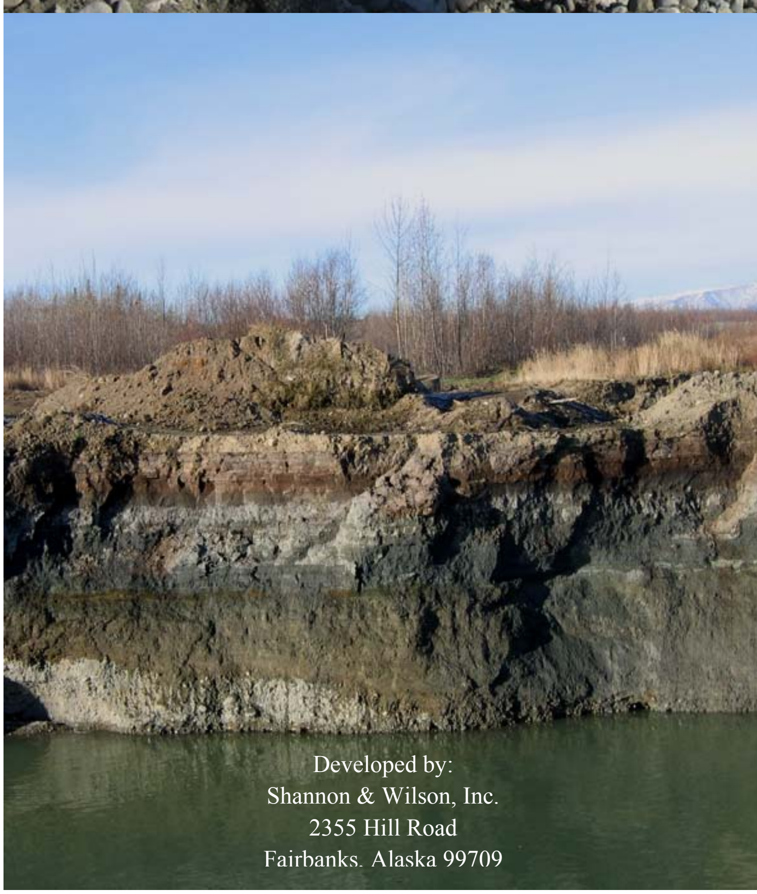
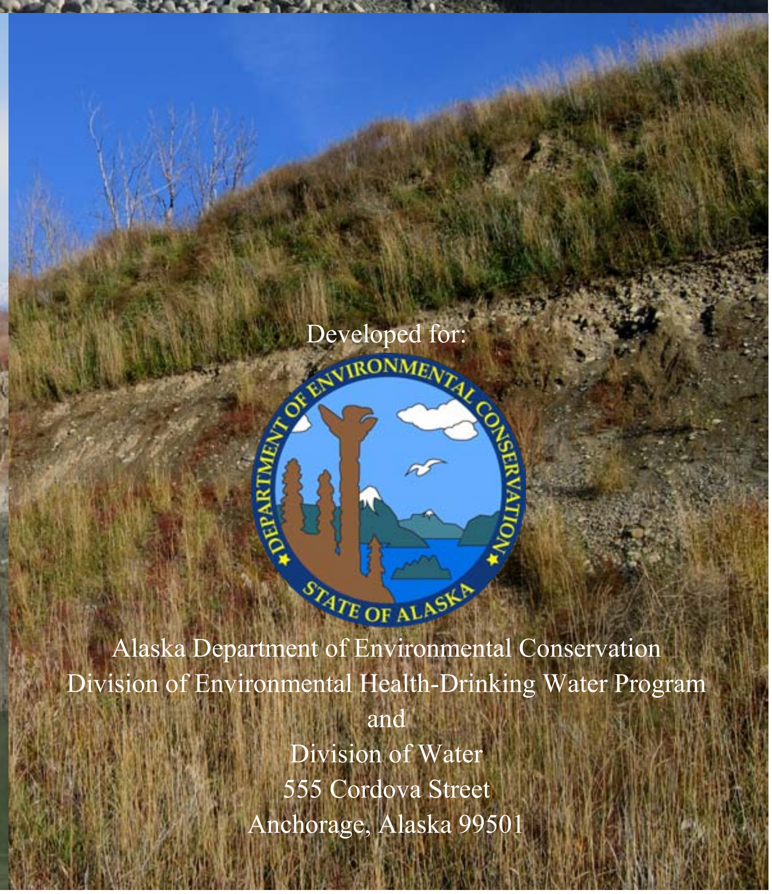
Alaska DEC User's Manual

BEST MANAGEMENT PRACTICES
FOR
GRAVEL/ROCK AGGREGATE EXTRACTION PROJECTS

Protecting Surface Water and Groundwater Quality in Alaska

September 2012





Developed for:

Alaska Department of Environmental Conservation
Division of Environmental Health-Drinking Water Program
and
Division of Water
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Anchorage, Alaska 99501

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PREFACE

This document is a revision to the *User's Manual: Best Management Practices for Gravel Pits and the Protection of Surface Water Quality in Alaska*, dated June 2006. Revisions were made in 2012 to provide updated information regarding permitting processes and agencies, and to address the growing need for best management practices pertaining to the protection of groundwater.

ACKNOWLEDGEMENTS

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DISCLAIMER

This document is intended to be used as a general guide to assist the aggregate mining community in designing and implementing effective best management practices for protecting surface water and groundwater quality. It is not intended to be the only source of such information or to provide legal advice of any nature. Users of this document are encouraged to seek legal, technical, and engineering advice from qualified professionals who are familiar with their project area. The organizations and individuals contributing to the preparation of this document expressly disclaim any responsibility or liability for any acts or omissions taken by any party as a result of this document's use.

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ACRONYMS

AAC	Alaska Administrative Code
ADR	Alaska Department of Revenue
DEC	Alaska Department of Environmental Conservation
AMD	Acid Mine Drainage
APDES	Alaska Pollutant Discharge Elimination System
BMP	Best Management Practices
CGP	Construction General Permit
DMLW	Division of Mining, Land, and Water
DNR	Alaska Department of Natural Resources
EDGP	Excavation Dewatering General Permit
EPA	United States Environmental Protection Agency
FBATFE	Federal Bureau of Alcohol, Tobacco, Firearms, and Explosives
HMC	Hazardous Materials Control
MSGP	Multi-Sector General Permit
NOI	Notice of Intent
NOA	Naturally Occurring Asbestos
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
PWS	Public Water System
SWPPP	Storm Water Pollution Prevention Plan
TAH	Total Aromatic Hydrocarbon
TAqH	Total Aqueous Hydrocarbon
TMDL	Total Maximum Daily Load
TWUP	Temporary Water Use Permit

1 INTRODUCTION

1.1 Purpose of the Manual

Key Points – Chapter 1

- The manual provides information on permitting and best management practices for gravel and rock aggregate operations to protect surface water and groundwater quality.
- The manual provides meaningful and comprehensive guidelines that will reduce impacts to water quality.

Aggregate is an important resource for Alaskan communities, used extensively in road building, foundation preparation, concrete, and other applications. Alaskan communities also depend on the quality of their surface and groundwater for drinking and livelihood. Aggregate mines occur throughout Alaska, and their improper operation can result in adverse impacts to surface water and groundwater quality. The primary purpose of this manual is to help protect the quality of Alaska's water from such impacts. One of the most effective ways to control impacts is the use of effective best management practices (BMPs). BMPs are physical, chemical, structural, and/or managerial techniques to minimize water pollution. This manual provides owners and operators of gravel/rock extraction operations in Alaska with guidance regarding permitting processes, as well as a comprehensive list and description of BMPs which can be implemented to help meet permit requirements, protect the quality of water, and reduce conflict with the public.

1.2 Organization of the Manual

This manual is organized into the sections described below:

Chapter 1 – Introduction, including how to use the manual.
Chapter 2 – Provides information on state and federal permit requirements.
Chapter 3 – Describes how to determine potential impacts.
Chapter 4 – Gives guidelines and recommendations for protecting surface water and groundwater quality.
Chapter 5 – Describes how to choose Best Management Practices.
Chapter 6 – Contains BMPs for preventing chemical pollution.
Chapter 7 – Contains BMPs for erosion control and stormwater management.
Chapter 8 – Contains operational BMPs.
Chapter 9– Contains BMPs for reclamation.
Chapter 10– Provides a list of references used in the manual.

Appendix A - Provides definitions for terms used in the User's Manual.
Appendix B – Lists contacts throughout Alaska for additional information on gravel pit BMPs and requirements.
Appendix C – Provides additional resources of information.
Appendix D – Provides limited information regarding state and federal permit requirements.
Appendix E – Is an index of BMPs presented in this manual.

1.3 How to Use the Manual

This manual is appropriate for use by owners and operators of gravel and rock aggregate extraction projects throughout Alaska. The techniques and practices given in this manual can be applied to both small and large-scale operations. Personnel that do not have extensive expertise in designing and implementing control measures may benefit from review of the entire manual. Personnel that have previous experience with the planning, design, and implementation of BMPs may benefit primarily from the BMP guidance given in Chapters 6 through 9, indexed in Appendix E – Best Management Practice Index.

2 PERMITTING AND REGULATORY REQUIREMENTS

Key Points – Chapter 2

Links to Key Documents:

- EPA's Multi-Sector General Permit: http://cfpub.epa.gov/npdes/stormwater/msgp.cfm
- DEC's Excavation Dewatering General Permit: http://www.dec.alaska.gov/water/WPSDocs/2009DB0003_pmt.pdf
- Alaska Water Quality Criteria (18 AAC 70): http://www.dec.state.ak.us/regulations/index.htm
- EPA's NPDES Website: http://cfpub.epa.gov/npdes/

This section provides a brief description of the DEC Alaska Pollutant Discharge Elimination System (APDES) Multi-Sector General Permit, DEC's Excavation Dewatering General Permit, the Alaska Water Quality Criteria, and Alaska Department of Natural Resources (DNR) Temporary Water Use Permit (TWUP) and Material Sale application as they apply to gravel pits. This is not intended to be a complete list of regulatory requirements but instead to provide a brief introduction to major regulations for gravel pits with respect to stormwater. Appendix D presents a summary of state and federal permits that may apply to material extraction operations in Alaska.

DEC permit requirements:

- APDES MSGP
- Excavation dewatering
- Water quality criteria

DNR permit requirements:

- Temporary Water Use Permit
- Material Sale Application

2.1 APDES Multi-Sector General Permit and Other APDES Requirements

Certain stormwater discharges, including those from industrial sites such as gravel pits, are regulated under the DEC APDES program. Both the discharge of stormwater and the discharge of dewatering effluent (uncontaminated groundwater) from gravel pit operations are permitted under the APDES Multi-Sector General Permit (MSGP) under Sector J (Mineral Mining and Dressing).

To apply for permit coverage under the MSGP, a facility operator must complete and submit to DEC a Notice of Intent (NOI) form. To comply with the permit, the facility operator must prepare and follow a Storm Water Pollution Prevention Plan (SWPPP). To discontinue permit coverage, a facility operator must complete and submit to DEC a Notice of Termination form.

There are certain circumstances where a general permit is either not available or not applicable to a specific operation or facility. In this type of situation, a facility operator must obtain coverage under an individual permit. DEC will develop requirements specific to the facility.

Some permits may remain in effect that had been issued by the Environmental Protection Agency (EPA) under an old permit that has since expired. For example, for North Slope Oil and Gas Exploration activities, gravel pits/material sites used for construction of pads and roads were permitted under a Slope-wide NPDES General Permit AKG33-0000. However, pursuant to

Section 401 of the Clean Water Act, the state of Alaska certifies EPA permits, which then become enforceable by the state.

2.2 Excavation Dewatering General Permit

Authorization for excavation dewatering is covered under DEC's Excavation Dewatering State Permit (Permit No. 2009DB0003). The general permit covers wastewater disposal from excavations on sites located less than one mile from a contaminated site and excavations located more than one mile from a contaminated site not eligible for coverage under the ADPES MSGP. Eligible projects covered under this general permit include gravel extraction.

A Notice of Disposal must be submitted to DEC when a total excavation dewatering discharge volume equal to or greater than 250,000 gallons is planned. A Notice of Disposal is not required if the total discharge volume is less than 250,000 gallons. However, it is important to note that the water quality standards in 18 AAC 70 and the terms and conditions of the general permit still apply. If DEC determines that a known contaminated site is located within one mile of a proposed dewatering activity and the wastewater discharge volume is equal to or greater than 250,000 gallons, additional information regarding the contaminated site including hydrogeologic conditions at the site may be needed. Monitoring wells and/or proposed treatment may be additionally required. Monitoring requirements are listed in the general permit.

Management practices must ensure that the dewatering operation is conducted so that the terms of the general permit are met. Some BMPs are outlined in the permit. This may include leaving the dewatering site, including any settling ponds, in a condition that will not cause degradation to the receiving water beyond that resulting from natural causes. If an earthen channel to transport wastewater from a dewatering operation to the receiving water is used, construction equipment should not be driven in the channel, which will result in re-suspended sediment. Fuel handling and storage facilities shall be managed to ensure petroleum products are not discharged into receiving waters.

The DEC dewatering permit was intended to authorize short-term discharges associated with construction. Gravel pits tend to be on-going projects, sometimes planned in phases. Although DEC has not issued an individual permit for a gravel operation, it is an option for larger, on-going gravel extraction with wastewater discharge associated with it.

2.3 Alaska Water Quality Criteria

Water quality criteria adopted by the State of Alaska are found in the Water Quality Standards in 18 AAC 70.020(b) and the DEC's Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances (May 26, 2011). These criteria were taken from the EPA criteria documents and Alaska Drinking Water Regulations in 18 AAC 80. Although these EPA criteria documents are no longer adopted directly into state regulation, they contain valuable information on the science used to create the criteria limits and may affect how the criteria are applied or modified. DEC can use these criteria as limits in the absence of mixing zones or other water quality standard exceptions in 18 AAC 70.

Pollutants that might be expected in the discharge from gravel pits are sediment, turbidity, total metals, and petroleum hydrocarbons. Table 2-1 and Table 2-2 contain numeric surface water quality standards for sediment, turbidity, and petroleum products in freshwater and marine waters. Narrative criteria are not included in Table 2-1 and Table 2-2. Criteria for total metals can be found in *Alaska's Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances* (2011). Alaska regulations (18 AAC 70) should be consulted for a full list of requirements, both numeric and descriptive criteria, and uses.

2.4 Temporary Water Use Permit

A water right is a legal right to use surface or groundwater under the Alaska Water Use Act (AS 46.15). A water right allows a specific amount of water from a specific water source to be diverted, impounded, or withdrawn for a specific use. When a water right is granted, it becomes appurtenant to the land where the water is being used for as long as the water is used. If the land is sold, the water right transfers with the land to the new owner, unless the DNR approves its separation from the land. In Alaska, because water is a common property resource wherever it naturally occurs, landowners do not have automatic rights to groundwater or surface water.

A temporary water use authorization may be needed if the amount of water to be used is a significant amount, the use continues for less than five consecutive years, and the water to be used is not appropriated. This authorization does not establish a water right but will avoid conflicts with fisheries and existing water right holders. To obtain water rights in Alaska, you need to submit an application for water rights to the DNR office in the area of the water use. After your application is processed, you may be issued a permit to drill a well or divert the water.

2.5 Material Sales Application

Material Sales Applications are required for extracting material from state-owned land. To determine if a site is on state-owned land, visit or contact the DNR Public Information Center:

DNR Public Information Center
550 West 7th Avenue, Suite 1260
Anchorage, AK 99501-3557
Phone: 907-269-8400
Fax: 907-269-8901

DNR Public Information Center
3700 Airport Way
Fairbanks, AK 99709-4699
Phone: 907-451-2700
Fax: 907-451-2706

DNR Public Information Office
400 Willoughby Street, 4th Floor
Juneau, AK 99801
Phone: 907-465-3400

There are three different types of state material sales:

- The first and smallest is a "limited" material sale which cannot be for more than 200 cubic yards per 12 month period per person. This is a revocable, nonexclusive contract for personal or commercial use.

- The second type is the "negotiated" sale, which generally cannot exceed 25,000 cubic yards per year per person or company. Material purchased under this type of sale can be sold or used for commercial purposes. The term of the sale is generally one year, but can be longer depending on circumstances.
- The third and larges is the "competitive" sale. The sale contract can be issued for an unlimited amount of material to be taken over many years. Award will be determined by public auction if there are multiple bidders for the same location. If no competitive interest is expressed during the public notification period, no auction is necessary and the sale can proceed to contract upon completion of the decision making process. Material purchased through competitive sale can be sold or used for commercial purposes.

Material Sale Applications care available from and may be submitted to any of the DNR Public Information offices listed above. Applicable State statute and regulations include, but are not limited to: AS 38.05.110-120, AS 38.05.550-565, and 11 AAC 71. Additional information on Material Sale Applications can be found at http://dnr.alaska.gov/mlw/factsht/material_sites.pdf.

Table 2-1: Summary of Selected Freshwater Criteria from 18 AAC 70.020(b)[1]

Pollutant	Water Use	Criteria
Sediment	Water Supply – Agriculture	For sprinkler irrigation, water must be free of particles of 0.074 mm or coarser. For irrigation or water spreading, may not exceed 200 mg/l for an extended period of time.
	Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	Percent accumulation of fine sediment in the range of 0.1 mm to 4.0 mm in the gravel bed of waters used by an anadromous or resident fish for spawning may not be increased more than 5% by weight above natural conditions. In no case may the 0.1 mm to 4.0 fine sediment range in those gravel beds exceed a maximum of 30% by weight.
Turbidity	Water Supply – Drinking, culinary, and food processing	Nephelometric turbidity units (NTU) may not exceed 5 above natural conditions when the natural turbidity is 50 NTU or less. May not have more than 10% increase in turbidity when natural turbidity is more than 50 NTU, not to exceed a maximum increase of 25 NTU.
	Water Supply – Aquaculture & Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	May not exceed 25 NTU above natural conditions. For all lake waters, may not exceed 5 NTU above natural conditions.
	Water Recreation – Contact	May not exceed 5 NTU above natural conditions when the natural turbidity is 50 NTU or less. May not have more than 10% increase in turbidity when natural turbidity is more than 50 NTU, not to exceed a maximum increase of 15 NTU. For all lake waters, may not exceed 5 NTU above natural conditions.
	Water Recreation – Secondary recreation	May not exceed 10 NTU above natural conditions when the natural turbidity is 50 NTU or less. May not have more than 20% increase in turbidity when natural turbidity is more than 50 NTU, not to exceed a maximum increase of 15 NTU.

Table 2-1: Summary of Selected Freshwater Criteria from 18 AAC 70.020(b)[1]

Pollutant	Water Use	Criteria
		For all lake waters, may not exceed 5 NTU above natural conditions.
Petroleum Hydrocarbons	Water Supply – Aquaculture & Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	Total aqueous hydrocarbons (TAqH) in the water column may not exceed 15 µg/L. Total aromatic hydrocarbons (TAH) in the water column may not exceed 10 µg/L.

[1] Refer to regulations for full description of criteria and designated uses:
DEC, 18 AAC 70, Water Quality Standards (Amended as of April 8, 2012)
http://dec.alaska.gov/commish/regulations/pdfs/18%20AAC%2070.pdf

Table 2-2: Summary of Selected Marine Criteria from 18 AAC 70.020(b)[1]

Pollutant	Water Use	Criteria
Sediment	—	No numeric criteria. See 18 AAC 70 for descriptive criteria.
Turbidity	Water Supply – Aquaculture & Water Recreation (Contact and Secondary)	May not exceed 25 NTU.
	Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife & Harvesting for Consumption of Raw Mollusks or Other Raw Aquatic Life	May not reduce depth of the compensation point for photosynthetic activity by more than 10%. May not reduce the maximum secchi disk depth by more than 10%.
Petroleum Hydrocarbons	Water Supply – Aquaculture & Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	TAqH in water column may not exceed 15 µg/L. TAH in water column may not exceed 10 µg/L.

[1] Refer to regulations for full description of criteria and designated uses:
DEC, 18 AAC 70, Water Quality Standards (Amended as of April 8, 2012)
http://dec.alaska.gov/commish/regulations/pdfs/18%20AAC%2070.pdf

3 DETERMINING POTENTIAL IMPACTS

Key Points – Chapter 3

- Prevent potential impacts by gathering information and understanding the characteristics of the mine site:
    - Topography
    - Climate
    - Vegetation
    - Soil properties
    - Extraction material properties
    - Groundwater conditions
    - Proximity to
        - Public water system sources
        - Surface water bodies
        - Contaminated sites

Potential pollutants of surface and groundwater from gravel pits include sediment, turbidity, total metals, and/or petroleum hydrocarbons. An increase in turbidity within a stream environment may result in a potential decrease in available free oxygen necessary to support aquatic life. An increase in the concentration of total suspended solids, such as silt or decaying plant matter, can destroy water supplies for human, animal, and other wildlife consumption. Increased sediments in water can also potentially damage fish gills by abrasion, and smother or bury fish redds, effectively killing them.

It is easier and cheaper to prevent impacts to the environment before they happen, rather than attempting to fix them after they have occurred. When planning a mining operation, it is important to determine what impacts that operation might have on the surrounding environment and vice versa. A preliminary assessment should be performed which gathers information on general site conditions, Alaska-specific conditions, and the proximity of public water system sources, surface water bodies, and contaminated sites. Much of the information that should be gathered can be obtained over the internet from sites given below, and by a qualified person performing a thorough field reconnaissance of the mine site.

