Aggregate Operators Best Management Practices Handbook

PART I

Chapter 2
COMMON COMMUNITY AND ENVIRONMENTAL CONCERNS

Table of Contents

Tables and Figures

Common Community and Environmental Concerns

This chapter briefly reviews common community and environmental concerns with respect to aggregate production, as background for later chapters that discuss ways of addressing those concerns.

Community Context

Common community concerns regarding aggregate operations include:

- Noise
- Dust
- Traffic
- Appearance (Viewscape)
- Hours of operation
- Water management

These concerns can be managed with adequate mine planning, diligent procedures, appropriate use of BMPs and, on a larger scale, by integrating aggregate operations with local community planning.

New aggregate operations often locate near existing urban and rural developments. The type and proximity of adjacent land uses may influence many of the mine planning and operating decisions. For example, in a community where tourism is important, an operator may choose to begin extraction at a less visible part of the property and establish a perimeter berm with fast-growing trees that will eventually become an effective visual screen. Table CEC - 2 lists common community concerns related to aggregate operations, and highlights the modules and some sample BMPs in this handbook that can be used to lessen the effects of those concerns.

Image CEC - 1: Fast growing poplar hybrids on a gravel pit's landscape berm in Sechelt, British Columbia. Growing up to 3 metres a year, these hybrids can provide a quick effective visual screen and block noise and dust from leaving the site. They can also be harvested in 12-14 years for pulp, leaving a healthy stand of evergreens that will eventually cover the berm.
Photo courtesy of: Construction Aggregates Limited, Sechelt Operation and SYLVIS Environmental of Vancouver.

Table CEC - 2: Common community concerns

CONCERN	MANAGEMENT CHALLENGE	MODULE	SAMPLE BMPs
Noise	• Noise from equipment operations, loading and transportation can affect a wide area around a pit or quarry.	Site Layout • Noise Section	• Berm • Buffer Zone
Dust	• Dust from exposed soils, traffic and processing may create a nuisance for local agricultural operations, nearby residents and businesses.	Site Layout • Dust Section	• Drop Height • Water Spray
Traffic	• Large dump trucks used to carry aggregate may increase traffic, affect road safety, create dust and increase road maintenance requirements.	Traffic	• Tarps • Wheel Washer
Viewscapes	• By their nature, aggregate operations disturb the land, and the appearance of the site from adjacent areas may be unattractive.	Site Layout • Visual Landscape Section	• Berm • Lighting Management • Vegetation Cover
Hours of operation	• Operations in the early morning, evening and weekends are more noticable and are therefore more likely to cause concern than operations during regular business hours.	Extraction	
Water Management	• Extraction of aggregates requires the removal of vegetation and the exposure of soils and can alter stormwater drainage patterns. This exposed soil may pick up sediment if not managed appropriately.	Stormwater & Erosion Control	• Ditches • Check Dams • Retention Basin • Silt Fence

Integration of aggregate operations into communities can be challenging, but workable solutions can often be found through cooperation and coordination of mine planning with local planning processes. To assist in this effort, refer to Chapter 4 of this handbook.

Environmental Concerns

In an undisturbed state, sand and gravel and quarry rock are environmentally benign materials. Environmental concerns arise because aggregate resources cannot be extracted from the landscape without causing some disturbance. Care must be taken to ensure that the effects on the environment (i.e. plants, animals, soil, water and air) and the landscape are appropriately considered when formulating plans for extraction, operations and reclamation.

Pairing of environmental concerns to appropriate modules and BMPs can begin with Tables CEC - 2, 3 and 4 in this chapter or the "Identifying Potential Environmental Issues" section of the Risk Management Module (RMM). The RMM can help the operator identify potential environmental concerns through references to numerous sources of information.

All aggregate production must be carried out in an environmentally sensitive manner. This can be accomplished through careful planning and BMP use on the property, and through coordinating on-property activities with the environmental activities of the immediate neighbouring area. For planning purposes, information concerning local environmental activities can be found in the environmental goals, strategies and plans of the Official Community Plan or Growth Strategy (as defined in the *Local Government Act*), or where there are federal or provincial environmental guidelines.

