Aggregate Operators Best Management Practices Handbook

PART II

Chapter 5 - 5: Planning Modules
STORMWATER & EROSION MODULE - SECM

Table of Contents

Tables and Figures

STORMWATER & EROSION CONTROL MODULE - SECM

Common Concerns: Stormwater & Erosion Control

Without adequate stormwater or erosion protection measures, exposed soils have the potential to introduce large amounts of sediments and silts to both natural and manmade environments. Proper control of stormwater and erosion at aggregate operations may decrease the need for pre-discharge treatment of stormwater and decrease the likelihood of off-site environmental impacts, such as degraded surface waters and fish habitat. A *Mines Act* permit application (Notice of Work & Reclamation for a Gravel Pit or Quarry) requests a description of surface run-off and sediment control measures (schedule B). If stormwater is discharged to the environment, a *Waste Management Act* permit may be required, and if diversion ditches or settling ponds are constructed, a *Water Act* authorization may be required.

The geotechnical requirements of the *Health, Safety & Reclamation Code for Mines in BC* are designed to prevent landslides, slumps and debris flows caused by extreme stormwater and erosion from occurring at mine sites. This module will address the slower and less spectacular, yet potentially as damaging phenomena of unchecked erosion, transport and sedimentation of soils, silts and clays into surface waters and aquatic environments.

Stormwater and erosion control planning can help limit topsoil and fine product loss due to erosion by wind or precipitation, and reduce the amount of siltation, fugitive dust and exposed soils. Effective stormwater and erosion control practices keep working sites dry, which cuts operating costs through reducing wear and tear on equipment and tires, and lessens the need for pre-discharge treatment of storm water.

Stormwater planning can help to identify the stormwater management requirements of a site and the selection of BMPs for stormwater control. The scale of the stormwater planning should reflect the size and complexity of an aggregate operation. Stormwater planning can be as simple as stormwater BMPs sketched on a copy of the extraction map, or as comprehensive as a professional hydrological analysis.

Erosion control planning can help identify the location and character of the erosion hazards and risks on an aggregate site and assist in the selection of control methods. For both stormwater and erosion control, the basic control BMPs are:

- Bioengineering
- Buffer Zone
- Ditches
- Retention Basins
- Settling Pond
- Vegetation Cover
- benches
- hydroseeding
- swales
- treed wind breaks
- wetlands

Stormwater and Erosion Basics

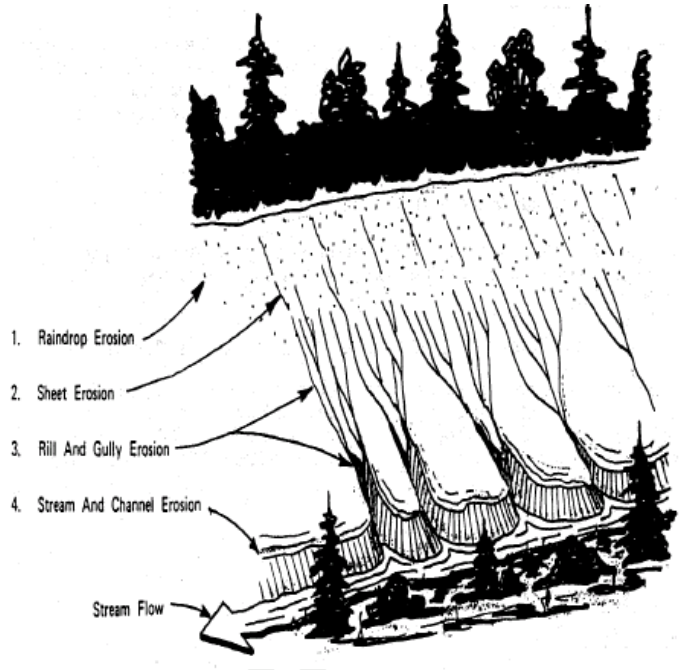
Stormwater

Stormwater is the portion of rainfall or snowmelt that does not immediately percolate into the ground or evaporate. Stormwater flowing across exposed soils can pick up fine clays and silts which, if not managed properly, may negatively impact offsite water quality.

Erosion

Erosion is the dislodgment, removal and loss of topsoil, silt or clay from its original location by water, wind, ice or gravity. At aggregate production sites, soil erosion is caused by vegetation removal, the exposure of soils to water, and to a lesser extent, wind.

Figure SECM - 1: Types of water erosion on soils (topsoil, silt and clay)



Types of Water Erosion	
Raindrop Splash Erosion	• The impact of falling droplets of rain mechanically dislodges soil particles causing them to be carried away by runoff.
Sheet Erosion	• Before concentrating into small channels, raindrop splash and runoff moves as broad sheets over the land and removes layers of exposed soil.
Rill and Gully Erosion	• As runoff concentrates in rivulets, it cuts grooves called rills. • If the flow of water is sufficient, rills will develop into gullies.
Stream and Channel Erosion	• Large volumes of fast flowing water in unprotected channels will cause stream bank and stream bottom instability, scouring, and removal of significant portions of the stream or channel banks and stream bottoms.