3.1 General Site Conditions

Before developing a mining plan, it is important to gather information on general site conditions, including local topography, climate, vegetation, soil properties, extraction material properties, and groundwater conditions. In looking at topography, consider the proposed operation with respect to slopes, slope aspects, and natural drainages. Also consider climate, particularly precipitation and wind. These factors will greatly influence the sensitivity of the site to erosion and sediment transport, which can be detrimental to water quality (see Chapter 7). The type of local vegetation, as well as the type, distribution, and thickness of soil are also important to understand because vegetation is one of the best sustainable means of preventing erosion. Local vegetation is already suited to the environment and, if planted in appropriate soil, will require little maintenance and facilitate cost effective reclamation. The type, depth, and thickness of the material to be extracted should also be understood in order to appropriately plan cuts, benches, etc. It is also important to know if the material to be extracted contains naturally occurring asbestos (NOA), which can be a hazard to mine workers and users of the product, or acid-forming minerals that could contribute to acid mine drainage. The presence of NOA can negatively impact worker health and significantly affect the market available for the resulting aggregate. Basic groundwater characteristics should also be determined, such as groundwater depth, gradient, and the presence or absence of confining layers. It is necessary to have a basic understanding of all these factors (topography, climate, vegetation, soil properties, extraction material properties, and groundwater conditions) in order to understand how a mining operation and the natural environment will interact with one another. It is the understanding of that interaction which allows the development of a mining plan that prevents impacts to surface and groundwater quality.

3.2 Alaska-Specific Conditions

The environments found in Alaska are highly diversified and often extreme. Temperature, precipitation, and wind are key factors that must be taken into account when planning a mining operation, keeping in mind that conditions at one mine site in Alaska may be very different from another at a different location. The mean minimum temperature in Alaska in January ranges from about 23°F in the southeast to -31°F in parts of Northcentral. Figure 3-1 shows mean annual precipitation in Alaska. As shown in this figure, Southeast Alaska and parts of Southcentral receive over 2,000 mm (approximately 78 inches) of precipitation a year. In areas of high precipitation such as these, BMPs targeted to divert or manage stormwater runoff are more critical. Seasonal temperature and precipitation fluctuations also greatly affect the types of vegetation that can be used for soil stabilization, and when they can effectively be planted.

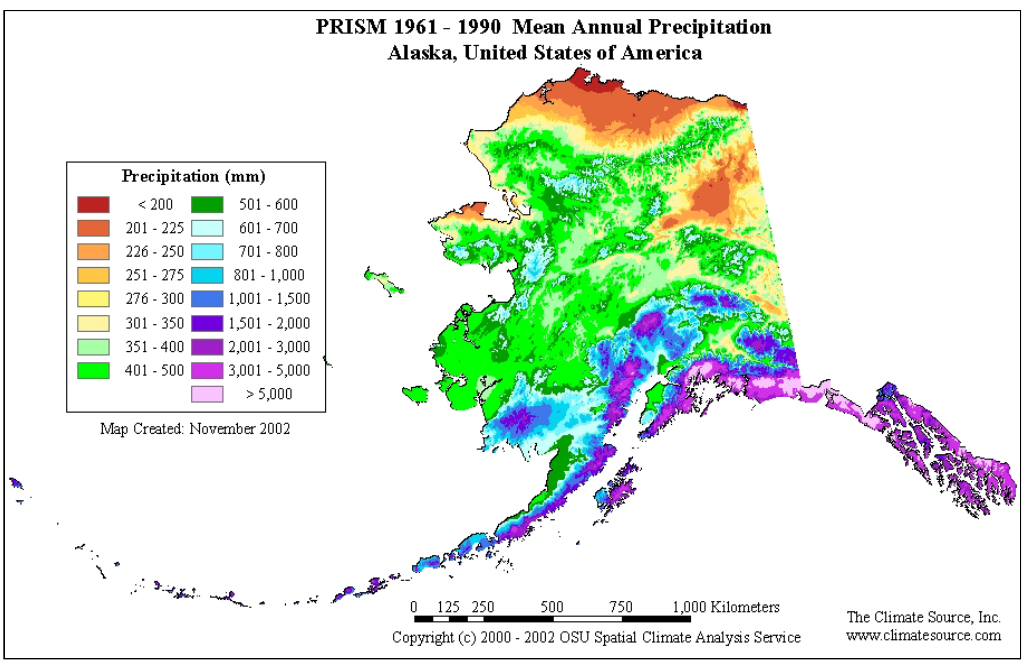

Figure 3-1: Mean Annual Precipitation in Alaska

High winds can increase erosion of exposed soil. A normal storm track along the Aleutian Island chain, the Alaska Peninsula, and all of the coastal area of the Gulf of Alaska exposes these parts of the state to a large majority of the storms crossing the North Pacific, resulting in a variety of wind problems. Direct exposure results in the frequent occurrence of winds in excess of 50 mph during all but the summer months. Wind velocities approaching 100 mph are not common but do occur, usually associated with mountainous terrain and narrow passes. Winter storms moving eastward across the southern Arctic Ocean cause winds of 50 mph or higher along the arctic coast. Except for local strong wind conditions, winds are generally light in the interior sections (Western Regional Climate Center 2006). Erosion control BMPs should be used in areas with high winds or during high wind seasons.

3.3 Proximity Mapping

Surface runoff and groundwater flow are not constrained by mine site boundaries. Surface and groundwater interact with one another and, although it may not be visible, groundwater can flow from one side of a mine site to another, picking up or dropping off pollutants along the way. Mining changes the natural landscape and therefore can change the flow patterns of surface water and groundwater. It is therefore important to ascertain the proximity of public water system sources, surface water bodies, and existing and potential sources of contamination.

The Alaska Department of Environmental Conservation (DEC) has established drinking water protection areas which act as recommended buffer zones, which are available at their website, given below. Drinking water protection areas should be shown on maps submitted with permit applications wherever proposed project area boundaries fall within drinking water protection area buffer zones. Surface water bodies such as lakes, rivers, and streams can be identified on many web-based maps, such as Google Earth™. Some surface water bodies are considered by DEC to be impaired waters, meaning that they are too polluted or otherwise degraded to meet water quality standards. For these water bodies, a Total Maximum Daily Load (TMDL) for pollutants has been determined or will be developed. A TMDL is the maximum amount of a pollutant that a water body can receive in a day and still meet water quality standards. If a mine operation will place pollutants into impaired waters, via permitted discharge or otherwise, it is important to know the TMDLs for that water body. The location of impaired waters and the associated TMDLs can also be found on the DEC website, given below.

In areas of contamination, mining operations can expose contaminants in groundwater or cause them to migrate to previously unaffected areas by altering the groundwater flow regime. DEC has identified and mapped many contaminated sites, and these can be found on the website below. Other potential sources of contamination to consider are industrial sites where contamination has occurred but has not been detected or reported, abandoned mine sites, and untouched locations with natural acidic drainage.

The locations of drinking water protection areas, locations of impaired waters, TMDL information, identified contaminated sites, and other GIS data associated with DEC permits are available at http://dec.alaska.gov/das/GIS/apps.htm.

4 GENERAL GUIDELINES AND RECOMMENDATIONS FOR PROTECTING SURFACE WATER AND GROUNDWATER QUALITY

Some of the best ways to prevent mining impacts to surface and groundwater quality are to maintain distance between mining operations and the water to be protected, and to monitor water quality. This chapter presents recommended setbacks for mining operations from public water system (PWS) source areas, surface water bodies, and the groundwater table. Where proposed mining is closer to these waters than the recommended setbacks, it is recommended that a detailed hydrogeologic study be performed by a qualified person to evaluate potential impacts and design effective mitigation alternatives.

Key Points – Chapter 4

- Surface water and groundwater quality can be protected in part by:
  - Setbacks/Separation from:
    - PWS source areas
    - Surface water bodies
    - Groundwater table
  - Monitoring of:
    - Quantity
    - Temperature
    - pH
    - Specific conductance
    - Contaminants
  - Detailed hydrogeologic studies

4.1 Setbacks

Depending on the site, permits may require specific horizontal setbacks from water bodies or vertical separation distance from the groundwater table. All requirements of any permit should be met at all times. The following sections provide some general guidance for instances where setbacks are not specifically addressed in permitting.

4.1.1 Public Water System (PWS) Source Areas

DEC has established drinking water protection areas and recommended buffer zones for public water system (PWS) sources, which can be found at http://dec.alaska.gov/das/GIS/apps.htm. There are also PWS sources for which drinking water protection areas have not yet been delineated. For those PWS sources, it is recommended that the buffer zone be considered a 1,000-foot radius around the source area. It is recommended that excavation limits be restricted to areas outside any PWS source buffer zone. Equipment storage, maintenance, and operation should be as limited as possible within designated buffer zones, and appropriate BMPs should be used to prevent water contamination (see Chapter 6).

4.1.2 Lakes, Rivers, and Streams

Due to the interconnected nature of surface water, an impact to one part of a stream or river can have dramatic consequences downstream or upstream and affect the quality of surface and groundwater far from a mine site. Appropriate setbacks from surface water bodies will vary from case to case, but in general, a minimum setback of 200 feet is recommended between excavation limits and the ordinary high water level of surface water bodies, including lakes, rivers, and streams. For in-water work, a U.S. Army Corps of Engineers Section 404 permit for discharging dredged or fill material would be required. BMPs for in-stream work would be site-specific and addressed in the permit. Mine sites that affect levee-protected areas may require a U.S. Army Corps of Engineers Section 404 permit.

4.1.3 Groundwater and Working Below the Water Table

In general, it is recommended that mines maintain a minimum of four (4) feet of vertical separation distance between extraction operations and the seasonal high water table, and that they restrict activities that could significantly change the natural groundwater gradient.

If mining must be done below the water table, groundwater may become exposed. Upon issuance of a local government conditional use permit, if available, allowing extraction of materials from below the seasonal high water table, no extraction should be performed below the first aquitard encountered within the saturated zone. During the active operation phase of a gravel pit, the top portion of the groundwater is considered treatment works, as authorized under 18 AAC 60 or 18 AAC 72, as long as it does not come in contact with hazardous contaminants. When operation at the gravel pit ceases, the exposed groundwater will once again become a water of the state. At that time, the water will need to comply with water quality standards based on the applicable designed use.

Notice to discharge is required under the Excavation Dewatering General Permit (EDGP) for discharges to land of equal to or greater than 250,000 gallons, or discharges to land at a rate equal to or greater than 40 gallons per minute. For discharges less than this volume and rate, notice under the Excavation Dewatering General Permit is not required; however, the discharge requirements in the permit must be followed. The Multi-Sector General Permit (MSGP) covers excavation pit dewatering discharges to surface waters. However, if an operation is within 1 mile from a contaminated site, the MSGP does not apply and authorization under the EDGP may be required. The DEC will provide more information on conditions and best management practices for a specific site in its permit. If excavation dewatering is needed, BMPs will be required to minimize adverse impacts to the receiving waters resulting from dewatering activities. Some general BMPs for dewatering are presented in Chapter 8.

4.2 Monitoring

Monitoring is the best way to measure the impact of a mining operation on surface water or groundwater quality, and is often required by permit. If required by permit, parameters to be monitored will be specified. Monitored parameters often include:

- surface water and groundwater elevation,
- surface water and groundwater flow,
- surface water and groundwater temperature,
- turbidity,
- pH,
- specific conductance, and
- likely contaminants.

The appropriate or required timeframe for monitoring will vary from case to case, but in general a good practice is to monitor relevant parameters at least 1 year prior to mining, throughout mining, and at least 1 year after reclamation is complete. Monitoring prior to mining provides a baseline record of preexisting conditions and establishes a range of seasonal variability and responsiveness to external influences among measured parameters. Once mining has started, this baseline data cannot be obtained. Monitoring during mining allows early detection of impacts and provides opportunities to evaluate BMP effectiveness and implement additional or different BMPs as needed. Monitoring after reclamation can provide early indications of slow onset problems that may develop after mining shuts down, such as acid drainage. A thorough monitoring program protects both water quality and the mining operation. It is much easier to resolve disputes quickly and fairly with a complete and comprehensive set of data in hand. Modern datalogging equipment can be used to measure and record many parameters at a high frequency with relatively low labor costs. High frequency data provides the ability to evaluate and document impacts from things like climactic and flood events.

Water quality sampling and hydrologic data collection should be accomplished under the supervision of a qualified professional engineer, hydrogeologist, or hydrologist and follow a written sampling plan approved by the permitting agency. All data should be made available to permitting agencies upon request, with the understanding that the permitting agency may provide the data to other public agencies and to the general public upon request.

DEC has prepared a document entitled Monitoring Well Guidance, which provides recommendations for monitoring well construction, maintenance, and decommissioning (http://dec.alaska.gov/spar/csp/guidance/Monitoring%20Well%20Guidance.pdf).

4.3 Detailed Hydrogeologic Studies

Where proposed mining is closer to PWS sources, surface water bodies, or groundwater than the setbacks recommended in this chapter, it is recommended that a detailed hydrogeologic study be performed to evaluate surface and groundwater relationships and potential impacts, and to design effective mitigation alternatives. The hydrogeologic study should be conducted by a qualified person and address the following general framework, modified from Fellman (1982):

1. Geology, topography, and drainage
2. Surface Water
    - Location
    - type (e.g., river/stream, gradient, flow volume, seasonal variability in flow, etc.)
    - present surface water quality and quantity
    - present use of surface water
3. Groundwater
    - depth to groundwater
    - aquifer type (e.g., confined, unconfined, multiple aquifers, perched water, geologic material description, etc.)

- groundwater gradients, flow rates, flow directions
- surface water and groundwater interaction
- present groundwater quality and quantity
- present use of groundwater

4. Determine possible effects of mine development on water quality and quantity
5. Develop strategies to mitigate possible effects
6. Establish a monitoring program

5 HOW TO CHOOSE BEST MANAGEMENT PRACTICES

Key Points – Chapter 5

- ➢ Source controls are usually more cost effective, easier to implement, and more effective than treatment controls.
- ➢ The selection of a BMP will most likely be driven by cost, effectiveness, availability, feasibility, durability, compatibility, and operation.
- ➢ Several factors, including climate and soil type, impact the effectiveness of a BMP.
- ➢ Using BMPs at your site may result in more money in your pocket and more fish in Alaska's streams.

This chapter discusses types of BMPs, BMP selection criteria, and some issues to consider when selecting BMPs. In most cases, one BMP will not meet all the goals of a project. Appropriate BMPs for a project may vary seasonally, may be site specific, and may depend on the phase of mine operation. Chapters 6 through 9 provide detailed BMPs for preventing chemical pollution, controlling erosion and sediment, managing stormwater, mine operations, and mine reclamation. This chapter discusses the process of selecting appropriate BMPs.

The first steps in selection of BMPs are to understand the site, understand regulatory requirements (see Chapter 2), and determine potential impacts (see Chapter 3). Local, regional, and statewide issues, concerns and requirements should also be considered, as these will also influence aspects of planning, the selection of the BMPs, and the time frame for implementation. With intelligent mine planning, BMPs can be implemented in such a way that they complement one another and efficiently achieve impact mitigation goals.

5.1 Types of BMPs

Stormwater BMPs are implemented at two general levels:

- ***Source controls***: practices that prevent pollutants from coming in contact with stormwater.
- ***Treatment controls***: practices that treat stormwater once it has come into contact with pollutants.

Source controls are given priority over treatment controls, as they are generally more cost effective, easier to implement, and more effective at minimizing pollution. Source controls include things like vegetating bare slopes to prevent wind and stormwater from transporting sediment, restricting mine traffic to haul roads, and using wheel washers to avoid tracking sediment. Treatment controls are practices that reduce pollutants in water through chemical or physical systems, like settling ponds or oil-water separators.

5.2 Selection Criteria

To determine best practices for a specific project, a menu of potential BMPs should be identified with the goals of the project in mind. Selection criteria for BMPs can include:

- Effectiveness
- Implementation cost
- Temporary vs. permanent
- Cost of construction
- Long-term cost (operation and maintenance)
- Suitability for the site, including environmental compatibility
- Regulatory acceptability
- Availability
- Durability
- Longevity
- Ability to achieve vegetation schedule
- Technical feasibility
- Public acceptability
- Risk/liability

Of these criteria, cost, effectiveness, availability, feasibility, durability, compatibility and operation will most likely drive the selection of a particular BMP. Each of these factors is discussed below. Information was obtained from Oregon Department of Environmental Quality's *Erosion and Sediment Control Manual* (April 2005).

Cost. Things to include in the evaluation of cost effectiveness of a BMP include material costs, preparation costs, installation costs, maintenance costs, and cost of government requirements.

Effectiveness. BMPs should only be implemented if they will be effective. Not all BMPs work in all types of conditions.

Availability. The BMP materials must be readily available from a local supplier or be capable of immediate shipment to the area within the timeframe designated by the plans. This may be a significant issue in Alaska, specifically in areas not accessible by a road year round.

Feasibility. The BMP materials must be capable of relatively quick and easy application with minimal training required. Each BMP should be considered for its flexibility or applicability to a variety of field conditions. Factors to be considered relative to feasibility include:

- The number of steps needed to apply the BMP;
- Whether machinery is required;
- Whether locally available materials can be utilized; and
- The time required for the BMP to be operational, including time needed to not be affected by rainfall.

Durability and Compatibility. Given the nature of the site conditions, the BMP materials must maintain their structural integrity throughout use. History of durability in Alaska or cold weather climate is important. Environmental compatibility is also highly important. For example, if using a vegetative cover BMP, the plants chosen for the vegetative cover must be compatible with native plants and the climate. The State of Alaska suggests using native plants. The Alaska Plant Materials Center (contact information listed in Appendix B) has published, "A Revegetation Manual for Alaska," which can be found at http://dnr.alaska.gov/ag/RevegManual.pdf.

Operation. Regardless of the BMPs selected, follow-up is always required. Maintenance and repair requirements, and their cost, should be considered. Training of staff for BMP operation may be required for optimal effectiveness of the BMP selected.

Information regarding the required material, equipment, costs, specifications (including operation and feasibility) and compatibility for individual BMPs is provided in Chapters 6 through 9.

5.3 General Considerations

Some issues to consider when choosing BMPs include the following:

- Consider how selected BMPs will work when implemented together as part of a system.
- Climate, particularly precipitation and winds, may have the biggest impact on what type of BMPs are needed for stormwater, erosion, and sediment control.
- Where possible, significant grading operations or exposure of soil should be planned during periods of low rainfall.
- Total exposed soil areas and duration of exposure should be reduced during high rainfall times.
- Wheel washing activities may be needed during high rain events to reduce tracking of sediments.
- Sediment control measures such as berms and silt fencing may not alone adequately reduce discharge during high rainfall.
- Higher than normal amounts of runoff may need to be diverted during high rain events.
- BMPs may need increased inspection and maintenance in areas or times of high rainfall.

5.4 Special Conditions

In addition to the issues discussed previously in this section, some projects may need to consider special operations in choosing appropriate BMPs. Some situations that require special consideration include the dewatering of an excavation pit, mining of gravel below the water table, gravel washing operations, and working in streams and rivers.

5.5 Benefits of Best Management Practices

Properly selected and maintained BMPs can result in economic and environmental advantages for gravel extraction businesses in Alaska.

Some of the **economic benefits** gained from an aggressive soil stabilization plan for a gravel pit may include:

- Stabilized slopes require less repair and are safer for operators;
- Reducing short- and long-term erosion will result in less soil loss;
- Reduction in restoration costs at the end of the project;
- Negative public opinion can be minimized;
- Liability exposure can be decreased; and
- The potential for monetary fines from non-compliance to a permit can be reduced or eliminated.

Some of the **environmental benefits** of effective BMPs are:

- Protection of fish spawning areas, their food sources and habitat;
- Reduction of toxic materials that are introduced into the environment by their attachment and transport by sediment particles;
- Lowered impact on commercial fisheries from decreased sediment;
- Improved water storage capacities in lakes and wetlands; and
- Protection of receiving waters with designated uses such as for drinking water, recreation and wildlife habitat.

6 BEST MANAGEMENT PRACTICES FOR PREVENTING CHEMICAL POLLUTION

Key Points – Chapter 5

- Sources of chemical pollution include:
  - Chemical reactions involving naturally occurring materials
    - Acid Mine Drainage
    - Radioactivity
  - Release of chemicals brought to the site
    - Petroleum Products
    - Antifreeze

Chemical pollution can occur at mine sites due to reactions that release chemicals from the naturally occurring materials, such as acid mine drainage, or by the release of chemicals brought to the site, such as diesel fuel or antifreeze. This chapter provides BMPs to mitigate common forms of both types of chemical pollution. Chemical pollutants can be mitigated with both source and treatment controls. However, as discussed in Chapter 5, source controls are generally more cost effective, easier to implement, and more effective in minimizing pollution.

6.1 Pollution From Native Materials

6.1.1 Acid Mine Drainage

Acid mine drainage (AMD) results from weathering of acid-forming minerals, such as pyrite (FeS_2), in the presence of water and oxygen. The weathering reaction forms sulfuric acid (H_2SO_4), which can drastically lower the pH of surface and groundwater and allow toxic levels of metals to leach into it. While it may occur on natural rock outcrops, it can be exacerbated by excavation for mining or road building.

The first step in preventing AMD is determining if and where acid forming materials are located on your site. Published geologic maps and qualified professionals can help you determine if acid forming materials, such as pyrite, are likely to exist on your site. AMD is most intense in environments where the acid-forming material is cyclically wetted and dried. The key concept in preventing AMD is preventing the weathering reaction in acid-forming materials that generates acid. This is done by limiting the material's exposure to oxygen or water, or both. AMD can be prevented as follows:

- Separate spoils containing acid forming materials for immediate disposal.
- Dispose of the acid-forming material in a designated area with a liner and cap sufficient to keep the weathering reaction from occurring.
- Immediately deal with seams of acid forming minerals remaining in highwalls. This can be done by covering the exposure with water in a permanent impoundment. The impoundment will need to be treated with a buffering agent such as lime until the reaction stabilizes.