Table CEC - 3: Common environmental concerns

Concern	Impacts	Module(s)	Sample BMPs
Stormwater	• increased erosion and siltation	Stormwater & Erosion Control	• Ditches • Retention Basin
Groundwater	• reduced filtering capacity • altered recharge rates • lowering of groundwater table • contamination	Risk Management	• Ditches • Pollution Prevention
Water Quality	• increased total suspended solids (TSS) • increased turbidity • increased hydrocarbons	Stormwater & Erosion Control Risk Management	• Oil/Water Separator • Settling Pond • Silt Fence
Water Discharge	• increased siltation	Stormwater & Erosion Control Processing	• French Drain • Retention Basin
Acid Rock Drainage	• increased acidity	Refer to the MEM Acid Rock Drainage Guidelines, available on-line at <http://www.em.gov.bc.ca/mining/MinePer/ardguide.htm>, or contact a local MEM office.	
Loss of Plant Cover	• degraded topsoil • erosion • changes to runoff and percolation rates.	Stormwater & Erosion Control Stockpiling	• Erosion Control Blanket • Topsoil Management
Wildlife Habitat	• loss of habitat	Stockpiling	• Buffer Zone
Fish Habitat	• increased siltation and degradation of fish habitat	Stormwater & Erosion Control Processing Site Layout	• Buffer Zone • Settling Pond • Silt Fences

Water Management

Water management is often the most significant environmental concern at an aggregate site. This concern includes stormwater management, groundwater and surface water protection, and

discharge options for stormwater and process water. An illustration of a water budget, showing how water can pass through an aggregate operation, is depicted in figure CEC - 5.

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 silt which, if not managed properly, *will* negatively impact offsite water quality. For further discussion of stormwater management on aggregate sites and its potential environmental concerns, please refer to the Stormwater and Erosion Control Module.

Surface Water

"Surface water" is water that flows in streams and rivers, or is stored in natural lakes, ponds, wetlands and human made reservoirs. This water can be used for any number of applications from agriculture to drinking water. Extreme care should be exercised whenever aggregate operations interact with surface waters. For discussions on pollution prevention, refer to the Risk Management Module, "Emergency and Spill Response" section, and related BMPs.

Operations that use, or are located in the vicinity of surface waters must comply with the *Water Act*. For water use, either a licence (for long-term use) or a section 8 approval (for short-term use) is required. For any construction or resource development in or about a stream, a section 9 approval is required in the case of major works (diversions, rip rapping), and a notification form outlining the proposed work must be submitted in the case of minor works. The federal *Fisheries Act* may also apply if an operation is likely to affect a fishery.

Table CEC - 4: Aggregate activities and their potential environmental concerns.

Mining Activity	Activity Details	Potential Effects on Environment	Sample BMPs
Clearing, Grubbing and Stripping	• timber clearing • vegetation removal • soil removal • overburden removal	• removal of hydrological buffers / filters • habitat loss or disturbance • soil exposure	• Tillage • Topsoil Management • Vegetation Cover
Extraction, Processing & Transport	• blasting • crushing • stockpiling • waste rock management	• dust generation • noise generation • water quality impacts	• Berm • Pollution Prevention • Settling Pond • Water Spray
General Operations	• stormwater management • erosion and sediment control	• increased runoff • increased erosion • increased sediment load • increased groundwater recharge	• Buffer Zone • Retention Basin • Silt Fence
Reclamation	• staged • interim • final	• re-establishment of habitat	• Bioengineering • Grading • Vegetation Cover

Groundwater

Sand and gravel pits do not always contaminate groundwater either directly or indirectly, but may increase the risk of groundwater contamination by removing vegetation and soil buffers. Assessments should always be made on a case-by-case basis. The potential impact of an aggregate operation on a groundwater system depends upon a number of factors, including:

- presence of a groundwater source below an operation,
- characteristics of the groundwater system,
- characteristics of the gravel deposit and operation,
- thickness of the overburden,
- presence of clay or bedrock immediately under the sand and gravel deposit, and
- climate.