O'Brien, page 5.

Erosion Control Pointers

Keep Existing Vegetation Intact

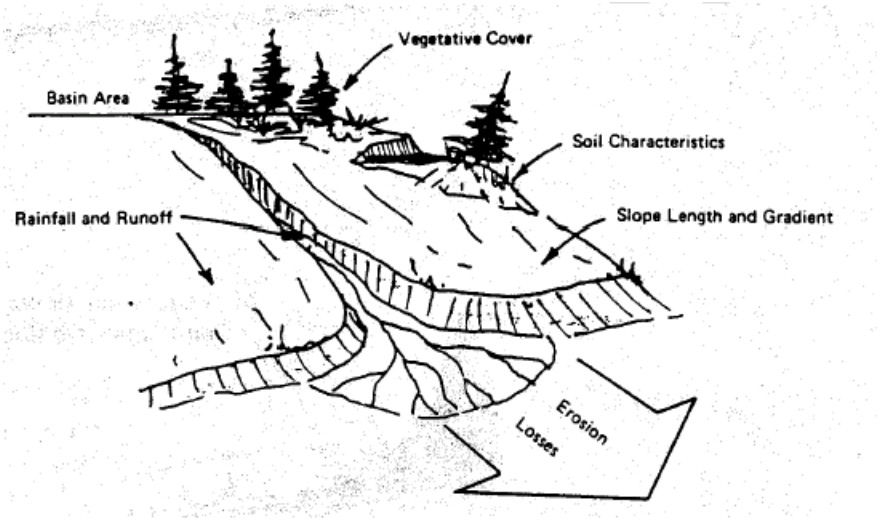
Vegetation (Figure SECM - 2) plays an extremely important role in controlling erosion by:

- shielding the soil surface from the impact of falling rain,
- slowing the velocity of runoff, thereby permitting greater infiltration,
- maintaining the soil's capacity to absorb water, and
- binding soil particles to plant roots.

Erosion can be significantly reduced by limiting the removal of existing vegetation and by decreasing the duration of soil exposure to rainfall. Operators should retain existing vegetation on areas of high erosion potential such as erodible soils and steep slopes. If it becomes necessary to

remove vegetation from these areas, revegetation should be done as quickly as possible thereafter. Interim measures could include covering the site with tarps, geotextiles, or straw.

Figure SECM - 2: Effect of vegetation on stormwater runoff.



O'Brien, 2001, page 9.

Limit Slope Steepness & Length

Slope length and steepness are key elements in determining the volume and velocity of runoff and the degree of erosion. As slope length and/or steepness increase, the velocity of runoff and the potential for erosion also increase. An operator should limit slope steepness and length by either controlling grade or benching.

Managing Stormwater & Erosion

Aggregate operations expose soils as part of their day-to-day operations. Table SECM-3 lists a number of strategies, BMPs and other control measures that can be used to reduce stormwater and erosion risks posed by this exposure.

Table SECM - 3: Strategies and BMPs for erosion and sedimentation control.

Stabilization (prevention)	Structural (treatment)	Inspections
• Buffer Zone • Bioengineering • Ditches • Erosion Control Blanket • Tarp • Vegetation Cover • benching • hydroseeding • limit clearing • tree protection	• Check Dam • Ditches • Outlet Protection • Retention Basin • Settling Pond • Silt Fence • swales	• post - storm events • weekly

Stabilization Practices

Stabilization practices help prevent erosion and consequent siltation. Typical stabilization practices include hydroseeding, mulching, geotextiles, sod stabilization, buffers, protection of trees, preservation of mature vegetation and decreasing slope angles or lengths.

Structural Practices

Structural BMPs divert flows from exposed soils, store flows, or otherwise limit runoff and the discharge of sediments from exposed areas of the site. Such practices may include ditches, silt fences, earth dikes, drainage swales, sediment traps, check dams, slope drains, level spreaders, reinforced soil retaining systems and sediment basins.

Inspections

Erosion and sediment control structures are like mechanical equipment, and require regular attention to ensure proper performance. At active operations, visual inspections of on-site stormwater and erosion control measures can be made a part of general site inspections. A recommended schedule might be once every seven days, and within 24 hours after any storm event of greater than 1 cm of rain per 24 hour period. A log of these visual inspections, recording the date and pertinent observations (e.g., 12/7/99 - very heavy storm but no significant turbidity in runoff) can be kept and managed with other records.

Table SECM - 4 highlights stormwater and erosion control issues for aggregate operations and recommends BMPs and other control measures to reduce potential environmental impacts.

Table SECM - 4: Stormwater and erosion control issues for aggregate operations and recommended BMPs.

