanent or temporary cover over the soil surface. Cover can reduce rainfall impact, reduce surface water velocities, enhance infiltration, trap sediment, and promote permanent vegetation establishment. Cover can have the most significant impact on the amount of erosion.

P - Support practice factor – Conservation practices are our man made attempts to reduce erosion when soils have been disturbed by construction or other practices.

The numerical values for these factors can be found in Agriculture Handbook Number 703 of the United States Department of Agriculture- Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE) or by contacting Publishing Editor Joe Galetovic for a copy of the complete guidelines and the public domain RUSLE software:

Joe R. Galetovic, Technical Coordinator
The Office of Technology Transfer
Western Region Coordination Center
Office of Surface Mining
1999 Broadway, Suite 3320
Denver, CO 80202-5733

Voice: (303) 844-1448
Fax: (303) 844-1546
E-mail: jgaletov@osmre.gov

The designer should also consider if the potential for other types of erosion exist. Rill or gully erosion is mainly caused by factors like flow concentrations on bare soils like swales, slope breaks, and steep slopes. Channel erosion is usually caused by disturbances at or adjacent to stream banks, while snowmelt erosion can be caused by snow that accumulated on disturbed areas and as it melts detaches and transports sediments.

Erosion by Wind

Wind erosion is a function of soil cohesiveness, particle density, and regional wind speeds. The wind erosion increases as soil cohesiveness lessens, the smaller the particle size and the higher the wind speeds. Also, soils low in clay, but high in sand content tend to detach easier and be transported longer distances. The amount of erosion associated with wind can be calculated by the potential wind erodibility equation which is expressed by:

$$E = f(I, K, C, L, V)$$

Where:

E - Total erosion loss.
F - Indicates function of the variables in the parenthesis.
I - Soil erodibility index that is based on the texture and aggregation of the particles.
K - Surface roughness.
C - Climate factor dependant on the windspeed and effective soil moisture.
L - Effect of field length.
V - Equivalent quantity of vegetation cover.

The numerical values can be found in several text books including Soils – An Introduction to Soils and Plant Growth (Donahue, 1985).

Based on the calculations and charts, the designer can determine if significant amounts of sediments will be transported off site, or if the amount of soil detachment are negligible.

Identify the Areas of Potential Erosion and the Type of Erosion and/or Sedimentation that Could Occur at the Identified Areas on the Construction Site.

From the topographic maps, field observation, and the Erosion and Sediment Control Design reports, the designer should determine which areas could potentially be impacted by erosion. Based on the erosion type descriptions in Section 2.1.1, the designer can determine which types of erosion could potentially be present at the construction site.

Select Appropriate BMPs for the Construction Site

BMPs should be implemented when construction activities disturb native soils exposing bare surfaces receptive to water and wind erosion. The BMPs should be installed as close as possible to the original source of sediments. Refer back to Section 3 of this manual to help identify all the BMPs appropriate for the reduction of erosion and sedimentation. The EPA stresses the use of a management system approach, which utilized a combination of BMPs at each construction site to maximize the overall effectiveness of the BMPs.

The presence of vegetation prevents soils from being eroded by creating a natural cover and holding soils together. If possible, vegetation should not be disturbed during construction activities or only remove when construction activities begin at a particular area of the site. Designers should consider phasing the activities and only removing vegetation when necessary avoiding bare soils during long periods of time. The use of designated haul routes, temporary fencing and other measures that minimize the disturbance of natural vegetation should also be considered when planning construction activities.

Table 4.4.1-1 summarizes BMPs and their best application to reduce and control specific erosion processes. Note that some measures are designed to prevent erosion while other are designed to repair damage occurred due to erosion. For example, silt fences are installed to reduce velocities and protect the soils against channel erosion, as well as to collect sediment

before they discharge into surface waters. Silt fences are not designed to reduce erosion occurring upgradient the silt fence but to prevent sediments from migrating offsite.