Potential Effects of Aggregate Production on Groundwater:

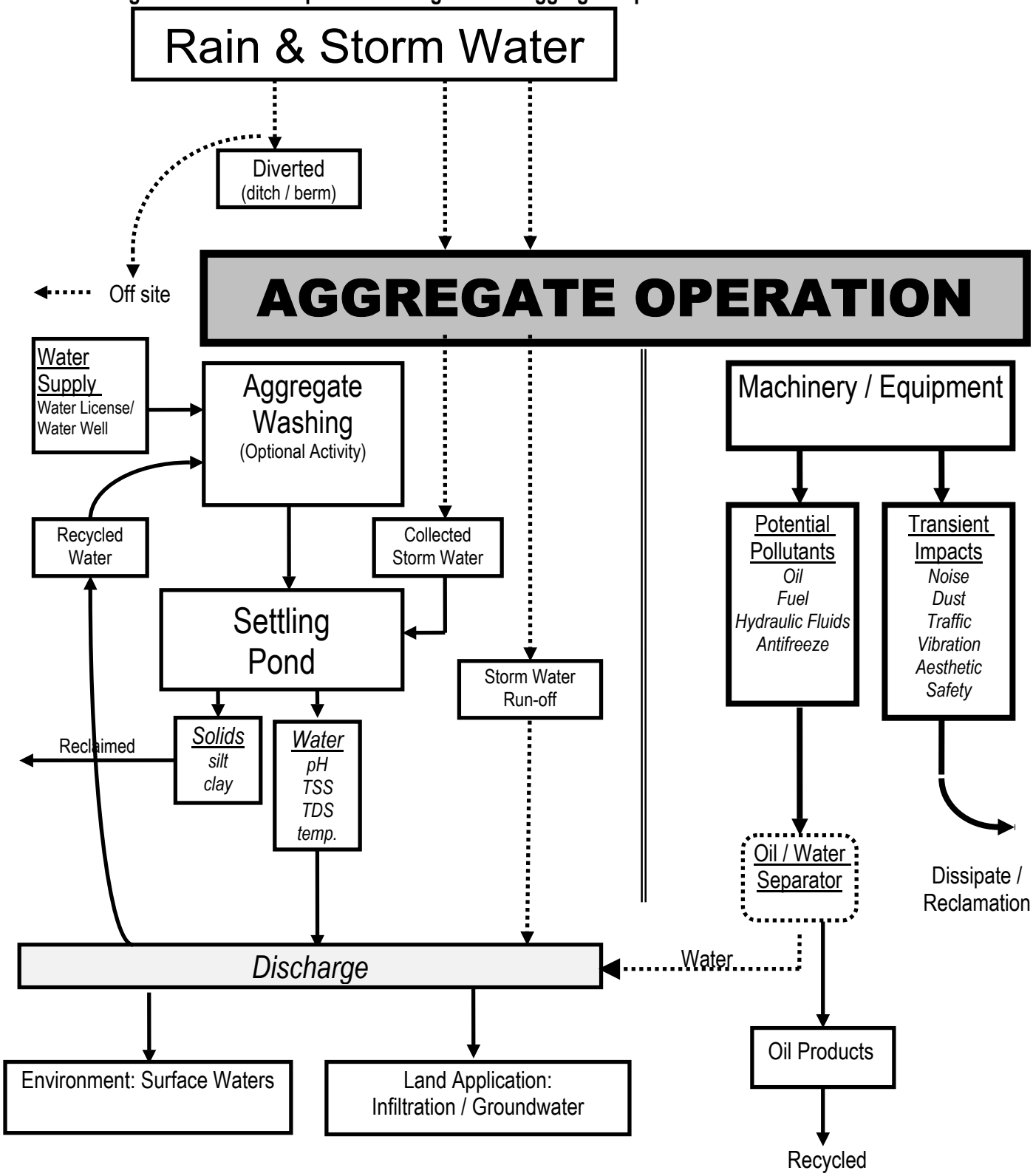
1. **Decreased Safety Margin for Pollution Prevention** - By reducing the thickness of unsaturated sediments above the groundwater table, an aggregate operation may affect the ability of those sediments to ameliorate contaminants. The use of operational practices such as regular maintenance, proper fuel handling, spill avoidance, use of spill kits and emergency planning will keep contamination as low as possible. These measures can be planned using the "Stormwater, Emergency and Spill Response" section of the Risk Management Module and the Traffic Module from this handbook. These provisions should be described in the Notice of Work and Reclamation application for sand and gravel pit and rock quarry permits.