Component	Considerations & Suggestions	BMPs & Other Measures
Precipitation	• stormwater starts as rain or snow • contact the local office of the Ministry of Land, Air and Water for estimates of expected rainfall and wet seasons • rainfall estimates (seasonal & peak storms) multiplied by the surface area of the site will yield rough run-off volumes that can be used to set performance targets	
Adjacent Areas	• the type of adjacent land uses will determine runoff volumes; for example, hard surfaces such as parking lots will result in high runoff • stormwater flows from upslope or upstream may impact the operation if they pass through the property • where will the stormwater go once it leaves the site? What path will it take and what may it affect (streams, lakes, wetlands, residential areas, roads, etc.)?	• Risk Management Module, IPEI section.
Site Characteristics	• how does stormwater flow over the undisturbed site? • what existing onsite drainage features are significant, and can they be used to assist in managing stormwater? • what are the existing topography and vegetation, and how do they affect stormwater?	
Critical Areas	• some areas are more susceptible to impact from unmanaged stormwater than others, such as a salmonid stream • critical areas may include water wells, wetlands, riparian areas or fish streams	• Risk Management Module, IPEI section.
Soils	• where soils have not been stripped for aggregate extraction, they can play an important role in stormwater management by absorbing stormwater like a sponge • exposed and unprotected soils are highly susceptible to erosion by stormwater	• Erosion Control Blanket • Silt fence • Tarp • Vegetation Cover
Erosion Problem Areas	• size, shape, steepness and slope length can make some areas more susceptible to erosion than others • some topsoil, silt and clays are more susceptible to erosion due to their composition	• Erosion Control Blanket • perimeter planting
Clearing, Grubbing and Stripping	• clearing, and especially grubbing, expose soils to stormwater and erosion, potentially causing siltation • limit the extent of clearing and grubbing to what is immediately necessary • clearly mark clearing boundaries to avoid inadvertent excessive clearing	• Preserve Natural Vegetation
Ditches	• divert surface flows around/away from exposed soils (*Water Act* approval required) • convey stormwater around the property • channel water into sediment basins	• Ditches • swales
Flow Controls	• slower water flows have less energy to cause erosion and transport sediment • check dams, swales, retention basins and vegetation can decrease flow rates within ditches • divert runoff away from exposed areas wherever possible	• Check Dam • Retention Basin
Source Control of Pollutants	• preventing pollutant release through source control BMPs is preferred over treatment (e.g., oil/water removers). • refer to the Risk Management Module for a discussion of pollution prevention	• Oil/Water Separator • covered storage
Sediment Control	• sediment free stormwater is the goal of stormwater management • minimize the amount and rate of runoff and that will reduce sediment entrapment • remove any entrained sediment from the stormwater using swales, retention basins and silt traps before discharging	• Retention Basin • Silt Fence • Wheel Washer
Stabilize Soils	• exposed soils can be eroded by raindrop impact and flowing water • preserve existing vegetation and/or establish new ground cover • exposed soil stockpiles can be covered with tarps	• Erosion Control Blanket • Tarp • Vegetation Cover
Protect Slopes	• stormwater flowing down slopes picks up speed (energy) increasing its ability to cause erosion and pick up sediment • minimize slope length and steepness with terracing and diversions • divert runoff around the top of a slope • slopes can be protected with hydroseeding, erosion control blankets and tarps.	• Bioengineering • Erosion Control Blanket • Tarp • Vegetation Cover
Discharge	Stormwater discharge options include: 1. Recycle into processing water 2. Land application (field application, irrigation, level spreader, swale) 3. Surface water application (see Water Quality Guidelines)	• French Drain • Retention Basin

Stormwater & Erosion Control Maps

Stormwater and erosion control (SEC) maps are not generally required for a *Mines Act* permit, but can be a useful tool to summarize and illustrate how stormwater flows over a site, potential erosion prone areas, and measures used to control flows and erosion. A SEC map would also fulfill the Notice of Work & Reclamation for a Gravel Pit or Quarry requirement to show on a map "watercourses and drainages (wet, dry or intermittent) on the property and within 150 meters of its boundaries."

Table SECM - 5: Suggested features for a stormwater & erosion control map.

Stormwater Plan Map Checklist	
Exposed Soil	• show areas where soils are currently exposed, by natural processes or by current or previous work • steep or long slopes • exposed soils • erodible soils • proposed clearing sites
Vegetation	• indicate existing tree lines, ground cover and grassy areas on the site that can be used to help control stormwater
Erosion Problem Areas	• identify potential erosion problem areas
Critical Areas	• identify any on-site and adjacent critical or sensitive receiving areas such as water wells, wetlands, riparian areas, fish habitats and streams
Adjacent Areas	• indicate if stormwater may come onto the site from adjacent areas • indicate where the stormwater will go if it leaves the site • indicate what may be affected (e.g., streams, lakes, wetlands, residences, etc.)
Drainage Areas & Patterns	• show how stormwater currently flows about the property • identify collection areas (often called basins or watersheds), waterways and natural discharge points
Clearing Areas	• show areas that are to be cleared, grubbed and stripped
Ditches	• show on the map the following ditches: 1. diversion ditches to divert stormwater away from extraction, stockpiling, problem and cleared areas, and roads 2. conveyance ditches that move stormwater around the site (e.g., to sediment basins or other control features)
BMPs	• plot location of BMPs (ditches, checkdams, swales, vegetation, bioengineering, retention basin, etc.) • BMP infosheets in chapter 7 of this handbook have map codes in their top left hand corners for this purpose

After: O'Brien, 2001, pages 36-38.