If AMD is already occurring at a site, it may be mitigated in part by active or passive measures. Active measures include direct chemical treatment systems. In these systems, chemicals, like lime, are added to the drainage to neutralize acidity and cause metals to precipitate. This often results in a metal-laden sludge which must also be disposed of appropriately. Passive systems, which typically are designed for longer term (decades long) treatment, include constructed anaerobic wetlands and limestone drains. Passive measures are preferred, as they have lower overall maintenance costs.

- To construct an anaerobic wetland, mix limestone with an organic substrate, such as chicken litter. The limestone will reduce the acidity and, in anaerobic conditions, bacteria will remove some of the metal ions. Plants may also incorporate metal ions, helping to fix them to that location.
- A limestone drain is a conduit filled with coarse limestone fragments through which AMD passes. If kept anoxic (covered and saturated), the limestone will reduce acidity without causing metals to precipitate. Precipitates will form when the water comes into contact with oxygen outside the drain, and sludge can be collected in a pond there. The sludge can be placed as a lined and capped fill or sold, if metal content is sufficient. If the drain is open to the air, precipitates may armor the limestone and reduce efficacy.

6.1.2 Radioactive Tailings

Uranium is a naturally occurring radioactive element. It is also soluble in water. If present in uncovered tailings, Uranium can migrate into surface and groundwater, creating increased risk of radiation exposure. Tailings or other excavated materials that may contain Uranium should be isolated from surface and groundwater interaction. This can be accomplished by surrounding the Uranium-bearing fill with a clay liner and cap.

6.2 Petroleum Products

6.2.1 Storage and Handling

- Petroleum product storage and handling should not be performed within PWS source buffer zones, within 200 feet of surface water bodies, or directly adjacent to mining pits, particularly if groundwater is exposed.
- Fuel transfer should always be supervised by an employee to prevent overfill or spillage.
- Storage tanks should be inspected at least once per month.
- Storage tanks should have a secondary containment structure that is impervious to the contents of the tank, that is large enough to accommodate precipitation events, and that has a sump or valve for draining rainwater.
- Water accumulated in containment areas should be visually inspected for the presence of a rainbow sheen, indicating petroleum product contamination. If rainbow sheen is present, the water should be removed for appropriate disposal or allowed to evaporate,

but it should not be discharged. It is illegal to apply any type of oil dispersant without prior state authorization from DEC (this includes soap/dish detergent).

6.2.2 Used Oil

- Used oil can be burned for energy in a properly vented used-oil burner or transported off site for disposal or recycling.
- Check local regulations prior to burning used oil for energy or disposal in a burner or incinerator.
- Do not pour oil into the ground.
- Do not use oil for dust abatement.
- Do not use oil for weed control.

6.2.3 Designated Equipment Maintenance Areas

- Restrict equipment maintenance activity to one area at a site, outside PWS source buffer zones.
- Use drip pans when disconnecting lines to collect dripping fluids.
- Place oil-laden parts on a drip pan instead of the ground.

6.2.4 Hazardous Material Control (HMC)

- Prevent spills by implementing BMPs for the use, storage, and handling of petroleum products.
- Have a Hazardous Materials Control (HMC) Plan that addresses all types of spills possible at the site, such as fuel, hydraulic oil, grease, antifreeze, leaching chemicals, etc.
- Train employees on the HMC plan and practice it annually.
- Have spill response equipment on hand, including:
    - pads, booms, absorbents, shovels
    - containers (drums, dumpsters, etc.) to hold spilled waste and used absorbent products
    - protective equipment, like gloves
- Do not use water to dilute spills.
- For larger spills, use soil and booms to contain and divert spilled product away from surface water and mining pits.
- Have a defined, appropriate off-site disposal agreement in place and train staff on waste management.

6.2.5 Oil/Water Separators

If petroleum products spilled on a site make their way into stormwater runoff, they can be removed through the use of oil/water separators. Oil is less dense than water and will float to the surface if the two are mixed. Figure 6-1 shows two examples of possible oil/water separator designs that make use of this principal. Separated oil can be removed with absorbent pads or by skimming and disposed of appropriately. Keys to successful implementation of oil/water separators include:

- sufficient surface area for the oil to remain on the surface of the water,
- low enough water velocity to avoid mixing, and
- adequate residence time in the sediment pond for sediment to settle out before separation, and
- regular maintenance and clean out.

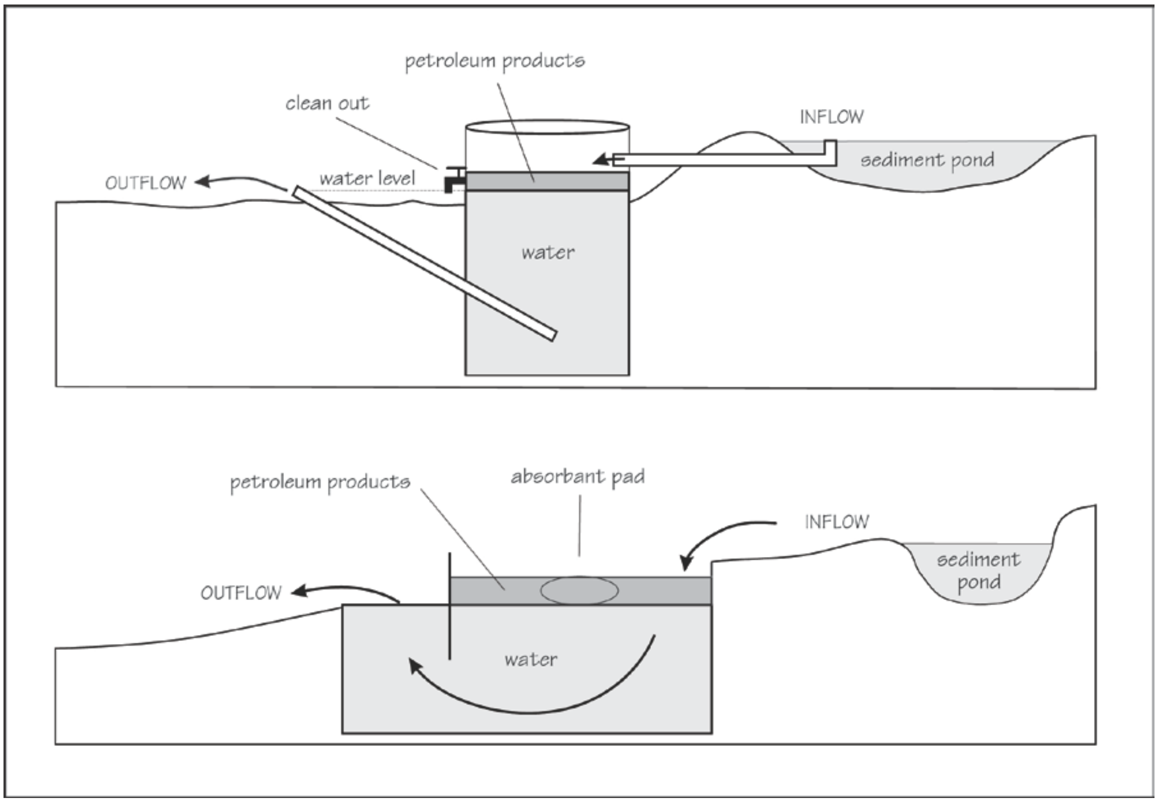

Figure 6-1: Oil Water Separator Details
(Modified from Washington State Department of Natural Resources, 1997.)

6.3 Hazardous Waste

Activities at a mine site may generate hazardous waste. Hazardous waste is any waste material that could be dangerous to human health and the environment. It is the mine's responsibility to determine whether a waste is hazardous or not. The federal government publishes lists of hazardous wastes and regulations regarding them. They may be found at http://www.epa.gov/osw/laws-regs/regs-haz.htm.

7 EROSION CONTROL, SEDIMENT CONTROL, AND STORMWATER MANAGEMENT

Key Points – Chapter 5

- Rain, wind, and melting snow can dislodge sediment and carry it to surface water bodies, degrading their quality.
- Use BMPs in this section to:
  - Prevent erosion
  - Control eroded sediment
  - Manage and treat stormwater

Stormwater is water runoff from rain and melting snow. Runoff can be sheet flow off of a site or it can drain to streams and ditches that route it to rivers, lakes, and marine water. In some areas, runoff is routed to storm drains, which ultimately discharge to surface waters. When stormwater flows across exposed soils, construction sites, or pavement, it can pick up and carry sediment, oil, bacteria, road runoff and other pollutants. Sediment and associated pollutants can clog ditches and culverts, destroy habitat and reduce oxygen for fish, and be toxic to aquatic life. Stormwater runoff is a common cause of water pollution and is a challenge to control. The key to limiting impacts is to prevent erosion, capture and control sediment that does erode, and proactively manage stormwater runoff, including runoff that comes to your site from other properties. It is important to remember that stormwater can run off of other properties and onto your site, bringing increased erosion potential and contaminants with it.

Erosion Control is any practice that protects the soil surface and prevents the soil particles from being detached by rainfall, snowmelt, or wind.

Sediment Control is any practice that traps the soil particles after they have been detached and moved by wind or water. Treatment controls, as well as source controls, can be used in controlling the transport of sediment. Such controls include passive systems that rely on filtering or settling the particles out of the water or wind that is transporting them.

Stormwater Management is the practice of collecting stormwater, diverting it away from disturbed areas, collecting it for treatment (if necessary), and discharging it to a receiving area with the capacity to absorb it.

In general, erosion control and good stormwater management practices are more effective than sediment controls, and are preferred because they keep the soil in place and enhance the protection of the site resources.

When implementing erosion and sediment control BMPs, the following principles should be adhered to as much as possible:

- Fit the natural topography, soils, and vegetation of the site;
- Minimize disturbances to natural vegetation;
- Minimize soil exposure during high precipitation storm events;
- Vegetate disturbed areas;

- Minimize concentrated flows and divert runoff away from slopes or critical areas;
- Minimize slope steepness and slope length;
- Utilize channel linings or temporary structures in drainage channels to slow runoff velocities;
- Keep sediment on-site using settling ponds, check dams, or sediment barriers; and
- Monitor and inspect the site frequently and correct problems promptly.

Erosion control systems cannot perform adequately without the control of runoff. It is important to control flow of runoff to prevent scouring exposed soil. Diverting stormwater away from potential pollutant sources and/or managing runoff from a site are one category of source control BMPs. Numerous factors may affect the amount of runoff generated from a site, including the following:

- Precipitation;
- Soil permeability;
- Watershed area; and
- Ground cover.

The risk of high sediment discharge is greatest in the spring when vegetative cover is not yet established and snowmelt runoff occurs. As winter ends, ensure all appropriate BMP structures are in place and that any elements damaged over the winter are repaired.

7.1 Erosion Control

7.1.1 Vegetation

From temporary stockpiles to permanent reclamation of slopes, vegetation is one of the very best guards against soil erosion. Vegetation is so effective because, if implemented properly, it is self-sustaining and works to protect the soil in a variety of ways. Vegetation absorbs some of the energy of falling rain. Its roots hold soil in place and maintain the moisture-holding capacity of the soil. It reduces groundwater infiltration through evapotranspiration, which is the sum of water reintroduced into the atmosphere by evaporation and plant transpiration. In transpiration, water moves up through a plant and is released into the atmosphere as water vapor through stomata in its leaves. At the ground surface, the presence of vegetation reduces surface flow velocities. Additional benefits of vegetation can include noise reduction, dust control, and improved visual appearance. Some guidelines for vegetation are:

- If an area is already vegetated and does not need to be disturbed, do not clear it.
- If an area must be cleared for mining, clear only the amount needed for expansion within one year.
- As an area is cleared, save the sod or slash and stake it down over the cleared slopes to temporarily filter runoff until the area is mined.

- Replace topsoil, revegetate, and reclaim mined areas as soon as possible.
- Use native species whenever and wherever possible. It would be ideal to use the same species that were cleared, but the growth rates of the native plants and the need for more immediate erosion control may make that impractical.
- Use plant species that are appropriate for the application and climate, and plant them at the appropriate time of year. Table 7-1 summarizes plant species that are commonly used at sites in Alaska.

The Alaska Plant Materials Center, under the DNR Division of Agriculture, has created a manual to help those involved in revegetation efforts select appropriate seed mixes and methods for revegetation. Gravel/rock aggregate extraction site operators should refer to this document, *A Revegetation Manual for Alaska* (2008) for detailed guidance on region-appropriate plant species and revegetation methods. It can be found at: http://dnr.alaska.gov/ag/RevegManual.pdf.

Additional information, including local sources for native plants and seeds, can be found on the Alaska Plant Materials Center website: http://plants.alaska.gov/index.php.

Table 7-1: Species/Cultivar Characteristic Chart (adapted from A Revegetation Manual for Alaska, 2008)

Species	Cultivar Or Equivalent	Availability[1]	Site Conditions Adaptation	Growth Form[2]	Height Average	Region Of Use[3]
Bluegrass, Alpine <u>Poa alpina</u>	Gruening	Fair	Dry	Bunch	6 in.	All
Bluegrass, Glaucous <u>Poa glauca</u>	Tundra	Fair	Dry	Bunch	10 in.	A,I,W
Bluegrass, Kentucky <u>Poa pratensis</u>	Merion	Excellent	Lawns	Sod	10 in.	I,SC,SE
Bluegrass, Kentucky <u>Poa pratensis</u>	Nugget	Good	Lawns	Sod	10 in.	I,SC,SE
Bluegrass, Kentucky <u>Poa pratensis</u>	Park	Excellent	Lawns	Sod	10 in.	I,SC,SE
Fescue, Red <u>Festuca rubra</u>	Arctared	Very Good	Dry to Wet	Sod	18 in.	All
Fescue, Red <u>Festuca rubra</u>	Boreal	Excellent	Dry to Wet	Sod	18 in.	W,I,SE,SC, SW
Fescue, Red <u>Festuca rubra</u>	Pennlawn	Excellent	Dry to Wet	Sod	12 in.	I,SC
Hairgrass, Bering <u>Deschampsia beringensis</u>	Norcoast	Good	Dry to Wet	Bunch	20 in.	All
Hairgrass, Tufted <u>Deschampsia caespitosa</u>	Nortran	Good	Dry to Wet	Bunch	20 in.	All
Polargrass <u>Arctagrostis latifolia</u>	Alyeska	Fair	Wetter Areas	Sod	24 in.	A,I,W,SC
Polargrass <u>Arctagrostis latifolia</u>	Kenai	Fair	Wetter Areas	Sod	24 in.	SC,SE,SW
Reedgrass, Bluejoint <u>Calamagrostis canadensis</u>	Sourdough	Fair	All	Sod	36 in.	All

1. Availability varies from year to year and within any given year.
2. Growth form and height will vary with conditions.
3. Region of Use: W = Western Alaska; I = Interior Alaska; SE = Southeast Alaska; SC = Southcentral Alaska; SW = Southwest Alaska; A = Arctic Alaska; All = All of Alaska.

7.1.1.1 Water and Fertilizer

Adequate water and nutrients are essential for successful revegetation. If it is suspected that the topsoil may be lacking in nutrients when it is time to plant, it may be worthwhile to have a chemical analysis done on it in order to determine what types of fertilizers would be helpful. When using fertilizers, try to apply them under conditions in which they are less likely to wash off into streams, rivers, and lakes. Losing fertilizer to surface water can have negative impacts on the ecological balance and is a waste of fertilizer.

7.1.1.2 Erosion Control Blankets and Mulching

Erosion control blankets are geotextiles made from natural materials, such as jute, coconut husk fibers, and straw, or synthetic materials like plastic. They help to hold seed and soil in place until vegetation is established. Erosion control blankets are very effective, but often prohibitively expensive for large areas. Mulching and hydroseeding are cheaper and also effective, though less effective in steep, erosion prone areas. A good practice is to use a combination of erosion control blankets in oversteepened and erosion-prone areas and to use mulch elsewhere to stabilize soil while vegetation becomes established. The effectiveness of blankets is greatly reduced if rills and gullies develop, so proper anchoring and ground preparation are important. The type of blanket selected depends on the longevity required, the gradient, climate, and other factors. The drawing below is one example. Follow the manufacturer's specifications for installation and stapling requirements.

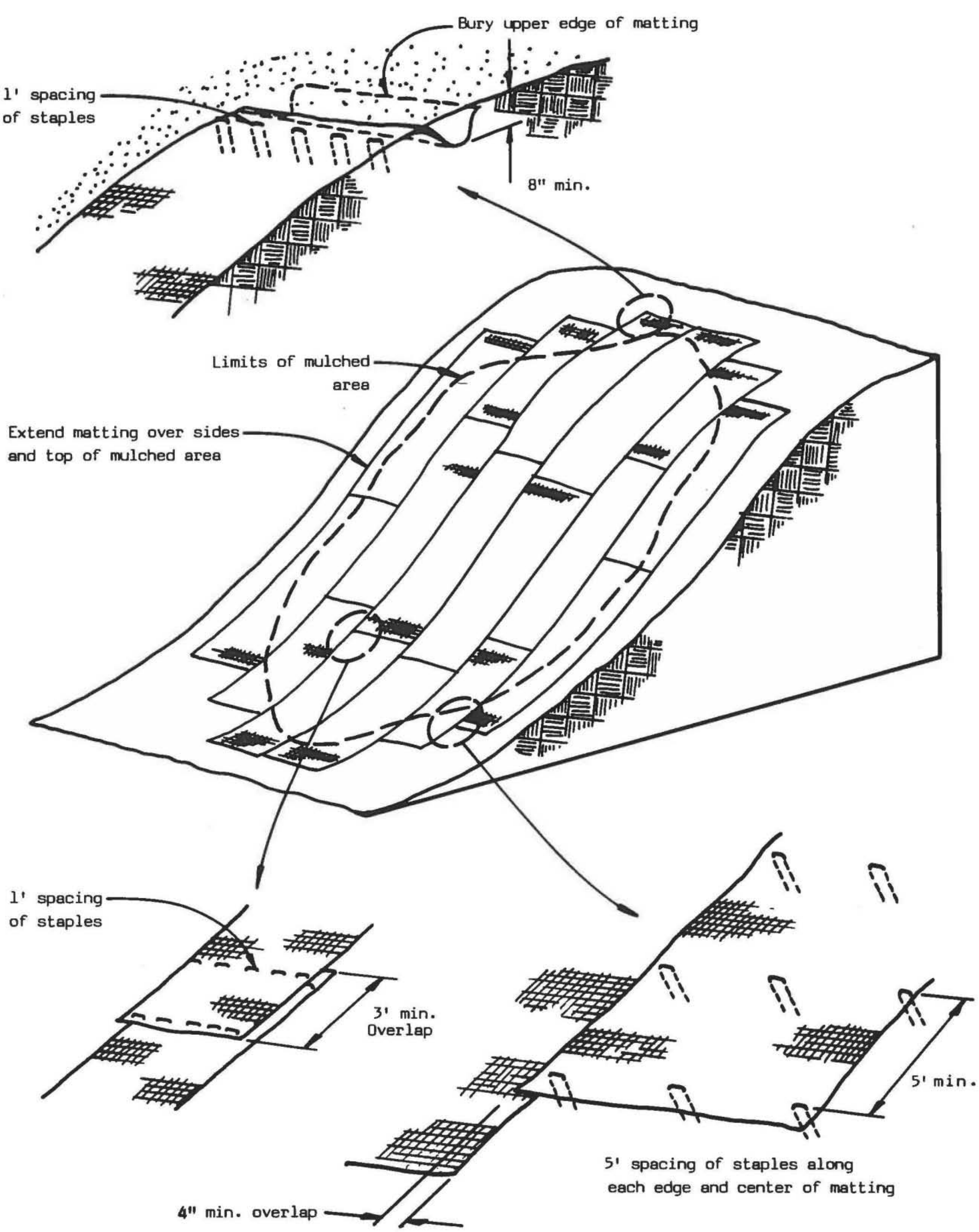

Figure 7-1: Erosion Control Blanket Installation
(Modified from Idaho Department of Lands, 1992.)

7.1.2 Wind Protection

Wind protection is any structure or method to block or reduce wind flow. The purpose of the BMP is to reduce the exposure of dust-generating material to wind. Techniques that reduce the exposure of dust-generating material to wind, or reduce the velocity of wind, will help in controlling dust generation and distribution (such as onto area vegetation or into surface waters) and in maintaining air quality. This BMP is appropriate for active and inactive sites with exposed soils, and is particularly useful around operations such as screening or crushing activities. Generally, wind protection includes:

- berms with trees and vegetation either placed or left in place;
- barriers, such as fences, around activities that might produce dust, such as screening and crushing (these barriers create a low pressure shadow which allows particles to settle to the ground rather than being released in the air and possibly settling off-site);

Windbreaks, whether composed of natural vegetation or fencing, will reduce wind speed for a distance of as much as 30 times the windbreak's height. For maximum protection, a windbreak setback should be two to five times the mature height of the trees. Other activities that might help reduce releases of dust include placing erodible mined materials in bays or bunkers, creating temporary enclosures or other containment, and covering transportation loads with tarps.

Figure 7-2: Wind Protection Example
(Photo: Alaska Sand and Gravel)

7.1.3 Grading

Grading is used for surface re-contouring, site operations, for implementing erosion control practices, and reclamation. A good grading plan will address sediment and runoff control needs, as well as final site stabilization or revegetation goals. Prepare a grading plan that details:

- slope angles and grade lengths;
- how graded areas are to be stabilized and protected from runoff;
- where and how excess earth material will be stored or disposed;
- berms for visual and wind protection;
- what potential new erosion and sediment loss conditions must be addressed;
- what drainage areas, patterns, and runoff velocities might be affected, and what provisions must be made, such as check dams or settling ponds; and
- seasonal or weather conditions that are of concern.