2. **Altered Groundwater Recharge Rates** - Vegetation, together with soil, may act as both a filter and a sponge and has the potential to return almost all rainfall to the atmosphere, allowing as little as 10% to become groundwater. When that filter and sponge capacity is removed due to a disturbance, there may be an increase in both the volume and rate of recharge into a groundwater system from the disturbed area. Recharge rates are also affected by the clay and silt content of the gravel deposit and the direction of the surface drainage with respect to the site.

3. **Lowering of Groundwater Table** - An aggregate operation can lower the groundwater table if excavation occurs at a depth below the average high table. In British Columbia, this situation rarely occurs because most aggregate operating permits prohibit excavation within one metre of the high groundwater table.

   Surface watercourses and groundwater have a complex yet balanced relationship. During low flow periods that relationship can be crucial in ensuring adequate water is supplied to rivers to support aquatic ecosystems. The average depth to the groundwater table is required information in the *Notice of Work and Reclamation application* for sand and gravel pit and rock quarry permit.

Figure CEC - 5: Example water budget for an aggregate operation.



Water Discharge

Wastewater in British Columbia aggregate operations is generally limited to stormwater, seeping groundwater and surplus process water. The quantity and quality of discharge waters varies considerably by region, and the need for discharge is commonly intermittent on both a day-to-day and seasonal basis. Aggregate permits usually require the installation of perimeter ditches to keep stormwater from entering a gravel pit or rock quarry. Nonetheless, the storm water that collects within the mine site may have to be discharged. Table CEC-6 discusses options for discharging water at aggregate operations.

Table CEC - 6: Discharge options for excess water at aggregate operations.

Discharge Option	Description	Advantages	Disadvantages
Recycle	• re-use for processing.	• provides additional source of water at no cost.	• limited supply • cannot store large volumes. • storage ponds may require an engineering design.
Land Application	• percolation through fields, French drains, infiltration trenches and on-site ponds. • application on land by level spreader (USDA & MSU) or sprinklers.	• mimics natural events, such as flooding. • sediment adds to soil development.	• requires land. • limited by infiltration rates and seasonal saturation of soils. • a summer / seasonal alternative for coastal areas. • will not handle large storm events.
Surface Water Discharge	• discharge to surface water courses.	• cost efficient. • no long term storage required.	• water quality compliance necessary. • requires discharge authorization.

Water Quality

Water quality involves the chemical (pH, TDS) and physical (TSS, turbidity) properties of water in relation to other values such as aquatic life, recreation, agriculture and livestock. Protecting water quality means ensuring that any water discharged from an aggregate operation will meet provincial and federal standards. For protection of water quality, prevention is always preferable to treatment. Table CEC-7 discusses water quality implications for aggregate operations.

Acid Rock Drainage and Quarrying

Metal leaching (ML) and acid rock drainage (ARD) are naturally occurring processes that can have negative impacts on the environment. The primary cause of ML and ARD are elevated concentrations of either sulphide minerals or their weathering products. Acid generation occurs when sulphide minerals are exposed to the weathering effects of oxygen and water, and acidity is produced in the oxidation of sulphur and the hydrolysis of ferric iron. ARD occurs when the resulting acidity and metals are entrained by water. Elevated ML is associated with ARD because of the high solubility of many metals under acidic conditions. For many rock types and environmental conditions, ML will only be significant if drainage pH drops below 6. However, leaching of arsenic, antimony, selenium, zinc and molybdenum may occur under neutral (pH = 7)

or alkaline (pH > 7) drainage conditions if the concentrations of these materials in the rock is sufficiently high.