Table 4.4.1-1 BMP Selection Guidelines

ID	BMP Name	Primary Purpose	Erosion Processes
SS-1	Scheduling	Sequencing of BMPs	All
SS-2	Preservation of Existing Vegetation	Protection of desirable vegetation by limiting soil detachment	All
SS-3	Hydraulic Mulch	Protection of disturbed soil with mulch by limiting soil detachment	Splash, Sheet, Rill/Gully, Wind, and Snow Melt.
SS-4	Temporary Seeding	Provide soil protection through new plant growth	All
SS-5	Soil Binders	Soil stabilization to prevent wind and water induced erosion	Splash, Sheet, Wind, and Snow Melt.
SS-6	Straw Mulch	Protect disturbed soil with straw mulch by limiting soil detachment	Splash, sheet, Rill/Gully, Wind, and Snow Melt.
SS-7	Geotextiles, Plastic Covers, & Erosion Control Blankets/Mats	Protect disturbed soil or slopes	All
SS-8	Wood Mulching	Protect disturbed soil with wood mulch	Splash, Sheet, Rill/Gully, Wind, and Snow Melt.
SS-9	Earth Dikes/Drainage Swales & Lined Ditches	Intercept, divert, and convey surface run-on	Stream Bank, Sheet, Rill/Gully, and Snow Melt.
SS-10	Outlet Protection/Velocity Dissipation Devices	Prevent scour of exiting storm water flows	Stream Bank, Snow Melt, and Shoreline.
SS-11	Slope Drains	Route overland flow into a pipe to protect slope	Rill/Gully, Sheet, and Snow Melt.
SS-12	Slope Roughening	Reduce runoff velocity, increase infiltration, trap sediments, and create microenvironment for seeding	Rill/Gully, Sheet, Splash, Wind, and Snow Melt.
SS-13	Terraced Slope	Reduce velocity and allow upland deposition	Rill/Gully, Sheet, Wind, and Snow Melt.
SS-14	Vegetated Buffer	Prevent soil erosion and catch sediment	Stream Bank, Sheet, Wind, Snow, and Shoreline.
SS-15	Erosion Seeding	Erosion control on steep slopes	All
SC-1	Silt Fence	Slow and filter runoff to retain sediment	Stream Bank, Wind, Snow, and Shoreline.
SC-2	Desilting Basin	Large pond with controlled outflow which allows sediment to settle out of runoff	Stream Bank and Snow Melt.
SC-3	Sediment Trap	Reducing sediment before it enters live water bodies	Stream Bank and Snow Melt.
SC-4	Check Dam	Provides minor detention and retention of sediment for small swales and concentrated flows	Stream Bank and Snow Melt.
SC-5	Fiber Rolls	Intercept runoff and remove sediment	Rill/Gully, Sheet, Stream Bank, and Snow Melt.