If possible, grading should not be done during an extreme rainfall event. Also to the extent possible, stabilize graded areas with hydroseed, vegetation, crushed stone, riprap, or other appropriate ground cover as soon as grading is completed. Use mulch or straw to temporarily stabilize areas where final grading must be delayed, and optimize finished slope angles for successful revegetation. During final grading, roughen slopes to retain water, increase infiltration, and facilitate root growth. In areas with high water tables, install underground drainage to prevent seepage, and thus keep the surface dry. Stable channels and floodways must be maintained to convey all runoff from the developed area to an adequate outlet, to avoid causing increased unintended erosion, ground instability, or off-site sedimentation.

7.1.4 Chemical Soil Binders

Chemical soil binders can be used as a cost effective alternative to geotextiles, or as an additive to mulches, as a means of protecting soil from erosion while vegetation becomes established. The binders are typically long chain polymers that work by binding soil particles together. The material usually comes in a liquid or powder form, is effective for 90 to 180 days, and costs on the order of $50 per acre. The chemical soil binder used should be tailored to the specific soil conditions found at the site. They should not be used where they might wash into surface water bodies or where forbidden by permit.

7.1.5 Biotechnical Slope Stabilization

Biotechnical stabilization uses live layers of brush imbedded in the ground to reduce surficial erosion and the risk of shallow slope failures. Steps:

- Cut branches and stems of trees and bushes up to 3 inches in diameter, preferably during the dormant season (fall or early spring).
- Lay the branches and stems between lifts of compacted soil in a criss-cross fashion so the structure extends the full width of the fill. Branches should protrude from the face of the fill slope.
- Space horizontal brush layers no more than 3 to 5 feet apart vertically. Closer spacing may be appropriate near the base of the slope.

- Alternate layers of brush and compacted fill from the toe to the top of the slope.
- Ideally, the cuttings will root and live shoots will develop, which will help control erosion.
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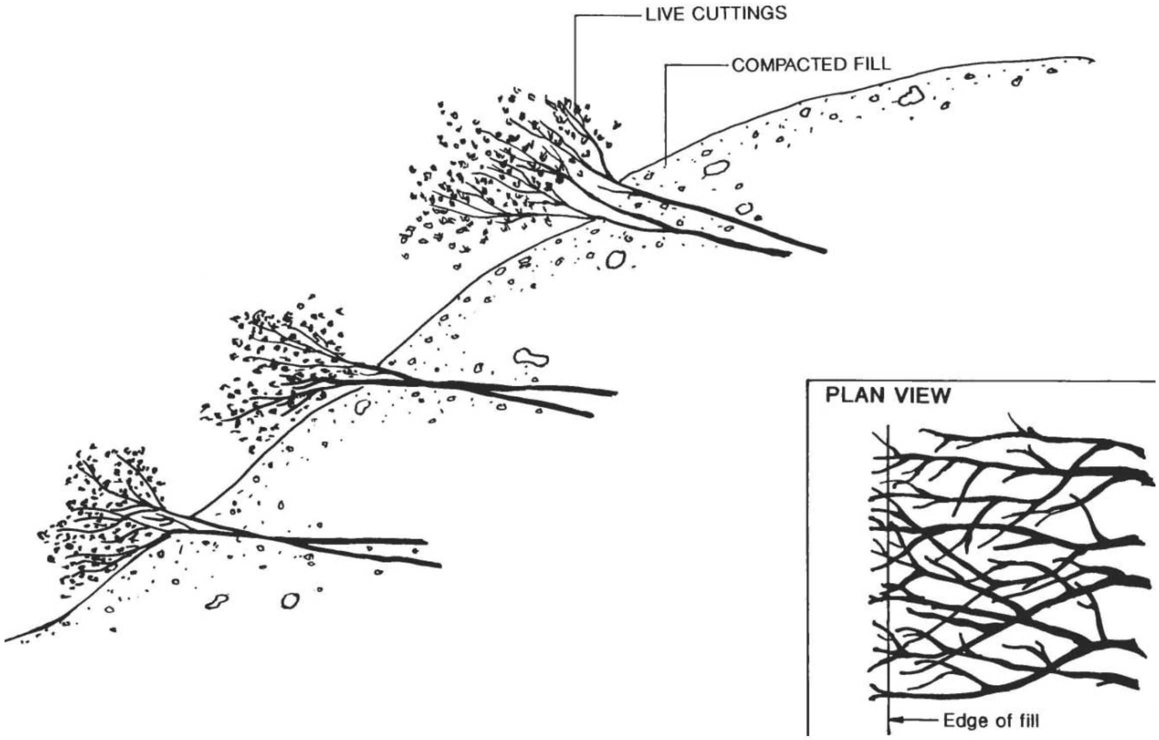


Figure 7-3: Biotechnical Stabilization Detail
(Modified from Idaho Department of Lands, 1992.)

7.1.6 Covering, Tarps, Geotextiles, and Caps

Slopes and stock piles can be covered with a variety of materials for a number of purposes. Some reasons to cover piles include immediate dust and erosion control, establishment of vegetation for sustainable erosion control, chemical stabilization of acid-forming material (reducing water and oxygen), and preventing contaminant release by reducing infiltration. Materials and applications are discussed below.

Tarps – for short term dust and erosion control.

> Tarps (tarpaulins) are a synthetic fabric usually made of vinyl, vinyl-coated polyester, or polyethylene. They can be placed over piles and fixed with pins, stakes, ropes, or ties, and weights like sandbags or tires. Edges should overlap like shingles to shed water. Tarps are effective in temporarily reducing erosion from light wind and stormwater. They tend, however, to degrade quickly. If long term erosion control is needed, other BMPs such as vegetation and geotextiles should be considered.

Geotextiles – for erosion control while establishing vegetation.

> The term geotextile encompasses a wide variety of fabrics, some made of natural materials and some synthetic. Geotextile manufacturers can typically recommend

appropriate products for specific applications. Typical uses of synthetic geotextiles at mine sites include use in silt fences (see page 34) and use as a liner for structures like trench drains (see page 38). Natural geotextiles, such as a coconut fiber mesh, can be used to reduce erosion on piles or slopes while vegetation is being established. They degrade over time, but their function is usually taken up by the vegetation they helped to foster.

Caps – for reducing infiltration and availability of oxygen.

Capping material to seal in contaminants, reduce infiltration, or reduce oxygen exposure is typically accomplished with a layer of very low permeability sediment, such as clay. Cap design thickness depends very much on the performance requirements of the cap, the environment, and the properties of material used in the cap. Caps are often on the order of a couple of feet thick. In situations where contaminants like acid rock drainage are involved, cap performance should be monitored. Permanent caps can be covered with topsoil and vegetated.

7.1.7 Riprap Stabilization

Riprap is loose, hard, angular rock (stone) placed over soil to help protect against erosion. It is generally used to protect ditches and channels (Figure 7-4), shorelines and stream banks, or drainage outlets. General guidelines to install riprap stabilization include:

- Place a layer of filter material (geotextile, sand, or fine gravel) between the soil to be protected and the riprap to prevent soil from migrating into the riprap.
- For the riprap, select a mixture of stone sizes. The mixture should contain mostly large stones, with enough smaller clasts to fill most of the void between the larger ones. The appropriate size of the riprap will depend on the site. Faster flows will require larger stones to protect against erosion. Some technical guidance on proper sizing of stones for riprap based on water velocity and other factors is provided in *Stream Restoration Design, Part 654 of the National Engineering Handbook*, published by the United States Department of Agriculture Natural Resource Conservation Service, available at http://www.nae.usace.army.mil/reg/nrrbs/TECHNICAL-SUPPLEMENTS/TS14C.pdf.
- Carefully place the riprap so as not to damage the filter material liner.
- In general, the thickness of the riprap layer should be 1.5 times the diameter of the largest stone, and no less than 6 inches thick.
- For shore or bank protection, riprap should be placed along the slope from a depth of 3 feet below the water line to a point above the high water mark where vegetation can be established.
- Routinely inspect riprap stabilization and repair it immediately if it becomes damaged or moves. If disruption is frequent, larger stones may be needed.

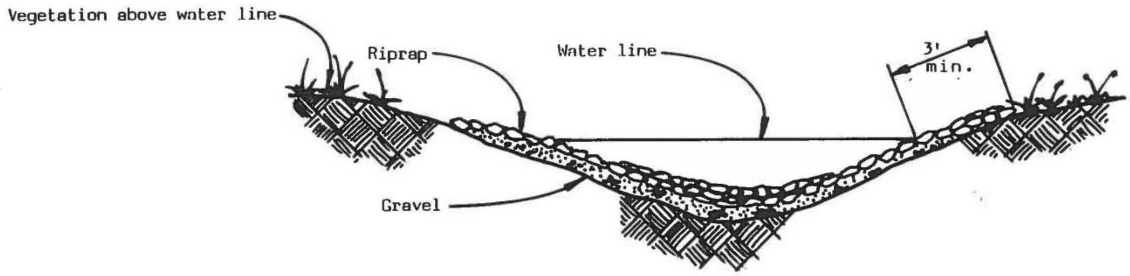


Figure 7-4: Riprap Stabilized Channel or Ditch
(Modified from Idaho Department of Lands, 1992.)

7.1.8 Outlet Protection

Outlet protection prevents scouring and sediment disruption at the location of outlets. It is typically established using riprap stabilization techniques (see page 31) to create an apron immediately below where the outlet releases to the receiving area. If needed, outlet protection can be upgraded to include sediment screens (Figure 7-5) or devices to prevent upstream fish migration.

This culvert captures sediment at a material extraction site that is operated by the City and Borough of Sitka. Photo courtesy of DEC.

Figure 7-5: Outlet Protection Example

7.2 Sediment Control

7.2.1 Sediment Barriers

Sediment barriers are used along the bottom of stockpiles or disturbed areas that trap sediment while allowing water to pass through. Three common types of sediment barriers are straw bale barriers, silt fences, and brush barriers. All of these are temporary measures and should be used to keep sediment contained until the source can be better controlled.

7.2.1.1 Straw Bales

Straw bales can be used to make successful sediment barriers, but are often poorly installed and therefore ineffective. Keys to good installation are:

- Set straw bales in a 6-inch-deep trench with vertical walls, dug along a topographic contour (Figure 7-6).
- Anchor the bales using rebar or steel pickets.
- For higher flow, combine with a gravel check dam (Figure 7-7).

Straw bales are best used as a short-term solution to relatively small sediment problems. They will float until they are wet and will typically last only 3 months once they become wet. Straw bale barriers in swales generally should not receive flows greater than about 0.3 cubic yards per second, and sediment should be removed once it reaches half the dam height. Keep in mind that when straw bale barriers fail, which they ultimately will if they are neglected and never removed, there if often more damage done than if no barrier had been installed. Straw wattles can be used for similar purposes as straw bale barriers, and have similar installation guidelines and limitations.

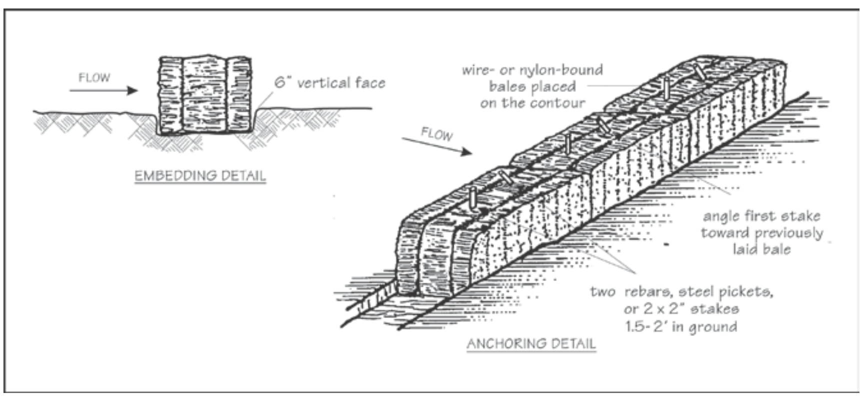


Figure 7-6: Straw Bale Sediment Barrier Detail
(Modified from Washington State Department of Natural Resources, 1997, and Idaho Department of Lands, 1992)

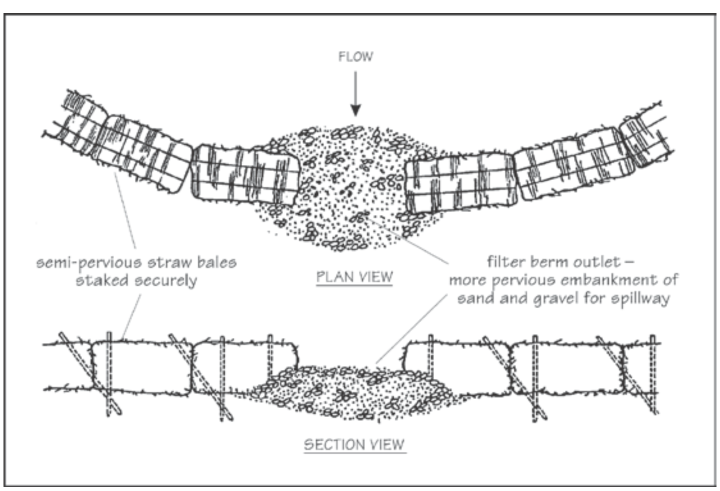


Figure 7-7: Straw Bale Sediment Barrier Detail
(Modified from Washington State Department of Natural Resources, 1997, and Idaho Department of Lands, 1992)

7.2.1.2 Silt Fences

A silt fence is a temporary liner or barrier that slows down or prevents silt or other sediments from moving away from disturbed areas. It is placed perpendicular to slopes below disturbed areas that may be affected by erosion. Using synthetic fabric or geotextile, the silt fence is staked in place and reinforced. Typically, silt fences are less than three feet in height to prevent failure with too much water pressure. Ideally, a silt fence is installed by trenching to anchor the filter fabric with backfill. A trench lined with the bottom of the filter fabric and filled with gravel will provide stability to the BMP. Very often silt fences will become ineffective in heavy rain events or when not monitored; therefore, regular monitoring will help make sure that the BMP is working. Remove all accumulated debris and sediment when they reach half of the height of the silt fence.

Figure 7-8: Silt Fence Example
(Photo: City and Borough of Sitka)

7.2.1.3 Brush Barriers / Slash Filter Windrows

Brush barriers or slash filter windrows can be used below roads, overburden stockpiles, or other bare areas with moderate to steep slopes to filter coarse sediment and reduce water velocity. They are relatively inexpensive, as they can be built with brush cleared from areas prior to mining. They are constructed by piling brush, sticks, and branches in to long rows below areas of concern and can be supported by logs or large rocks.

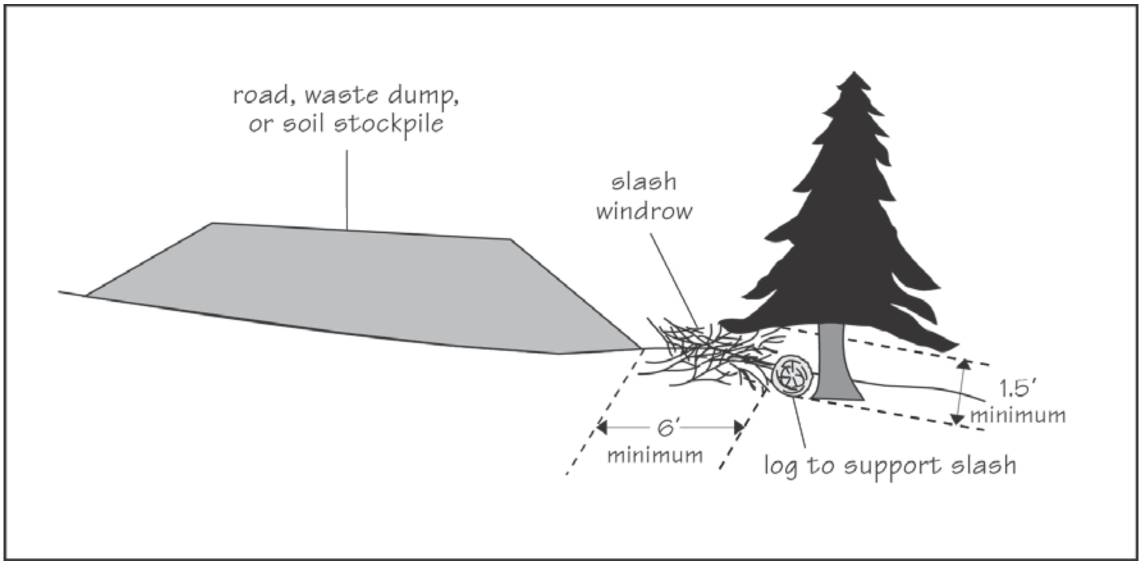


Figure 7-9: Slash Filter Windrow Detail
(Modified from Washington State Department of Natural Resources, 1997, and Idaho Department of Lands, 1992)

7.2.2 Check Dams, Sediment Filters

7.2.2.1 Check Dams

Check dams are used in ditches to slow surface flow, capture sediment, and minimize incision of the ditch.

- They typically consist of 2- to 4-inch-diameter coarse crushed rock, depending on the anticipated water velocity.
- Spacing of the dams depends on the gradient of the ditch.
- The top of the dam should be lower than the channel margins so that water can spill over it and stay in the channel.
- Gabion (wire mesh) baskets can be used to help keep the rocks in the dam from becoming displaced.
- Filter fabric (geotextile) can be placed on the upstream side to trap additional sediment, but it must be anchored in place and its mesh should be sized to avoid clogging. Filter fabric must be cleaned when it becomes clogged.
- Maintenance is required, including excavating captured sediment and maintaining the rock levels.

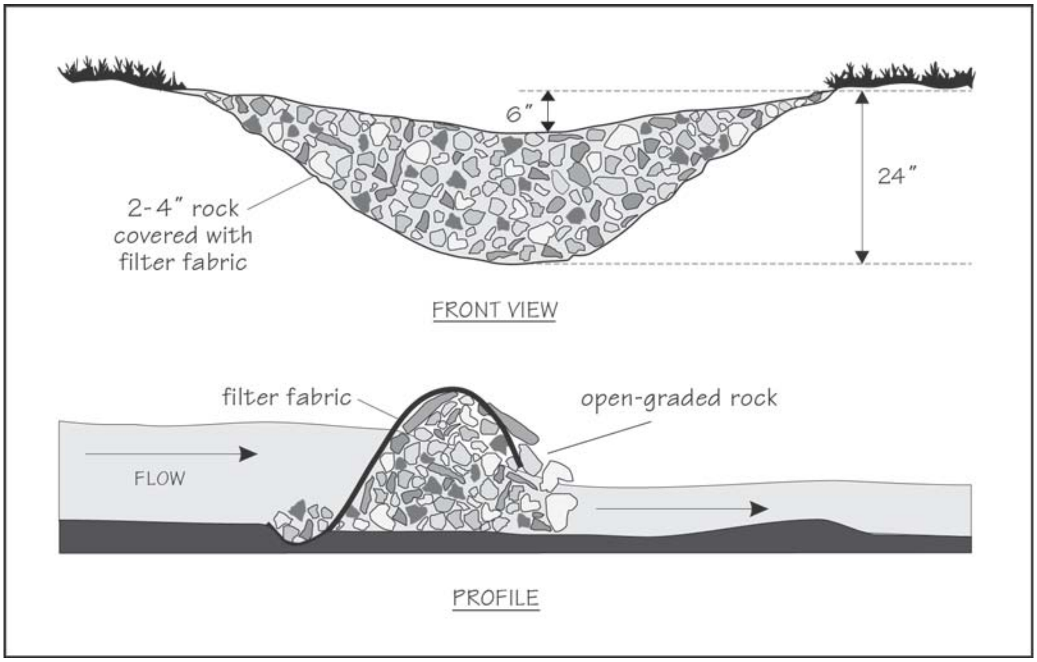


Figure 7-10: Rock Check Dam Detail
(Modified from Washington State Department of Natural Resources, 1997.)

7.2.2.2 Filter Berms

Filter berms are very similar to check dams, but are used in channels with low flow. They are designed to filter out finer sediment. In an ideal berm, fine sand, coarse sand, and gravel are placed sequentially from the upstream side to the downstream end of the berm. The sand will need to be replaced periodically as it becomes clogged with sediment.

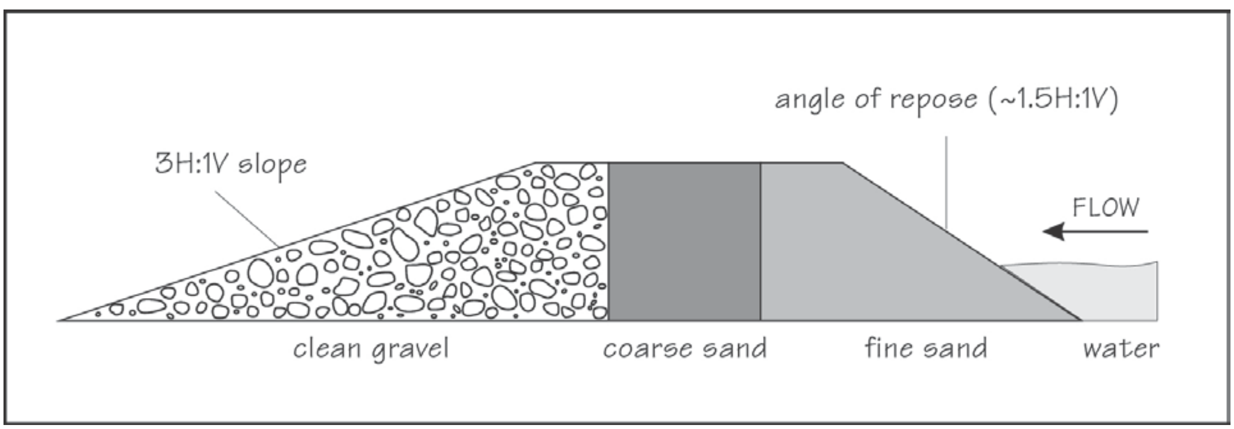


Figure 7-11: Filter Berm Detail
(Modified from Washington State Department of Natural Resources, 1997.)