Because these operations usually target unaltered and unmineralized materials, ML and ARD are rarely an issue at aggregate operations, and infrequently at quarry operations . However, the potential for ML and ARD should always be considered both prior to aggregate development and during operations. Predicting ML and ARD usually involves the evaluation of geological characteristics of the materials to be excavated and analytical testwork. Potential indicators include visible sulphide mineralization, visual indications of sulphide oxidation or hydrothermal alteration (rusty or bleached appearance in the materials), and proximity to a known metallic mineral deposit. If any of these indicators are identified, the potential for ML and ARD should be investigated further. In general, materials with the potential for ML and ARD should not be used as a source of aggregate since they may be damaging to the environment, and could result in substantial expenses to the operator for removal costs and associated environmental liability issues. For more information on ML and ARD, contact the Mines Branch of the Ministry of Energy & Mines.

Habitat

Mechanical disturbance at sand and gravel pits and rock quarries has the potential to disrupt wildlife habitat. Awareness of habitat types on the property, such as forest, grassland, etc., and their degree of significance (common, regionally significant and sensitive) can be helpful in planning to minimize disturbances. Habitat protection is preferable to habitat restoration (Murphy 1995). The "Identifying Potential Environmental Impacts" section in the Risk Management Module can aid in habitat identification.

Table CEC - 8 lists general types of environmental and habitat degradation that can occur as a result of sand and gravel pits and rock quarry operations.

Site Specific Environmental Impact Factors

British Columbia's environment ranges from rain forest to desert, and the potential environmental concerns regarding aggregate operations can vary tremendously. For example, storm water management is a significant issue in coastal British Columbia, whereas dust management is a major challenge in the dry Interior. Some other regional factors affecting environmental concerns are:

- rainfall
- temperature
- wind
- habitat diversity
- glacial history
- urban development and agriculture
- soil development
- terrain

Table CEC - 7: Water quality implications of aggregate operations.

Water Quality Factor	Description	Units	Sources	Issues	BMPs & Other Measures
PH	measure of relative acidity/alkalinity	range: 0 - 14 average: 6-8 (measured with a pH meter or litmus strips)	• acid rock drainage • limestone • metal leaching	• Sand and gravel deposits will generally not have acid generating constituents. • Quarry rock may have acid generating capabilities.	• Refer to metal leaching & acid rock drainage guidelines.
TSS (Total Suspended Solids)	measure of the weight of very small particulate matter, down to 1/1,000 of a millimetre: sand, silt and clay.	milligrams per litre	• stormwater • seepage • processing • dust suppression • runoff	• TSS at aggregate operations are silts, clays and fine sands that can be picked up by stormwater. • Excess TSS in aquatic ecosystems harm fish and shellfish by causing abrasive injuries and clogging gills, resulting in suffocation. • TSS may also clog small spaces between river bed gravels, eliminating sheltered areas that are important for spawning and immature fish. This clogging also prevents the free flow of oxygenated water, and may cause suffocation and egg mortalities. • TSS decreases visibility for prey species.	• Retention Basin • Settling Pond • Silt Fences • Vegetation Cover • Flocculants (may be toxic to fish, referral MWLAP & DFO required). • Clarification Plants (for large operations)
TDS (Total Dissolved Solids)	measure of soluble pollutants; dissolved matter < 1/1,000 of a millimetre.	milligrams per litre		• There are generally few opportunities for storm water to pick up TDS at aggregate sites. • TDS in quarries may come from metal leaching and calcite veins.	
Turbidity	measure of clarity of water	nephelometric turbidity units (NTU) (measured with a turbidity meter)	• stormwater • seepage • washing • dust suppression • runoff	• Turbidity is detrimental because it reduces water clarity and penetration of light, impairing the ability of aquatic plants to grow and fish to see and find food. • Reduced aquatic plant growth means less available food at the bottom of the food chain and less dissolved oxygen as a by-product of photosynthesis for fish to breath.	• Vegetation Cover • Retention Basin • Settling Pond • Silt Fences
H/C (Hydrocarbons)	petroleum derivatives	milligrams per litre	• spills & leaks • fuelling • storage	• Oil may adhere to fish gills or coat and destroy algae or other plankton. • Hydrocarbons may also pollute groundwater. • Direct toxicities	• Oil/Water Separators • Pollution Prevention
Temperature	temperature	degrees Celsius	• stormwater • stream side vegetation removal • settling pond discharge	• Temperature changes for stormwater are primarily a result of ambient air temperature and sun exposure. • Retaining riparian vegetation will help to maintain cool temperatures for surface watercourses.	• Buffer Zone • Stormwater BMPs
Nitrogen	nitrogen compounds	milligrams per litre	• residue from blasting • over fertilization.	• Increased growth of algae. • Decrease in dissolved oxygen in winter due to algae decomposition. • Toxicity	