ID	BMP Name	Primary Purpose	Erosion Processes
SC-6	Gravel Bag Berm	Intercept runoff and remove sediment	Rill/Gully, Sheet, Stream Bank, Shoreline and Snow Melt.
SC-7	Street Sweeping and Vacuuming	Prevent sediment from entering waterway	Stream Bank and Wind.
SC-8	Sandbag Barrier	Intercept runoff and remove sediment	Rill/Gully, Sheet, Stream Bank, Shoreline and Snow Melt.
SC-9	Straw Bale Barrier	Intercept runoff and remove sediment	Rill/Gully, Sheet, Stream Bank, Shoreline and Snow Melt.
SC-10	Storm Drain Inlet Protection	Intercept sediment at curb and field inlets. Should be used in conjunction with other on-site techniques.	Stream Bank and Snow Melt.
SC-11	Dugout Ditch Basin	Provides minor detention and retention of sediment for small swales and concentrated flows	Stream Bank and Snow Melt.
WE-1	Wind Erosion Controls	Prevent or alleviate dust nuisance	Wind
SN-1	* Snow Management	Reduce the volume of runoff in disturbed areas	Rill/Gully, Sheet, Stream Bank, and Snow Melt.
SN-2	* Snow Accumulation	Reduce the volume of runoff in disturbed areas	Rill/Gully, Sheet, Stream Bank, and Snow Melt.
SN-3	Freeze Reduction	Increase effectiveness of structures and BMPs	Rill/Gully, Sheet, Stream Bank, and Snow Melt.
TC-1	Stabilized Construction Entrance/Exit	Reduces offsite sediment tracking from trucks and construction equipment	Special
TC-2	Stabilized Construction Roadway	Control of dust and erosion created by vehicular traffic	Special
TC-3	Entrance/Outlet Tire Wash	Reduces offsite sediment tracking from trucks and construction equipment	Special
NS-1	Water Conservation Practices	Conserving water on construction sites	Special
NS-2	Dewatering Operations	Manage pollutants from dewatering operations	Special
NS-3	Paving and Grinding Operations	Minimize pollution of storm water during paving operations	Other Pollutants
NS-4	Temporary Stream Crossing	Minimize pollution at waterway crossings	Stream Bank
NS-5	Clear Water Diversion	Intercepts clear surface water runoff upstream of a project site	Rill/Gully, Stream Bank, and Snow Melt.
NS-6	Illicit Connection/Illegal Discharge Detection and Reporting	Recognize illicit connections or illegally dumped or discharged materials	Other Pollutants
NS-7	Potable Water/Irrigation	Reduce potential pollutants during discharge of water lines.	Other Pollutants
NS-8	Vehicle and Equipment Cleaning	Procedures to minimize or eliminate discharge of pollutants from cleaning operations	Other Pollutants
NS-9	Vehicle and Equipment Fueling	Procedures to eliminate the discharge of fuel spills into waterways	Other Pollutants

ID	BMP Name	Primary Purpose	Erosion Processes
NS-10	Vehicle and Equipment Maintenance	Procedures to eliminate the discharge of pollutants into waterways from maintenance activities	Other Pollutants
WM-1	Material Delivery and Storage	Proper handling and storage of materials	Other Pollutants
WM-2	Material Use	Procedures for eliminating or reducing the discharge of materials to waterways	Other Pollutants
WM-3	Stockpile Management	Procedures for eliminating or reducing pollution of storm water from stockpiles	Splash, Sheet, Rill/Gully, Stream Bank, Wind, and Snow Melt.
WM-4	Spill Prevention and Control	Prevent and control spills	Other Pollutants
WM-5	Solid Waste Management	Management of packaging, building materials, etc.	Other Pollutants
WM-6	Hazardous Waste Management	Management of paints, chemicals, fertilizer, pesticides, oil and grease, etc.	Other Pollutants
WM-7	Contaminated Soil Management	Procedures for eliminating or reducing pollution of storm water from contaminated soils	Other Pollutants
WM-8	Concrete Waste Management	Procedures for eliminating or reducing pollution of storm water from concrete wastes	Other Pollutants
WM-9	Sanitary/Septic Waste Management	Procedures for eliminating or reducing pollution of storm water from concrete wastes	Other Pollutants
WM-10	Liquid Waste Management	Reduce liquid waste pollution	Other Pollutants

* BMP functions best primarily in western region.

4.4.2 Rules of Thumb

Rules of thumb consist of a variety of different tools to aid in the design and construction process. Within the rules of thumb are erosion and sediment control planning and design checklists, slope measurement tables, slope inclination conversion tables, and seeding application rate tables.

4.4.2.1 Slope Measurement Tables

Slope measurement tables, like the one listed below, are a useful tool during the design and construction of a variety of earthwork projects. Typically, plan sheets show the run to rise ratio. The table below shows the commonly used slopes with the correspondingly multiplication factor. The Pythagorean Theorem (A2 + B2 = C2) describes the relationship between the run, rise, and slope length.

- **Run** is the horizontal change of the slope (A).
- **Rise** is the vertical change of the slope (B).

- **Slope length** at run length is the length of the slope using the rise and run factors (C).

- **Multiplication factor** is multiplied by the run to calculate the slope length.