7.2.3 Dust Abatement

7.2.3.1 Using Water

In dry conditions, dust from haul roads can become a problem. It can get into equipment and blow into surface water bodies. A periodic light spray of water is the most common tool used to control dust. The ground should not be saturated, but just wet enough that dust does not rise from it when it is disturbed by traffic or wind. This is often accomplished with water trucks, but can also be done with a sprinkler system. If water is in short supply, chemical dust suppressants, such as magnesium chloride, could be considered. Be sure to check state and local law prior to using chemical dust suppressants.

7.2.3.2 Drop Height

It is a good practice to minimize the distance material is dropped from loaders, excavators, and conveyors. This reduces the amount of dust released into the air, reduces noise, and reduces the risk of worker injury.

7.2.3.3 Dust Skirts

Dust skirts are rubber skirts placed around the outlets of conveyors or hoppers that run down to piles, shielding falling aggregate from wind. This reduces dust emissions and prevents material segregation. Dust skirts are useful where drop height is difficult or impossible to control.

7.2.3.4 Naturally Occurring Asbestos

Asbestos is a naturally occurring mineral that is present in some rocks and soils in Alaska. If it becomes airborne in the form of dust from activities like excavation, blasting, or crushing, it is a very serious respiratory hazard. Asbestos inhalation has been linked to numerous illnesses including asbestosis (fibrous scarring of the lungs), mesothelioma, and lung cancer. The possibility of encountering naturally occurring asbestos (NOA) at a mine site should be investigated before ground is broken. The California Geological Survey has published a document called *Guidelines for Geologic Investigations of Naturally Occurring Asbestos in California*. This document may be a useful starting point for determining if NOA exists on your site. It can be obtained at: http://www.consrv.ca.gov/cgs/minerals/hazardous_minerals/asbestos/Asbestos_Guidelines_SP124.pdf. If NOA is present, the dust abatement BMPs listed above will not likely be sufficient to reduce airborne asbestos to an acceptable level.

7.3 Stormwater Management

7.3.1 Diversion

7.3.1.1 Diversion Ditches

Ditches are open drainages that vary in size and depth to capture stormwater runoff and carry it offsite, or to onsite treatment. These can be particularly useful for managing stormwater that runs onto your site from adjacent properties. Ditches can route the flow around your work area, minimizing the exposure of your excavation to stormwater pollutants. Although some ditches may only carry water during rain events, others may be permanently wetted. Ditches may help remove sediments from stormwater, which might otherwise impact rivers, lakes, streams, or other aquatic sites. Naturally occurring vegetation left in ditches may aid substantially in removing sediments from stormwater as it leaves vegetated areas. Vegetation growing on the bank of the ditch can help to remove sediment as surface run-off flows through it.

- Ditches are commonly used to divert stormwater and to keep project sites as dry as possible to inhibit erosion.
- Ditches should be planned to carry more water than at peak flows, especially if they are to be vegetated.
- Oversized ditches may be allowed to naturally vegetate and will probably need less maintenance.
- Severe turns or grade changes along the course of ditches will likely need additional protection. Vegetation (trees or shrubs) may help prevent erosion during peak flows; riprap (see page 32) or other armoring may be necessary.
- Incorporate vegetated swales or check dams to help filter out sediment pollutants.
- In some areas of Alaska, fish (like salmon) have moved into ditches. Avoid this by creating a preventative barrier to fish passage to a constructed ditch.
- If ditches regularly fill with sediments, then use upstream source and sediment controls as needed.

Figure 7-12: Ditch Example
(Photo by permission of Central Paving Products, Anchorage Alaska)

7.3.1.2 Trench Drains

Trench drains can be used to help with stormwater control and dewatering unstable slopes. They are generally ditches that are lined with a geotextile filter fabric and backfilled with crushed drain rock or clean gravel. A perforated pipe can be placed near the bottom of the trench backfill to move water to the outlet more quickly. Trench drains do require an outlet to remove water. They may also require periodic maintenance. If a pipe is used, it is recommended that cleanouts along the pipe be installed.

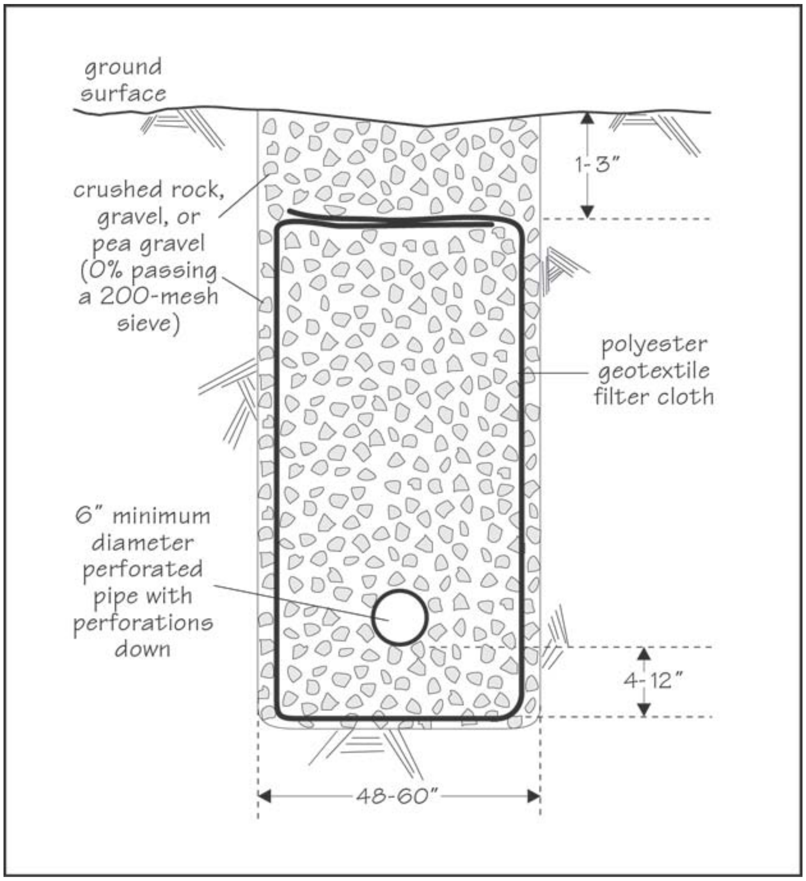


Figure 7-13: Trench Drain Detail
(Modified from Washington State Department of Natural Resources, 1997.)

7.3.1.3 Culverts

Culverts are used to move water under roadways or to divert water around areas or structures. They can be made of metal or plastic; for roadways, metal is typically used. In complex or critical cases, design professionals should be consulted. In general, culverts should:

- have headwalls at the inlet side and erosion protection at outlet locations (see page 32),
- be large enough to carry maximum stream volumes as well as additional seasonal runoff,
- be installed in firm, compacted soil with a minimum cover of 12 inches; and
- be inspected on a regular basis and cleaned or repaired when necessary.

Depending on the location and purpose of a culvert, a local or state permit may be required. Be sure to check before starting culvert construction.

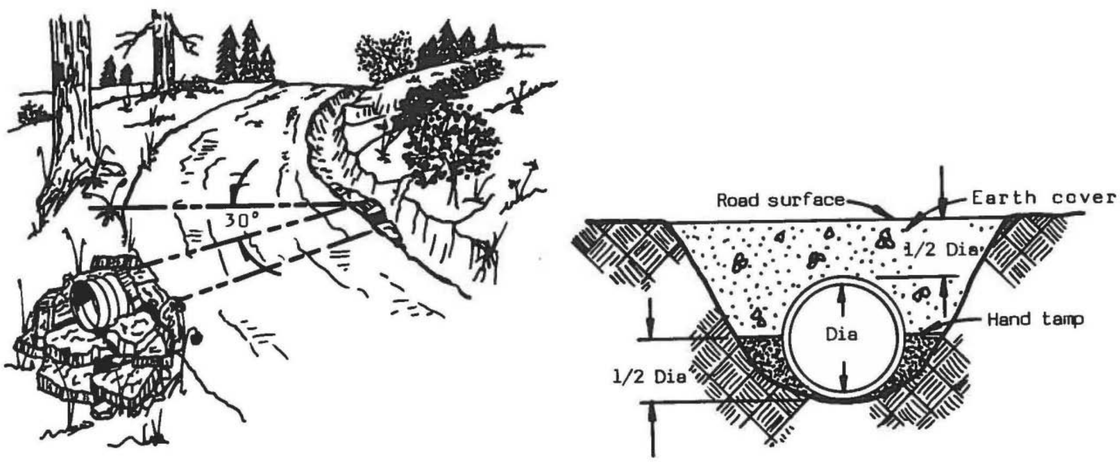


Figure 7-14: Culvert Detail
(Modified from Idaho Department of Lands, 1992.)

7.3.2 Treatment

7.3.2.1 Settling Pond / Retention Basin

Settling ponds are either permanent or semi-permanent structures, such as dugouts, impoundments, or raised tanks, which remove silt and suspended clays from water used for washing aggregate, and/or from sediment-loaded stormwater. Some keys to effective settling ponds are:

- Construct two or more ponds in series, with the coarsest material removed by the first pond, and the finer suspended solids by subsequent ponds. This approach allows one or more ponds to operate while another is being cleaned. (Settling ponds only remove roughly 80 percent of the trapped sediment that flows into them.)
- Locate the ponds in low areas and natural drainageways, but not in streams or wetlands.
- Design ponds for easy access and maintenance.
- Depending on the site conditions and potential for pollutants in the water, it may be appropriate to line settling ponds with plastic.
- Ponds should be cleaned out before they are more than 1/3 full of sediment.
- The distance the water travels within the settling pond should be three to five times the width of the pond.
- Baffles can add to the flow length and pond efficiency.
- Potential materials for construction include earth, riprap, pipe, collars, seed for stabilization of disturbed soil, and new or recycled metal tanks.
- Settling ponds should not be placed where the risk associated with a failure would pose significant risks for people or natural environments such as streams.

Figure 7-15: Settling Pond Example
(Photo: City and Borough of Sitka)

7.3.2.2 Flocculants

Chemical flocculants can reduce the size of settling ponds for a given site by increasing the rate at which particles settle out of water. They work by causing fine particles, like clays, to bind together into larger particles which settle out faster. It is important to choose the right flocculent for the type of fines that will be present in the water to be treated. It is also important to maintain a proper mixture of flocculent in the pond. It must be mixed, but not over-agitated. Ideally, at least 2 ponds are used; one with a retention time of about 20 minutes and another with a retention time of 3 to 8 hours. Ponds will need to be cleaned regularly. Most flocculants are non-toxic to aquatic organisms and fish, but the manufacturer should be consulted regarding the environmental effects of any given flocculent prior to use.

7.3.2.3 Constructed Wetlands

An alternative to a settling pond is a constructed wetland. Constructed wetlands have the added benefit of vegetation to help filter sediment and some pollutants, but they require much greater land area and often require more cost to properly design and upkeep. As they drain to natural waterways, structures must be put in place to prevent fish from entering, and cleaning is more difficult and time consuming due to the presence of vegetation. If a wetland is to be constructed, an environmental professional should be consulted.

7.3.3 Dispersion

7.3.3.1 Discharge to Receiving Waters

If stormwater is discharged directly to a surface water body, a permit is required. The water must meet the quality standards set in the permit. It should not induce physical or thermal erosion at the site of discharge, and should not create thermal barriers to fish movement.

7.3.3.2 Land Application

Land application sends stormwater through dispersal systems that allow turbid water to infiltrate into vegetated areas. The technique can be used to handle all sediment-laden stormwater or just to increase capacity in conjunction with other systems.

- Perforated pipes can be used as a distribution system, laid parallel to slope contours (Figure 7-16).
- Land application should not be used on steep slopes, and turbid water must not be allowed to enter creeks or wetland.
- Land application systems often cannot handle surges in water volume during storms. Soils may not accept stormwater if they are already saturated.
- Infiltration analyses can help determine the capacity and infiltration rate of a site's soils and improve design. Qualified professionals can assist in these analyses and designs.
- Concentration of outflows from land application systems should be avoided, as it may induce erosion.

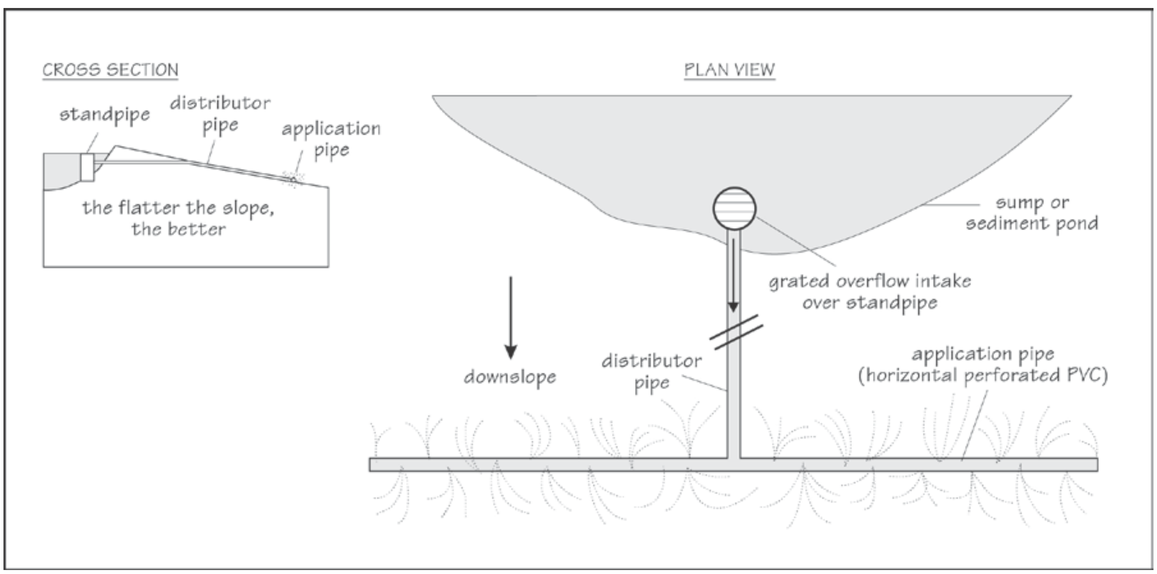


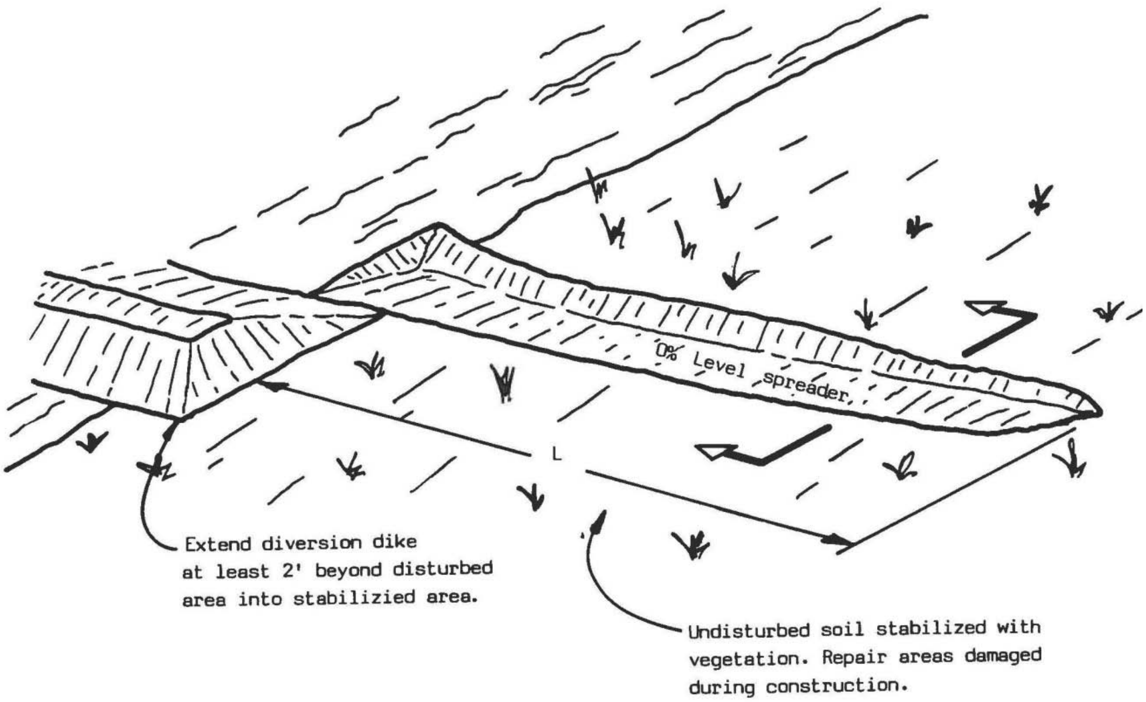
Figure 7-16: Land Application System
(Modified from Washington State Department of Natural Resources, 1997.)

7.3.3.3 Level Spreaders

Level spreaders can be used in locations where concentrated runoff from unvegetated ground needs to be controlled and dispersed over a broad area. They help to reduce water velocities, lessen erosion, allow sediment to settle out, and enhance infiltration. Level spreaders work best in areas with permeable soil. Some guidelines for level spreaders are:

- Do not construct level spreaders on slopes steeper than 3H:1V.
- Level spreaders should be constructed in undisturbed soil.

- Constructed length should be 15 feet for every 0.1 cubic feet per second of discharge water.
- Constructed width should be a minimum of 6 feet from the centerline to the outside edge of the spreader. See Figure 7-17.



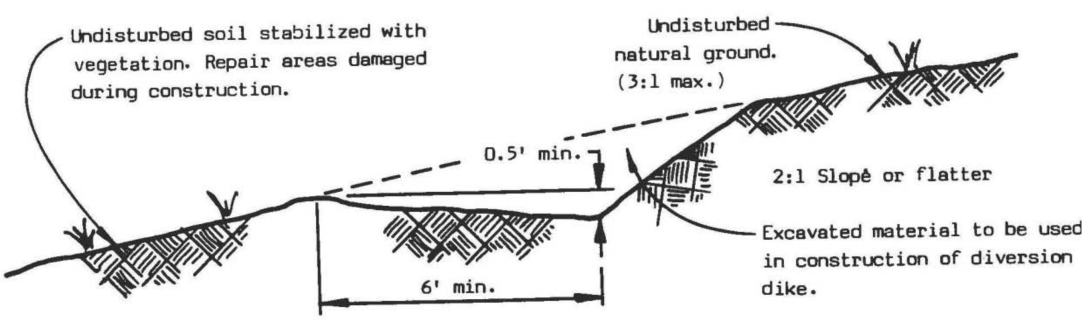


Figure 7-17: Level Spreader Detail
(Modified from Idaho Department of Lands, 1992.)

8 OPERATIONAL BEST MANAGEMENT PRACTICES

Key Points – Chapter 8

- This chapter contains general BMPs for setting up a mine site and mining activities.

Mining Plans should be developed to avoid and/or mitigate potential impacts to surface water, groundwater, and the environment in general. This chapter contains operational BMPs, which can be applied to the layout of a mine site and various mining activities to reduce surface water and groundwater impacts.

8.1 BMPs for the Mine Site

8.1.1 Buffer Zone

As a BMP, a buffer zone is either a natural or enhanced vegetated area around a disturbed site, or near sensitive areas such as a stream, wetland, or inhabited area. It provides distance and adds time to reduce flow and velocity of storm water. If dewatering is performed, buffers reduce offsite groundwater impacts. Buffer zones also reduce noise pollution, allow for dust settling, provide wildlife corridors, and reduce visual impacts. Once established, buffer zones that allow natural succession require little maintenance.

- Preserve or place a buffer zone around the site perimeter, adjacent to streams or other waters, along access corridors, and at the edges of disturbed areas.
- Help reduce sediment and pollution by placing a buffer zone alongside stormwater drainages.
- Retain or plant native trees and shrubs around the perimeter of disturbed areas to help reduce dust, noise, and provide a visual barrier.
- For windbreak protection, tree densities of greater than 20 percent are needed.
- Use other methods to reduce or control flow of surface water such as flow barriers, diversions, sediment traps, check dams, and vegetative plantings, or silt fences when natural buffers are not possible.

Figure 8-1: Buffer Zone Example
(Photo by permission of City and Borough of Sitka)

8.1.2 Berms

Well designed berms may provide some reduction of pollutants and will help reduce noise, dust, and the visual impact of the site within the community. Berms can be used around the perimeter of the property or adjacent to areas sensitive to impacts such as wetlands or surface water bodies. A berm can be used as a site control for surface water entering or leaving a site.

- The elongated and raised structure may be composed of selected material from onsite or offsite.
- Berm heights should be at least 6 feet. For berms taller than 6 feet, vary berms and contour side hills to provide a more natural appearance.
- Plan that berm heights, contours, and vegetation would blend in with naturally occurring conditions.
- If the berm remains in place long-term or permanently, add topsoil to help hold vegetation and provide for natural succession. Seed berm with native grasses or top with other native shrubs, trees, or other indigenous vegetation to reduce draining and drying of the berm.
- Establish ground cover quickly and stabilize soils with mulch, blankets, or other methods.