Demographic and regional factors, such as local product specification, may also affect environmental concerns. For example, aggregates used in high-rise buildings and bridges will likely require sizing and washing, so more attention should be paid to dust issues and to discharging of sediments. Fill for a parking lot at a recreational site, on the other hand, may not require any processing.

Site-specific concerns may also include property appearance, local groundwater potential and use, and proximity to environmentally sensitive areas.

Conclusion

In planning and operating a pit or quarry, it is important to recognize community and environmental concerns. This handbook presents a range of options to help with the challenge of addressing those concerns appropriate for each site.

Table CEC - 8 Types of habitat degradation from aggregate operations.

Habitat Element	Description	Modules & BMPs
Loss of Topsoil (top layer of soil with roots)	Topsoil can be lost or degraded by: • poor or incomplete salvage, • mixing of topsoil with subsoil or overburden during salvage, • burial under storage areas for overburden and stockpiles, • erosion by wind or water during salvage, stockpiling or reclamation, • improper storage or mechanical compaction and • theft of topsoil from stockpiles.	• Stockpiling Module • Topsoil Management • Vegetation Cover
Loss of Plant Cover	• Plant cover is an integral part of natural habitats, as plants provide food, habitat and protection for insects and other animals. • Vegetation physically protects soil from wind and water erosion. • Vegetation aids in soil development.	• Bioengineering • Vegetation Cover
Wildlife Habitat	• A site assessment can determine whether a site has value as wildlife habitat. • Wildlife habitat and wildlife trees can be disturbed by noise, removal of vegetation, interruption of animal movement and migration corridors, and human presence. • The habitat of previously forested sites near urban areas may be already significantly degraded .	• Buffer Zone • Constructed Wetland • Environmental Timing Windows
Fish Habitat	• Sediment laden surface runoff from a pit or quarry can be detrimental to fish habitat because it may alter the physical aspects and biological productivity of those ecosystems. • Sediments abrade the gill membranes of fish, increasing the risk of suffocation. • Turbidity curtails plant and algae growth, resulting in a food shortage for aquatic species. • Clogging of gravel with fine sediments eliminates sheltered areas important for spawning and fish. • Clogged gravel also prevents oxygenated water from reaching incubating fish eggs and impedes the removal of metabolites (wastes), causing suffocation, poisoning and egg mortality. • High silt loads may inhibit larval, juvenile and adult behaviour, migration and spawning. • Sediment accumulation in semi-closed environments, such as lagoons and marshes, may lead to the partial or complete loss of these habitats.	• Buffer Zone • Check Dams • Constructed Wetland • Ditches • Erosion Control Blanket • Retention Basin • Settling Pond • Silt Fences