4.4.2.1-1 Slope Measurement

Run	Rise	Slope Length	Multiplication Factor
20	1	20.025	1.00125
10	1	10.050	1.005
9	1	9.055	1.006
8	1	8.062	1.0078
7	1	7.071	1.0102
6	1	6.083	1.0138
5	1	5.099	1.0198
4	1	4.123	1.0308
3	1	3.162	1.0541
2	1	2.236	1.118
1.5	1	1.803	1.2018
1.25	1	1.601	1.2806
1	1	1.414	1.414
0.75	1	1.250	1.667
0.50	1	1.118	2.2361
0.25	1	1.031	4.1231

4.4.2.2 Slope Inclination Conversion Tables

Slope inclination conversion tables like the one listed below are another useful tool for design and construction of earthwork projects. They allow for the designer to gain another perspective of the slope and its correlation to erosion and sediment control. Three of these perspectives are the run/rise ratio, percent slope and degree slope.

- **Run** is the horizontal distance used to measure slopes.

- **Rise** is the vertical distance used to measure slopes. This distance is usually set at a unit of one and the run is adjusted accordingly.

- **Run to rise ratio** is simply the run to rise correlation, i.e. 20:1 is 20 unit of run for every unit of rise.

- **Percent slope** is the percentage difference between the run and the rise, i.e. a 20:1 slope would be 1 divided by 20, then multiplied by 100, to equal 5.0.

- **Degree slope** is the angle at the toe of the slope formed by the run and the rise. Since Tan θ equals rise over run, the slope in degrees can be calculated by taking the Tan^{-1} of the rise over the run.

Slope Inclination Conversion Worksheet

Run	Rise	Ratio	Percent	Degree
20	1	20:1	5.0	2.86
10	1	10:1	10.0	5.71
9	1	9:1	11.1	6.34
8	1	8:1	12.5	7.12
7	1	7:1	14.3	8.13
6	1	6:1	16.7	9.46
5	1	5:1	20.0	11.31
4	1	4:1	25.0	14.04
3	1	3:1	33.3	18.43
2	1	2:1	50.0	26.57
1.5	1	1.5:1	66.7	33.69
1.25	1	1.25:1	80.0	38.66
1	1	1:1	100.0	45.00
0.75	1	0.75:1	133.3	53.13
0.50	1	0.50:1	200.0	63.43
0.25	1	0.25:1	400.0	75.96

4.4.2.3 Seed Application Rate Tables

Seeding application rate tables can be found in the Temporary Seeding (SS-4) and the Erosion Seeding (SS-15) Detailed Drawings included in Section 3, Best Management Practices.

4.5 NOI Package Tools

The NOI package, which includes the NOI form and the SWPPP must be completed and submitted to the permitting authority. For Tribal lands, the EPA is the permitting authority, while for all other lands in the state of Montana, the DEQ is the permitting authority. The NOI form must be filled out and signed by the appropriate parties. The SWPPP is a document that addresses water pollution control during construction activities. The General Permit requires that all storm water discharges associated with construction activity must comply with the provisions of a NPDES permit. A copy of the General Permit is included in Appendix B.

4.5.1 NOI Form

Before completing the NOI form, the operator shall read the General Permit for Surface Water Associated with Construction Activities. NOI forms are included in Appendices C and D. The forms can be downloaded from http://cfpub.epa.gov/npdes/ for construction sites on Tribal land, EPA permitting authority and from http://www.deq.state.mt.us/wqinfo/MPDES/Index.asp for non-Tribal lands.

4.5.2 SWPPP

The SWPPP must be completed for submittal to the appropriate regulatory agency prior to commencement of construction activities. A copy of a blank SWPPP and an example of a SWPPP are included in Appendices E and F respectively, or can be downloaded from http://www.deq.state.mt.us./

4.5.3 NOT Form

At the completion of the construction activities, the operator must complete a NOT form and submitted it to the regulatory agency. Blank NOT forms are included in Appendices G and H or can be downloaded from http://www.deq.state.mt.us.