Figure 8-2: Berm Example
(Photo: City and Borough of Sitka)

8.1.3 Fences

Fences prevent unauthorized entry to a mine site. This protects the mine's equipment from sabotage, helps to manage risk associated with unauthorized people wandering onto the site and getting injured, and prevents wildlife from entering the site and becoming entrapped in pits or falling from high walls. Common fence types are barbed wire and chain link. Fences should be constructed in such a way and to a height sufficient to prevent people or animals from scaling or jumping over them.

8.1.4 Signage

Use signs to inform and remind mine employees of sensitive areas on the site, such as established setbacks from streams or hazardous areas. Also use signs to warn the public and site visitors of mine hazards.

8.1.5 Access and Haul Roads

The use of designated haul roads is recommended for all aggregate site operations. Well-designed and constructed haul roads can make site operations safer, more productive, and cause less wear and tear on equipment. Some keys to effective haul roads are:

- Keep haul roads dry by elevating them and cross-sloping the surface to facilitate drainage.
- For two-way traffic, road widths should be 3 times the width of the largest haul truck.
- Use road shoulder barriers/berms for safety and erosion control.
- Design the banking of curves and curve transitions to minimize the centrifugal forces on vehicles negotiating the curve.
- Maintain safe steepness grades.
- Place intersections at flat, straight alignments.
- Establish a regular grading program to minimize erosion, sediment build-up, noise, and dust. Haul roads may also require periodic scarifying, sanding, and resurfacing.
- Potholes, washboarding, and frost heaving should be repaired immediately to minimize noise, dust, and equipment wear.
- Apply approved dust suppressants such as water or calcium chloride, if necessary.

Figure 8-3: Haul Road Example
(Photo: Alaska Department of Environmental Conservation)

8.1.5.1 Wheel Washer

Wheel washers can be used where materials are being transported off site via paved public roads to help remove dirt, dust, mud, and rocks from trucks prior to mine exit. The reduction of dirt/dust transported onto paved public roads reduces the dust impacting air quality and the dust covering vegetation and settling into nearby bodies of water. It also reduces windshield damage from thrown rocks. Wheel washers may not be needed if other sediment control mechanisms are in place (stabilized exits, concrete pads), the haul road is paved, or the public roads are dirt/gravel surfaces.

A Wheel washer can be as simple as several railroad rails submerged in a pit, draining to a settling pond (Figure 8-4). Wheel washer design should result in shaking dirt or mud off of a vehicle passing through the pit. Placement of rumble strips, railroad rails, a cattle guard, or steel bars at 2- to 8-inch intervals can provide the agitation needed for removal of dirt, rocks and mud. More advanced designs or high volume facilities may invest in a concrete foundation and mechanized sprayers (Figure 8-5).

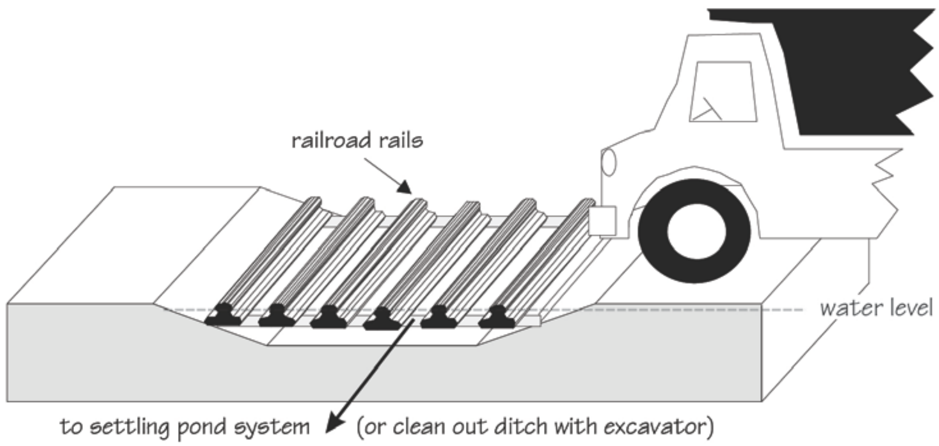


Figure 8-4: Simple Wheel Washer
(Modified from Washington State Department of Natural Resources, 1997.)

Figure 8-5: Wheel Washer with Sprayers
(Photo from January-February issue of Erosion Control Magazine article "Controlling Fugitive Dust on Roadways" by Carol Brzozowski)

8.1.5.2 Stabilized Construction Exits

Stabilized construction exits provide a transition from dirt roads on a mine site to paved roads, to reduce the tracking of mud onto public right of ways. They are an alternative to a wheel washer, and while less effective, may be sufficient for many situations. To construct a stabilized construction exit:

- Excavate a pad that is about 6 inches deep, as wide as the haul road, and at least 50 feet long.
- Lay down a filter fabric geotextile over the excavated area.
- Cover the geotextile with 6 to 12 inches of 2- to 3-inch-diameter angular drain rock.
- Dress the exit with additional stone as needed.

8.1.5.3 Street Cleaning

This BMP involves sweeping or other pavement cleaning practices for entrances or roadways in front of a site, loading areas, haul roads, parking areas, truck aprons, and where materials are being transported on paved roads. Used in concert with other BMPs, street cleaning aids to remove substances that might otherwise pollute rivers, lakes, and streams. Modern sweeper equipment is capable of removing very fine sediment particles. By using the most sophisticated sweepers, greater reductions in sediment and accompanied pollutants can be realized. By using this BMP, some pollutants can be captured before they become soluble with rainwater. The cost for sweeping using simple mechanical techniques is relatively low, but a more efficient sweeper system can be expensive to own and operate.

- Street cleaning is not effective on unpaved surfaces.
- Do not use water to wash paved areas clean if run-off would migrate to rivers, lakes, or streams.

8.1.6 Vibration Reduction

Blasting, screening, and crushing, as well as movement of heavy equipment on site and from the site may produce ground vibrations. Vibrations can affect unstable slopes and can potentially damage nearby structures such as houses. Since transport of materials is one of the primary causes of vibration, levels can be reduced by maintaining roads free of potholes, reducing speeds, and limiting the weight of loads carried by trucks. For blasting activities, which tend to generate stronger vibrations, it is important to monitor vibrations at nearby locations that may be impacted. A blasting specialist can give guidance for charge weights and sequencing that might minimize effects for operations in community areas with other businesses or residents. In some cases, vibrations from blasting can increase the turbidity of groundwater, which can impact nearby wells. If PWS sources or residential wells are within 1000 feet of a proposed blasting operation, vibration and groundwater turbidity before and after blasting should be monitored at the well sites.

8.1.7 Dumps and Stockpiles

Mines with thick overburden generate large amounts of waste soil and rock. This material is generally stockpiled either permanently or for later use in reclamation. Dumps and stockpiles, if poorly placed or constructed, can easily result in landslides and increased sediment loads to nearby surface waters. The following are some guidelines for placement and construction of stockpiles:

- Select a location that is geologically stable. Qualified professionals may be required to assess landslide hazard.
- Select a location that is away from waterways, seeps, and springs.
- Strip all vegetation from the storage area, as it will rot under the stockpile and create a plane of weakness and increase the chances of downslope movement.
- Vegetation removed from the stockpile area can be used around the perimeter of the stockpile to filter runoff.
- Install a blanket drain (drain rock and geotextile) at the base of the pile on any slope where drainage problems are anticipated, and key it into competent material within the slope.
- Construct diversion ditches above stockpiles on steep ground.
- Place the fill in 12- to 18-inch lifts and compact it with a sheep's foot or vibratory roller.
- Shape the pile to prevent water from ponding and to direct water to a drainage system.
- Final slopes should be between 2H:1V and 3H:1V or flatter. Flatter slopes are easier to access for reclamation. Slope designs may be optimized with the help of qualified professionals.
- Terraces may be constructed to slow runoff water velocities.
- When shaping is complete, seed and mulch the pile to establish vegetation.

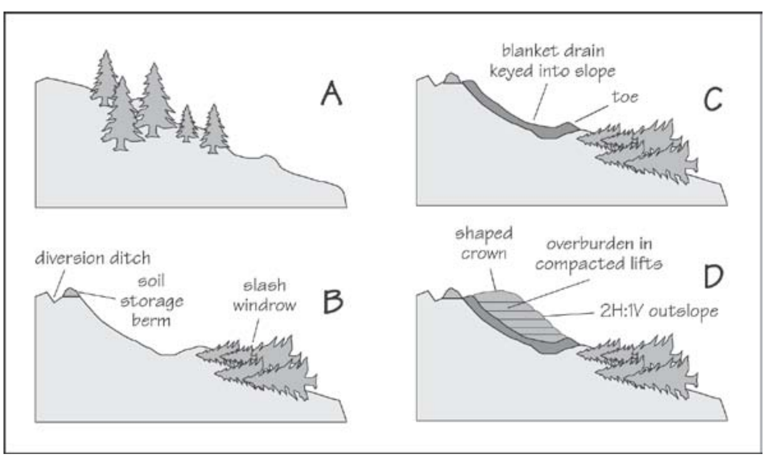


Figure 8-6: Stockpile Construction
(Modified from Washington State Department of Natural Resources, 1997.)

8.1.8 Employee Training

BMPs are only effective if they are properly implemented and maintained. This is accomplished through employee training. Field employees should be taught basic stormwater management and pollution prevention principals. Begin by clearly communicating the company's expectation that its employees should take personal responsibility for helping assure BMP effectiveness. Encourage and recognize their efforts to watch and monitor for BMP effectiveness. Management should lead by example. Create a learning culture for employees to help assure that stormwater management and pollution concerns are quickly and effectively addressed.

8.1.9 Environmental Timing Windows

Project activities such as blasting or clearing may impact fish or wildlife during certain times of the year. One way to help reduce impacts during critical times of the year is to adjust the project work schedule to minimize effects on seasonal life stages for fish or wildlife (such as in spawning fishes, or nesting waterfowl). Adjust project schedule to avoid impacts to fish and wildlife when project activities expose large quantities of soil or for long term operations. Help reduce siltation of natural watercourses and fish habitat by timing operations and project activities such as blasting and clearing land to avoid sensitive periods for fish and other wildlife. Coordinate with the appropriate agency to determine timing windows.

8.1.10 Scheduled Maintenance and Repairs

Scheduled maintenance and repair is a practice that maintains mine efficiency and protects water quality. Scheduled maintenance of equipment helps to reduce down time and helps to protect water quality by reducing oil and coolant leakage. Likewise, scheduled maintenance of BMPs can keep erosion and sediment under control so that the mine satisfies permit obligations and avoids more costly remedial measures.

8.1.11 Self Environmental Audit

The idea of a self environmental audit reflects a non-regulatory approach to helping assure the well-being of water resources in Alaska. This practice is designed to enhance protection of human health and the environment by encouraging operators to voluntarily and promptly discover, disclose, correct, and prevent potential violations of federal and state environmental requirements. The voluntary discovery, prompt disclosure, correction, remediation, and prevention of negative impacts on water quality are key elements of this BMP. Another key element of the self environmental audit is cooperation with state or federal entities with regard to site operations. There are potential economic benefits to self environmental auditing such as benefits to operators when "good faith" efforts are accomplished that address the needs and concerns of resource managers. There are low to moderate costs associated with possible delays in project activities, but these are offset by avoiding fines or more costly remediation measures if problems are not found early.

8.2 BMPs for Mine Activities

8.2.1 Test Holes

Follow all regulations at the state and federal level when drilling test holes to determine the depth and extent of deposits to be mined. Avoid contaminating groundwater by:

- placing holes in areas that do not flood and that have good surface drainage away from the hole;
- keeping holes away from chemical storage areas, landfills, and septic tanks;
- properly installing and decommissioning abandoned observation wells to avoid subsurface contaminant entry; and
- properly backfilling holes with bentonite and/or cement grout and surface seal.

8.2.2 Land Clearing and Grubbing

Clearing and grubbing the land is necessary to prepare a mine site for extraction, but increases the risk of environmental impacts from stormwater runoff. Permit coverage is required prior to beginning the land clearing and grubbing work. To reduce environmental impacts:

- Only clear areas of land that will be used immediately. Vast tracts of cleared land dramatically increase the risk of environmental impacts from stormwater runoff and the associated costs to control runoff from the mining site. Land that is not cleared is better at taking care of itself.
- Implement stormwater management, erosion, and sediment control BMPs before and concurrently with clearing so that sediment laden runoff does not leave the site.
- On slopes, divert slope water around disturbed areas using ditches.
- If possible, clear land and grub during dryer, less windy times of the year.
- Establish, mark, and remember to stay out of buffer zones; stay outside of recommended or permit-required distances from streams, rivers, lakes, wells, etc.

8.2.3 Stripping

Stripping is the removal of topsoil and overburden. If a mine plan employs contemporaneous reclamation (see Chapter 9) then topsoil and overburden can be placed onto previously mined areas as it is removed, which reduces handling costs and maintains useful soil properties. Otherwise, topsoil and overburden should be stockpiled for use in reclamation (see page 54 and page 56 for topsoil storage and stockpiles). Make separate stockpiles for topsoil and other overburden. In overburden soil, try to preserve soil horizons in the stockpiles so that the soil layers can be placed back in the order in which they were removed. Make sure stockpiles are located and built in a way that provides easy access for reclamation. As with land clearing, it is best not to disturb an area until it is ready to be worked.

8.2.4 Aggregate Washing and Process Pond Sludge

Aggregate often requires washing to separate sands and to remove fines. These types of operations typically discharge to processing ponds. Water in a processing pond is often very turbid and should not be discharged to surface water bodies prior to treatment. A series of settling ponds, for example, could be used to remove silt and suspended clays from water used for washing aggregate. Note that aggregate washing operations need an APDES permit from DEC if discharging offsite or if discharge may cause a chemical change in the groundwater.

Processing ponds will accumulate fine sediment and need to be cleaned, especially if they are designed to infiltrate water to the soils. Process pond sludge should be tested to determine metal content and pH prior to evaluating disposal options. Depending on the level of possible contaminants, disposal options may include drying the sludge and either placing it on site, on containment with a cap, or removing it to an off-site approved waste management facility.

8.2.5 Flow-Through Pits

Flow through pits, where a creek comes in one side of the pit and out the other, require an individual Army Corps of Engineers Section 404 permit. DEC's certification of the Corps permit might grant a short-term variance for water quality standards or specify conditions to ensure that the water leaving the pit meets Alaska Water Quality Standards. For information on permitting requirements, see Appendix D .

8.2.6 Dewatering

Dewatering is sometimes necessary for gravel pit operations in Alaska during gravel extraction or while cleaning settling or retention ponds. When dewatering 250,000 gallons or more and/or when operations occur within 1-mile of a contaminated site, notice to use the DEC's Excavation Dewatering General Permit (EDGP) is required. The DEC will provide more information on conditions and best management practices for a specific site in its permit, but some generally recommended BMPs for dewatering include:

- Consider the proximity of the pit to contaminated or potentially contaminated sites and to local water wells. If substantial draw down may occur due to dewatering, a contaminant plume from a contaminated site may move or be exacerbated. The DEC Contaminated Site Program staff should be contacted in advance in this instance. A detailed hydrogeologic study may be necessary.
- Wells, well points, or other systems may be most effective in drawing down the aquifer prior to mining, and reducing effects to aquifers. These methods are often preferred over using a sump or trash pump to dewater a pit while mining, because clean water is extracted and that simplifies discharge.
- Where offsite impacts to shallow aquifer are likely, infiltration trenches or wells can help to mitigate offsite drawdowns.

- For pit seepage, keep a perimeter trench around the outside of the excavation's floor. This trench will collect the groundwater seeping out of the pit walls and create a sump from which less turbid and uncontaminated water can be pumped.
- Make sure that dewatering does not result in or otherwise cause re-suspension of sediments in receiving waters. It is very important that any fluid leaving the site be free of any contaminants or additives such as fuel, antifreeze, solvents, corrosion inhibitors, toxic substances, oil, and grease, and anything which causes foaming in the effluent.
- Perform equipment maintenance away from the pit perimeter.
- Dispose of waste away from the open pit.
- Store fuels and hazardous materials away from the open pit.

Dewatering should not be done in such a way that it results in thermal or physical erosion, typically a problem at the site of discharge. Dewatering should be avoided or carefully (professionally) designed if it will result in offsite impacts such as contamination of surface or ground water, well impacts to neighboring properties, changes in flow patterns of surface water or aquifers, or if it causes flooding or damage to property or vegetation. Dewatering should not be done if discharge will result in thermal barriers to fish movement or otherwise exclude fish from aquatic habitat.

Monitoring of groundwater levels, pumping, turbidity, and other factors may be required by permit. A well-planned monitoring program is a valuable means of assuring the BMP is being conducted properly and that the true effect of dewatering is known. Active treatment of wastewater prior to discharge may be necessary to assure compliance with water quality standards. Should accidental discharge of contaminants occur, the operator should first correct the situation, then report the discharge to the Alaska Department of Environmental Conservation immediately to determine what, if any, mitigation is needed. Groundwater monitoring may be indicated in permitting before, during, or after de-watering.

9 RECLAMATION

This chapter describes various strategies and BMPs for reclamation. The primary goal of mine reclamation is to return a site to a condition that will not pose a hazard to public health and the environment. Reclamation plans are site specific, but they will generally include:

- removal of all mine facilities,
- a grading plan that establishes stable slopes and adequate drainage,
- self-sustaining vegetative cover,
- monitoring of performance during and after reclamation to ensure objectives are being achieved.

Key Points – Chapter 9

- Reclamation restores mined land to a stable condition that will not harm humans or the environment.
- Reclamation plans must be approved by Alaska DNR.
- There are different types of reclamation strategies:
  - Contemporaneous
  - Segmental
  - Post-Mining
- Proper handling, storage, and replacement of topsoil are crucial to revegetation.

By law, reclamation plans must be approved by the commissioner of natural resources from the Alaska Department of Natural Resources (DNR), Division of Mining, Land, and Water. This applies to state, federal, municipal, and private land and water in Alaska. Alaska DNR has published a book of Mining Laws and Regulations, which may be found at http://dnr.alaska.gov/mlw/mining/2009Reg_book.pdf.

9.1 Reclamation Strategies

9.1.1 Contemporaneous Reclamation

In contemporaneous reclamation, material is transported from a newly mined area directly to a previously mined area in one circuit (Figure 9-1). This method is preferred, because it minimizes handling of overburden and avoids creating large areas of unreclaimed land. It is optimal where a relatively small amount of material is extracted in comparison to the overburden moved, as it allows easy reproduction of soil and subsoil profiles. It may, however, be impractical for sites with very thin soil or where material like sand and gravel must be mixed from various parts of the mine in order to meet product specifications.

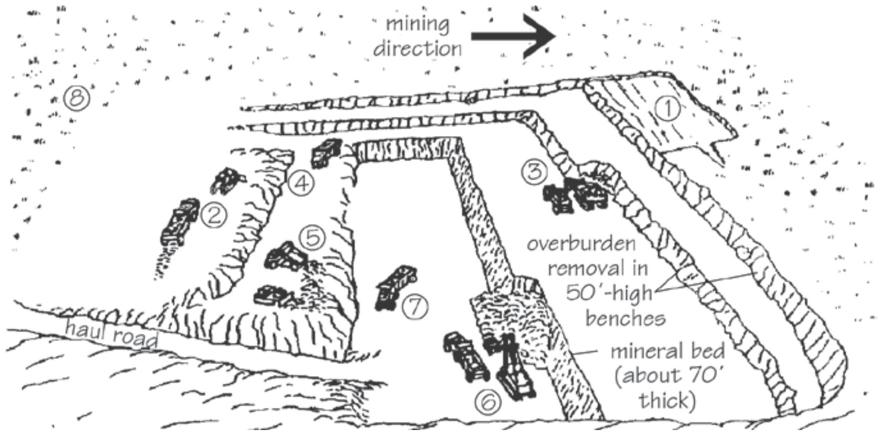


Figure 9-1: Contemporaneous Reclamation
(Modified from Washington State Department of Natural Resources, 1997, and U.S. Bureau of Land Management, 1992)

1) removal of topsoil;
2) spreading topsoil on graded wastes;
3) loading of overburden;
4) hauling of overburden;
5) dumping of overburden;
6) loading of product;
7) hauling of product;
8) reclaimed land.

9.1.2 Segmental Reclamation

In segmental reclamation, the mine site is divided into segments and the order of mining and reclamation among the segments is determined. Prior to mining, topsoil from the first segment is stockpiled. After all resources have been extracted from the first segment and the slopes have been reshaped in accordance with the reclamation plan, topsoil is stripped from the second segment and placed on the first segment and vegetation is planted. This continues until the final segment is mined, and then it is reclaimed with the stockpile of topsoil from the first segment. This reclamation strategy minimizes handling of topsoil and avoids creating large areas of unreclaimed land, but may be impractical for sites with very thin soil or where material like sand and gravel must be mixed from various parts of the mine in order to meet product specifications.

9.1.3 Post-Mining Reclamation

Post-mining reclamation is reclaiming a site after all resources have been extracted. While it may be necessary under certain circumstances, it is generally discouraged because it results in large areas being left unreclaimed for long periods of time. In post-mining reclamation, revegetation is typically slower and more expensive, stockpiled topsoils may deteriorate over time and become less fertile, and bonding liabilities are typically higher.

9.2 Reclamation BMPs

9.2.1 Preservation of Topsoil

Topsoil plays a crucial role for erosion control and is important for rehabilitation and permit requirements. Proper movement and storage of the soil is crucial for preservation and reuse.

Topsoil and other overburden should be removed separately before mining and retained for reclamation. Placing several inches of organic-rich soil over lower quality subsoil can dramatically improve the success of revegetation. If adequate topsoil is not preserved during mining, miners may need to import suitable topsoil, which can be costly. Topsoils must be properly handled and stored to preserve their porosity and biological content, including bacteria, fungi, algae, insects, and worms. Without these properties, the soil will be less helpful to revegetation. Some keys to topsoil preservation are:

- Store topsoil and other soil layers separately so they retain their characteristics and are easier to replace in the same order in which they were excavated.
- Do not strip topsoil when it is excessively wet or dry.
- Do not subject stored topsoil to excessive heavy equipment traffic.
- Storage piles should be constructed to minimize size and compaction.
- Avoid creating soil storage piles in excess of 25 feet in height.
- Do not use natural drainage ways as stockpile areas.
- Add some plant matter like grasses and chipped tree limbs to the pile to increase aeration, but not excessive amounts, as that will make the soil nitrogen deficient.
- Vegetate soil stockpiles. It is a good opportunity to do test seedings in preparation for final reclamation. Make sure seeds and plants used in revegetation are not or do not contain invasive plant species.

9.2.2 Overburden Storage

Overburden is often stockpiled for later use in reclamation backfill. This is a good practice, although long-term overburden stockpiles can contribute heavy sediment load to stormwater runoff. To avoid this, they should be:

- properly constructed for good slope stability (see Grading on page 28), and
- vegetated to prevent erosion.

9.2.3 Backfilling

Backfilling an excavated area may increase stability and help reduce erosion that otherwise might potentially affect surface water. Reducing slope angles can substantially reduce erosional effects and long term stability concerns. Backfilling can be considered when the final face heights in an excavated area are higher and steeper than permit specifications or general standards. Some guidelines for backfilling include:

- Do not backfill or approach an existing slope if stability is in question or the slope is unsafe, as it threatens worker safety.
- Keep backfill slopes at angles of 2 or more horizontal to 1 vertical.

- Unless otherwise specified, fill layers should be placed in lifts of no more than 6-9 inches and then stabilized by compacting, adding water to maintain moisture as needed. Compaction efforts can be made with equipment such as a sheep's foot roller or a smooth vibrating drum roller.
- Avoid flooding or erosion by providing good drainage with robust sediment control.
- Ideally, backfill concurrently with gravel extraction using overburden mined elsewhere on the site.
- Backfill materials may include overburden, waste rock, topsoil, clean excavation spoils from offsite, or select clean construction debris.
- Backfill materials should be free of contamination, brush, rubbish, organics, logs, stumps, and other material not suitable for stable fills.
- If previously stockpiled topsoil is used, it may need to be mixed with quality, clean fill material from sources offsite, as the moisture content of stored material may change and result in poor compaction.
- Establish healthy vegetative cover to avoid erosion (see Grading on page 28 and Vegetation on page 24).
- Use plastic sheeting, mulches, matting, or seeding with native species of grass or other vegetation to protect bare slopes against erosion or if permanent planting is delayed.

9.2.4 Benching

In reclamation, benching is a way of reducing slope lengths, enhancing stability, and facilitating revegetative efforts in soft or hard rock where bedding and structure are not prohibitively oriented. In some situations, it may be preferable to backfilling. A typical benched slope is shown in Figure 9-2. Some keys to benching are:

- Vertical bench cuts should be between 2 and 4 feet high.
- The vertical cut of the upper bench should begin immediately above the horizontal cut of the bench below.
- Benches should be horizontal and parallel to cut slopes or roadways.
- Excavation of each bench should be done in the opposite direction from the bench before, from the top of the slope to the bottom, to reduce the buildup of unconsolidated material at the side of the cut.

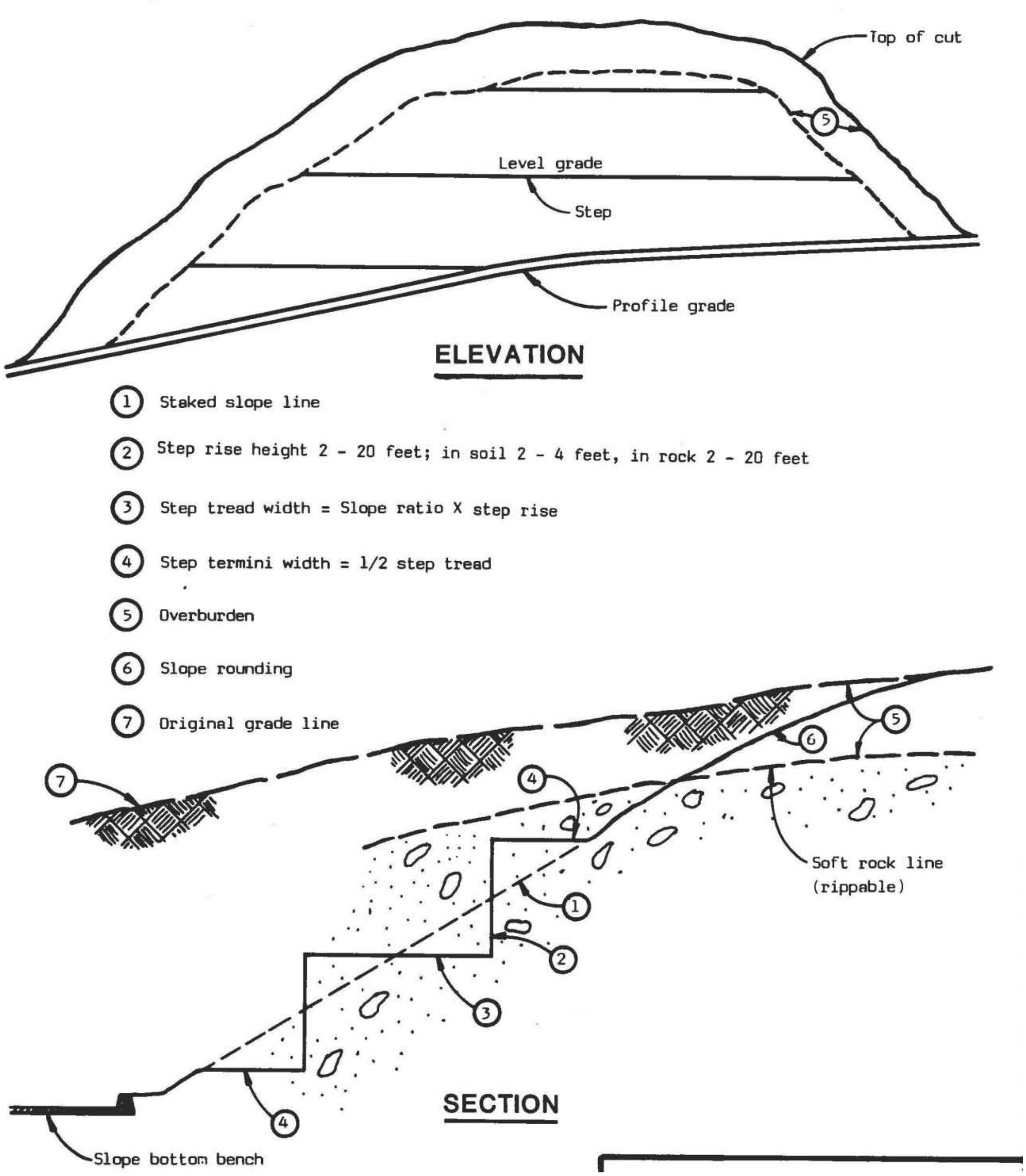


Figure 9-2: Benching Detail
(Modified from Idaho Department of Lands, 1992.)

9.2.5 Reclamation Blasting

Reclamation blasting is a technique that uses selective blasting to reclaim highwalls and benches to forms that blend in better with their surroundings. Holes are carefully placed and charged with explosive to essentially turn rock faces into scree slopes. The use of a blasting contractor familiar with this technique is highly recommended.

9.2.6 Draining Pit Floors

If desired, pit floor drainage can be improved by ripping or blasting.

- Ripping can be accomplished in soft rock or compacted soil or mine waste with vertical shanks mounted on heavy equipment.
- Blasting can be used for harder rock. It can be made into its own program, or if used in production, the last production shot can be drilled an extra 10 feet and some of the fractured material can be left in place.

Both methods will improve drainage and make it easier for roots to penetrate.

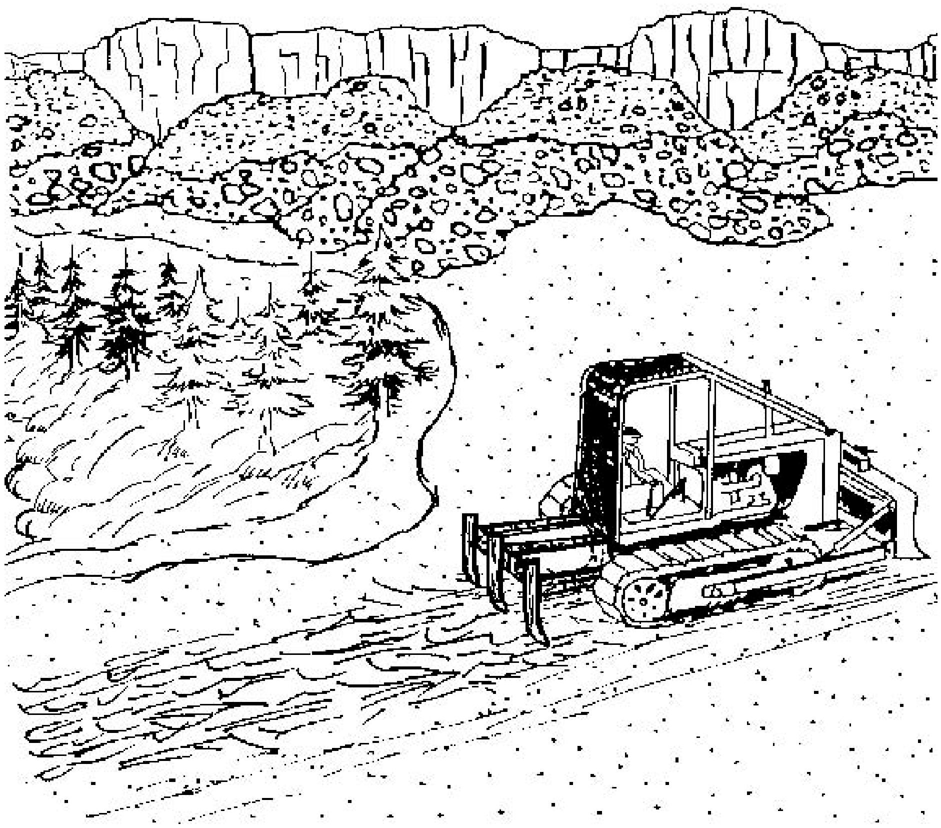


Figure 9-3: Ripping With A Dozer
(Modified from Washington State Department of Natural Resources, 1997.)

9.2.7 Topsoil Replacement

Proper replacement of topsoil on reclaimed surfaces is crucial to revegetation. Some topsoil replacement concepts are:

- Ideally, extract topsoil from its place of origin and place it directly onto an area already mined, backfilled, and graded for reclamation. In this scenario, soil is handled only once, has less moisture loss, and does not compact during storage within stockpiles
- Before spreading the topsoil, establish the erosion and sedimentation control structures such as berms, diversions, dikes, waterways, and sediment basins.

- Soil horizons in stockpiles should be placed in their original order for best results.
- Maintain grades on the areas to be topsoiled, and just before spreading the topsoil, loosen the subgrade slightly for bonding of the topsoil and subsoil.
- Do not spread topsoil when it is frozen or muddy.
- Topsoil should not be compacted.
- A minimum soil replacement depth of 12 inches is recommended for most reclamation applications.
- The minimum recommended soil depth for timber production is 4 feet over rock and 2 feet over gravel of soft overburden.
- If the volume of topsoil available for the site is low, restrict application to low areas that will conserve soil, retain moisture, and catch wind-blown seeds.
- After topsoil is placed, the soil can be analyzed to determine what soil amendments (nutrients and fertilizers) are necessary for proper vegetative growth.

9.2.8 Refuse/Soil Disposal

If excess overburden remains that will not be used in reclamation, it should be disposed of with care. It should not be placed in natural drainages, like drainage hollows on slopes, as it would be more likely to fail and impact surface water. Options for disposal may include sale as a fill material or proper construction of a permanent, vegetated stockpile.

9.2.9 Covering Acid-Forming Materials

If a site contains acid-forming materials, it has the potential to release acid mine drainage. This can be prevented during reclamation by identifying acid forming materials, isolating them, placing them on a liner (plastic or clay) and covering them with a cap (such as a clay) to prevent the chemical reaction which produces acid mine drainage (see page 19) from taking place. If exposures of acid-forming materials are left in a highwall, try to create an environment that does not result in repeated wetting and drying of the material, as these are the conditions most conducive to acid formation. In appropriate topography, a permanent impoundment with an initial addition of a buffering agent (such as lime) could be used.

9.2.10 Revegetation

Revegetation is one of the last but most important steps in mine reclamation, as it reduces erosion, reduces storm-water runoff, provides habitat for animals, and increases the value of the property. Guidance for vegetation is discussed in Chapter 7.

9.2.11 Creating Wildlife Habitat Using Ponds

Mine site reclamation often involves the creation of ponds. Ponds can easily be made into good wildlife habitat by following some general guidelines:

- Keep submerged slopes at 5 horizontal to 1 vertical or flatter to allow development of wetland plant species.
- Make the outline of ponds irregular to increase plant habitat.
- Build up islands in the ponds to provide nesting areas.
- Place structures like downed trees on the shoreline, and anchor them in place to provide fish habitat.

"North Slope Gravel Pit Performance Guidelines," Technical Report Number 93-9, by Robert F. McLean (1993) is a useful resource regarding the creation of wildlife habitat.

9.2.12 Well Decommissioning

Wells that will no longer be used for production or monitoring should be properly decommissioned. The purpose of decommissioning wells is to prevent the unnatural migration of water between different geologic formations in the subsurface. Wells that are not properly decommissioned leave pathways for possible future contaminant transport. Typically, wells can be decommissioned by:

- Sealing them in place with a bentonite grout or cement,
- Removing them and replacing them with bentonite chips, grout, or cement, or
- Redrilling them and backfilling the redrilled hole with bentonite chips, grout, or cement.

It is important that the hole previously occupied by a well is backfilled with bentonite chips, grout, or cement, and not hole cave, as cave does not provide an adequate seal between formations. For Alaska DEC requirements, review 18 AAC 80. For monitoring wells, the Alaska DEC has published a document called *Monitoring Well Guidance*, which includes details on proper techniques for decommissioning monitoring wells. (http://dec.alaska.gov/spar/csp/guidance/Monitoring%20Well%20Guidance.pdf). A well decommissioning form is available through the Alaska DNR Water Forms web site, http://dnr.alaska.gov/mlw/forms/.

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APPENDICES

Appendix A – Definitions

Below is a compilation of definitions used or pertaining to this User's Guide. Additional definitions can be found in the Alaska Water Quality Standards (18 AAC 70).

Best Management Practices (BMPs) – Schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices, that when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of the state. The types of BMPs are source control and treatment control.

Mining Operations – Typically consists of three phases, any one of which individually qualifies as a "mining activity." The phases are the exploration and construction phase, the active phase, and the reclamation phase.

Nonpoint Source Pollution – Any source of pollution other than a point source (18 AAC 70.990(42)). Point source pollution is a discernible, confined, and discrete conveyance, including a pipe, ditch, channel, tunnel, conduit, well, container, rolling stock, or vessel or other floating craft, from which pollutants are or could be discharged (18 AAC 70.990(46)).

Reclamation – The process of returning a site to a condition that will not pose a hazard to public health and the environment.

Residues – Floating solids, debris, sludge, deposits, foam, scum, or any other material or substance remaining in a body of water as a result of direct or nearby human activity (18 AAC 70.990(49)).

Sediment – Solid material of organic or mineral origin that is transported by, suspended in, or deposited from water. Sediment includes chemical and biochemical precipitates and organic material, such as humus (18 AAC 70.990(51)).

Settleable Solids – Solid material of organic or mineral origin that is transported by and deposited from water, as measured by the volumetric Imhoff cone method and at the method detection limits specified in method 2540(F), *Standard Methods for the Examination of Water and Wastewater*, 18th edition (1992) (18 AAC 70.990(52)).

Source Control BMPs – Source control BMPs **prevent** pollution, or other adverse effects of stormwater, from occurring. Source controls can be further classified as operational or structural. Examples of source control BMPs include methods as various as using mulches and covers on disturbed soil, slope grading, land clearing practices, putting roofs over outside storage areas, and berming areas to prevent stormwater run-off and pollutant runoff.

Stormwater – Storm water runoff, snowmelt runoff, and surface runoff and drainage (MSGP 2000).

Total Suspended Solids – Solids in water that can be trapped by a filter. Total suspended solids can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life and can block light from reaching submerged vegetation. As the amount of light passing through the water is reduced, photosynthesis slows down. Reduced rates of photosynthesis cause less dissolved oxygen to be released into the water by plants and possibly lead to fish kills. High total suspended solids can also cause an increase in surface water temperature, because the suspended particles absorb heat from sunlight.

Treatment Control BMPs – Treatment control BMPs include facilities or operations that remove pollutants by simple gravity settling of particulate pollutants, filtration, biological uptake, and soil adsorption. Treatment control BMPs can accomplish significant levels of pollutant load reductions if properly designed and maintained. An example of a treatment control would be a sediment basin.

Turbidity – Turbidity means an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a water sample. Turbidity in water is caused by the presence of suspended matter such as clay, silts, finely divided organic and inorganic matter, plankton, and other microscopic organisms (18 AAC 70.990(64)).

Waters – Alaska statutes (AS) 46.03.900(36) defines waters to include lakes, bays, sounds, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, straits, passages, canals, the Pacific Ocean, Gulf of Alaska, Bering Sea, and Arctic Ocean, in the territorial limits of the state, and all other bodies of surface or underground water, natural or artificial, public or private, inland or coastal, fresh or salt, which are wholly or partially in or bordering the state or under the jurisdiction of the state.

Appendix B – Contact Information

State and Federal Contacts

The following are state and federal contacts for additional information regarding mining and BMPs.

Alaska Department of Environmental Conservation
Drinking Water Program
http://dec.alaska.gov/eh/dw/index.htm

ANCHORAGE
555 Cordova Street
Anchorage, Alaska 99501
Toll Free 1-866-956-7656
907-269-7656

SOLDOTNA
43335 Kalifornsky Beach Rd Suite 11
Soldotna, AK 99669-9792
907-262-3408

FAIRBANKS
610 University Avenue
Fairbanks, AK 99709-3643
Toll Free 1-800-770-2137
907-451-2108

WASILLA
1700 E. Bogard Rd., Bldg. B Suite 103
Wasilla, AK 99654
907-376-1850

Alaska Department of Environmental Conservation
Wastewater Discharge Authorization – Storm Water Program
http://dec.alaska.gov/water/wnpspc/stormwater/Index.htm

ANCHORAGE
555 Cordova Street
Anchorage, AK 99501
(907) 334-2288

Alaska Department of Environmental Conservation
Nonpoint Source Water Pollution Control
http://dec.alaska.gov/water/wnpspc/index.htm

For TMDL information: http://dec.alaska.gov/water/tmdl/tmdl_index.htm

JUNEAU
410 Willoughby Ave., Suite 303
P.O. Box 111800
Juneau, Alaska 99801
907-465-5180

ANCHORAGE
555 Cordova Street
Anchorage, Alaska 99501
907-269-3059

FAIRBANKS
610 University Avenue
Fairbanks, AK 99709-3643
907-451-2125
907-269-3059

Alaska Department of Environmental Conservation
Contaminated Sites Program
http://dec.alaska.gov/spar/csp/index.htm

JUNEAU
410 Willoughby Ave., Suite 303
P.O. Box 111800
Juneau, Alaska 99801
907-465-5390

FAIRBANKS
610 University Avenue
Fairbanks, AK 99709
907-451-2143

ANCHORAGE
555 Cordova Street
Anchorage, Alaska 99501
907-269-7503

Alaska Department of Natural Resources
Division of Mining, Land & Water
550 West 7th Avenue, Suite 1260
Anchorage, Alaska 99501
907-269-8400
http://dnr.alaska.gov/mlw/

Alaska Department of Natural Resources
Plant Materials Center
5310 S. Bodenburg Spur
Palmer, Alaska 99645
907-745-4469
http://plants.alaska.gov/

Environmental Protection Agency, Region 10
NPDES Storm Water Coordinator
1200 Sixth Avenue
Seattle, WA 98101
206-553-6650
http://yosemite.epa.gov/R10/WATER.NSF/webpage/Storm+Water?OpenDocument

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Army Corps of Engineers, Alaska District
Regulatory Branch
P.O. Box 6898
Anchorage, Alaska 99506-0898
907-753-2712
http://www.poa.usace.army.mil/reg/

Local Government Contacts

Contact information for local governments in major cities throughout Alaska. Please contact the local governmental organization in your area.

Fairbanks North Star Borough
809 Pioneer Road
P.O. Box 71267
Fairbanks, Alaska 99707-1267
907-459-1000
http://www.co.fairbanks.ak.us/

Matanuska-Susitna Borough
Land and Resource Management Division
350 East Dahlia Avenue
Palmer, Alaska 99645
907-745-4801
http://www.matsugov.us/communitydevelopment/land-and-resource-management

City & Borough of Juneau
Engineering Department
155 South Seward Street
Juneau, Alaska 99801
907-586-0800
http://www.juneau.lib.ak.us/engineering/

City & Borough of Sitka
Public Works Department
100 Lincoln Street
Sitka, Alaska 99835
907-747-1804
http://www.cityofsitka.com/government/departments/publicworks/index.html

Kenai Peninsula Borough
144 North Binkley
Soldotna, Alaska 99669
907-262-4441
http://www.borough.kenai.ak.us/

Municipality of Anchorage
Public Works Department
4700 Elmore Road
Anchorage, Alaska 99507
907-343-8120
http://www.muni.org/departments/works/pages/default.aspx

Appendix C – Resources for Information

BMP METHODS

Barksdale, R.D., Editor. (1991): The Aggregate Handbook; *National Stone Association*.

Buttleman, C.G. (1992): A Handbook for Reclaiming Sand and Gravel Pits in Minnesota; *Minnesota Department of Natural Resources*, Division of Minerals.

Ciuba, S. and Austin, L. (2001): Runoff Treatment BMPs; *in* Stormwater Management Manual for Western Washington, Volume V. *Washington State Department of Ecology*, Publication 9915, URL http://www.ecy.wa.gov/biblio/9915.html, June 2001.

McLean, R.F., 1993, *North Slope Gravel Pit Performance Guidelines*, Alaska Department of Fish and Game, Technical Report Number 93-9.

Norman, D.K., Wampler, P.J., Throop, A.H., Schnitzer, E.F. and Roloff, J.M. (1997): Best Management Practices for Reclaiming Surface Mines in Washington and Oregon; *Washington State Department of Natural Resources* Open File Report 96-2 and *Oregon Department of Geology and Mineral Industries* Open File Report O-96-2, 128 pages, URL http://www.oregongeology.org/pubs/ofr/O-96-02.pdf , June 2001.

O'Brien, E. (2001): Minimum Technical Requirements; Stormwater Management Manual for Western Washington, Volume I. *Washington State Department of Ecology*, Publication 9911, URL http://www.ecy.wa.gov/biblio/9911.html, June 2001.

Oregon Department of Environmental Quality, 2005, *Erosion and Sediment Control Manual*, April 2005.

United States Department of Agriculture and Mississippi State University. (1999): Water Related BMP's in the Landscape; Watershed Science Institute. Created for the Natural Resource Conservation Service, United States Department of Agriculture by the Center for Sustainable Design Mississippi State University Departments of Landscape Architecture, Agricultural and Biological Engineering, and the College of Agriculture and Life Sciences, URL http://abe.msstate.edu/csd/NRCS-BMPs/contents.html, October 2001.

LOCAL BMP METHODS

City and Borough of Sitka, 2004, *A Contractor and citizen Guide to Reducing Stormwater Pollution*, June 2004.

Redburn Environmental & Regulatory Services, *Granite Creek Watershed Project Review Guidelines and Pollution Control Recommendations for Future Development*, for City and Borough of Sitka, June 2005.

ADDITIONAL INFORMATION

King County Washington (2009): Stormwater Pollution Prevention Manual; Department of Natural Resource, Water and Land Division, URL http://your.kingcounty.gov/dnrp/library/water-and-land/stormwater/stormwater-pollution-prevention-manual/SPPM-Jan09.pdf, January 2009.

Murphy, M.L. (1995): Forestry Impacts on Freshwater Habitat of Anadromous Salmonids in the Pacific Northwest and Alaska—Requirements for Protection and Restoration; NOAA Coastal Ocean Program, Decision Analysis Series No. 7, *in*. Schmitten R. A., Editor, (1996) NMFS National Gravel Extraction Policy, *U.S. Department of Commerce National Marine Fisheries Service*, URL http://swr.ucsd.edu/hcd/gravelsw.htm, June 2001.

North Carolina Department of Natural Resources and Community Development. (1988): Erosion and Sediment Control Planning and Design Manual; North Carolina Sediment Control Commission.

United States Department of Agriculture. (2000): Ponds--Planning, Design, and Construction; Agriculture Handbook Number 590.

United States Department of Agriculture, (1994): Planning and Design Manual for the Control of Erosion, Sediment, and Stormwater, Best Management Practice Standards.

Wright, Stoney J. and Hunt, Peggy, 2008, *A Revegetation Manual for Alaska*, Alaska Plant Materials Center, Division of Agriculture, Alaska Department of Natural Resources, 74 p.

DEWATERING INFORMATION

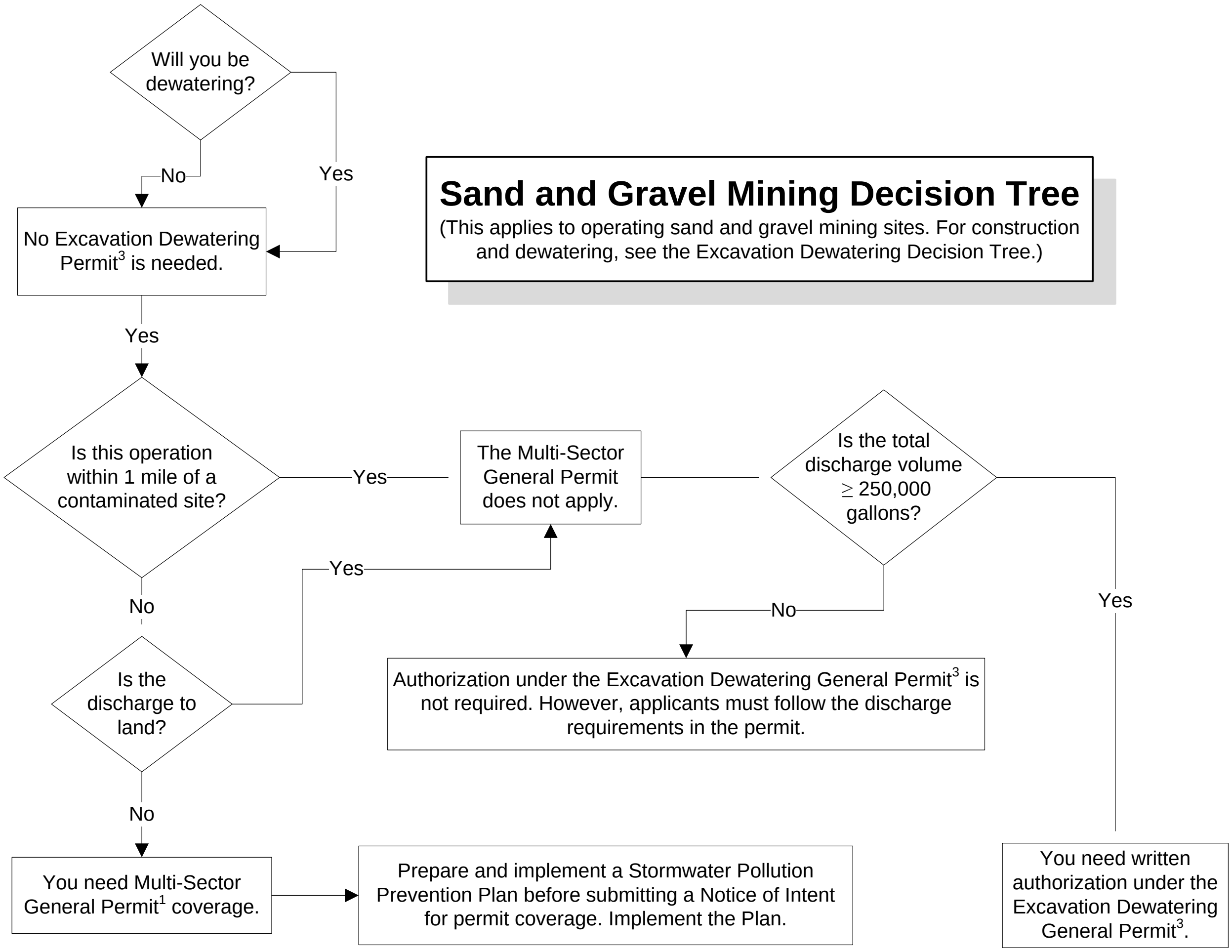
Powers, J.P., Corwin, A.B., Schmall, P.C., and Kaeck, W.E., (2007): Construction Dewatering and Groundwater Control: New Methods and Applications, Third Edition, John Wiley & Sons, Inc., Hoboken, NJ, USA.

Appendix D – State and Federal Permit Requirements

The table in this appendix provides an overview of state and federal requirements for gravel pit operations. **Not all requirements or permits might be identified or applicable**. In addition, local regulations or permits may be required. Please check with the responsible agency and local government agency to identify which apply to your operation.

Issue	Responsible Agency	Agency Requirement
Mining License	AK Dept. of Revenue	Provide copy of approved aggregate/sand & gravel mining license.
Letter of Intent	DNR	File the letter of intent required by AS 27.19.050 (b) annually on a form provided by the department before the mining begins.
Mining Permit	DNR	Provide copy of approved aggregate/sand & gravel mining permit, if extraction activity is conducted on state land.
Reclamation	DNR	Provide copy of approved state reclamation plan, if required (not required if less than 5 acres).
Water Quality – Run-off	DEC	Prepare SWPPP and submit NOI to obtain coverage under Multi-Sector general permit pursuant to APDES requirements. Dewatering discharges can be covered under DEC's construction general permit and Multi Sector General Permit, if less than 250,000 gallons or greater than one mile from contaminated site and is not otherwise contaminated.
Water Quality – Wetlands, Lakes & Streams	US Army Corps of Engineers	Any activity in wetlands, lakes, and streams requires Corps permit.
Water Quality – Groundwater	DEC	There is no prohibition on creation of man-made lakes or dredging into the water table. Dredging taking place into water table must be conducted in compliance with DEC notice of intent for the Multi-sector General Permit or APDES requirements, and DEC requirements for storage, spills and disposal of oil, antifreeze and hydrocarbons. Creation of man-made body of water may require Corps permit.
Water Quality – Dewatering	DEC	For dewatering that exceeds a total volume of 250,000 gallons or a rate of 40 gallons per minute and is within a mile of a DEC-listed contaminated site.
Water Quantity – Dewatering	DNR	Water Use Permit may be required.
Air Quality Control	EPA DEC	EPA Air Quality Control Permit required for asphalt plant and crushers. DEC has dust control regulations; no permits are required.
Burning	DNR DEC	Combustibles must be stockpiled separate from non-combustibles. Burning permit required from DNR. Burning must be conducted in compliance with DEC air quality standards.
Hazardous Materials	EPA	Use of hazardous material regulated by EPA standards.
Oil, Antifreeze & Hydrocarbon Storage (<1,200 gal.), Spills & Disposal	DEC	Regulated by DEC Oil and Hazardous Substances Pollution Control Regulation (18 AAC 75).
Oil, Antifreeze & Hydrocarbon Storage (>1,200 gal.), Spills & Disposal	EPA	Regulated by EPA standards.
Explosives – Storage and Use	FBATFE	Regulated by FBATFE.

Issue	Responsible Agency	Agency Requirement
Revised – June 2012. Key: DNR = Alaska Department of Natural Resources DEC = Alaska Department of Environmental Conservation EPA = United States Environmental Protection Agency APDES = Alaska Pollutant Discharge Elimination System FBATFE = Federal Bureau of Alcohol, Tobacco, Firearms & Explosives		



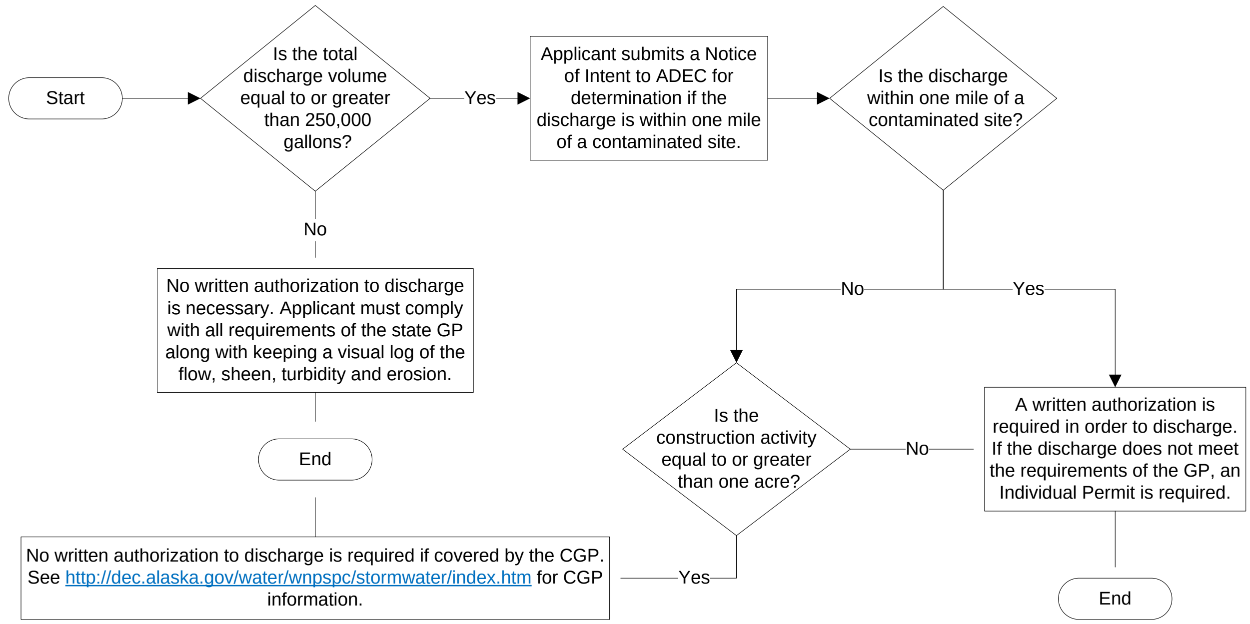
1 – DEC's APDES Multi Sector General Permit for Stormwater Discharges from Industrial Activities = MSGP
http://dec.alaska.gov/water/wnpspc/stormwater/MultiSector.htm

2 – DEC's APDES Construction General Permit for Stormwater Discharges from Construction Sites = CGP
http://dec.alaska.gov/water/wnpspc/stormwater/Index.htm

3 – State of Alaska Excavation Dewatering General Permit 2009DB0003
http://dec.alaska.gov/water/WPSDocs/2009DB0003_pmt.pdf

EXCAVATION DEWATERING DISCHARGE Decision Tree

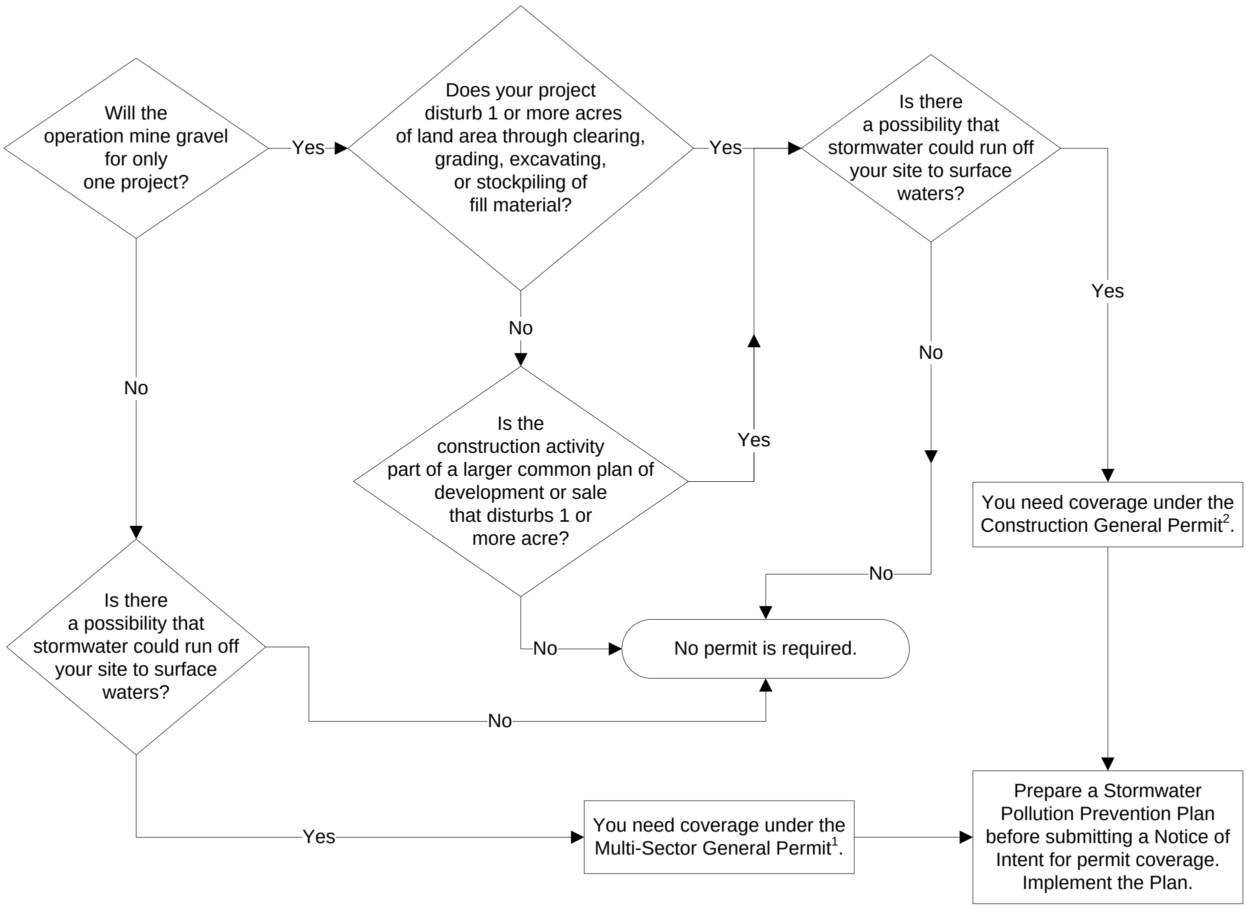
(For GENERAL PERMIT 2009DB0003)



DEC's APDES Construction General Permit for Stormwater Discharges from Construction Sites = CGP
http://dec.alaska.gov/water/wnpspc/stormwater/Index.htm

State of Alaska Excavation Dewatering General Permit 2009DB0003
http://dec.alaska.gov/water/WPSDocs/2009DB0003_pmt.pdf

Alaska Pollutant Discharge Elimination System (APDES)
Permit Decision Tree

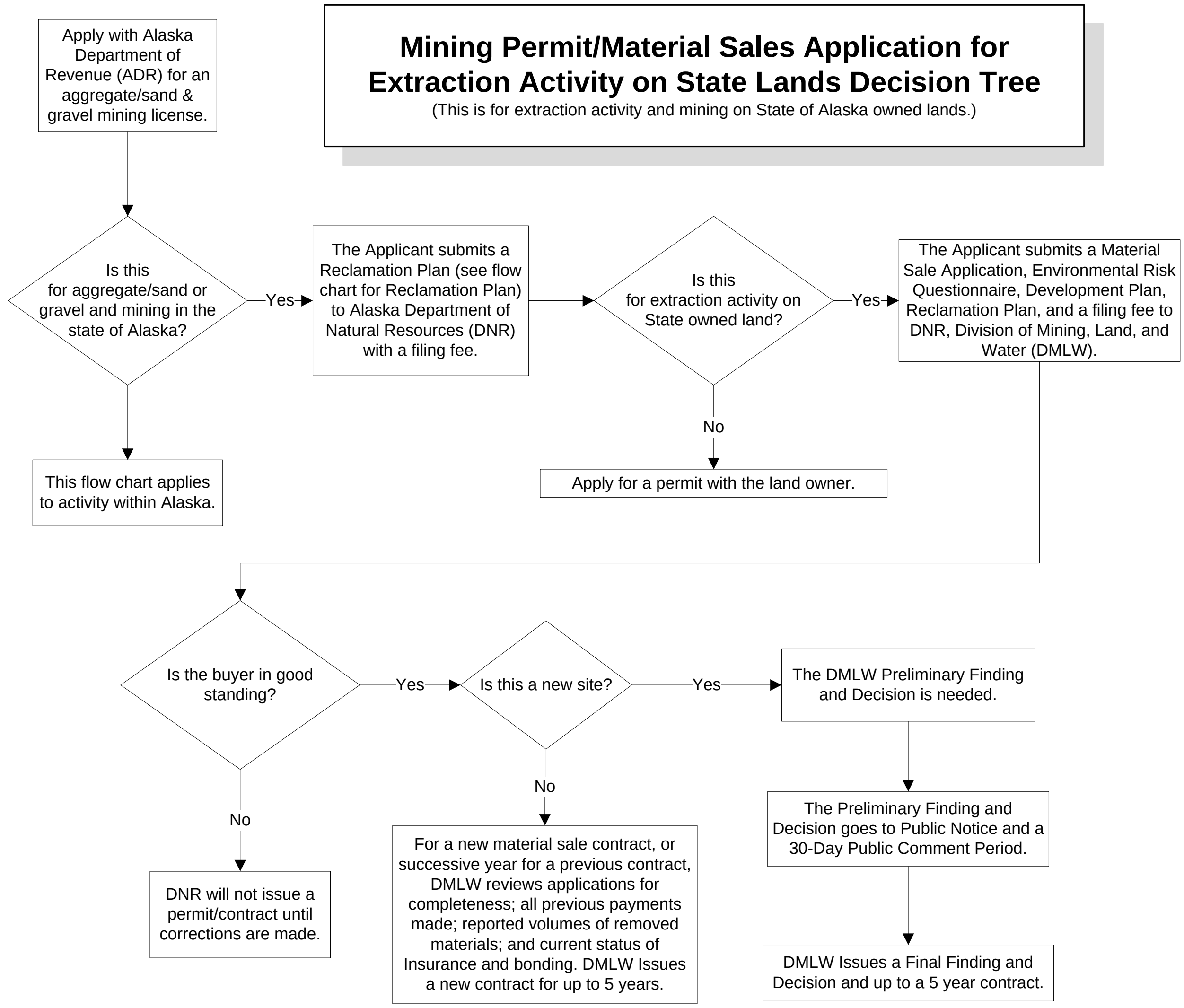


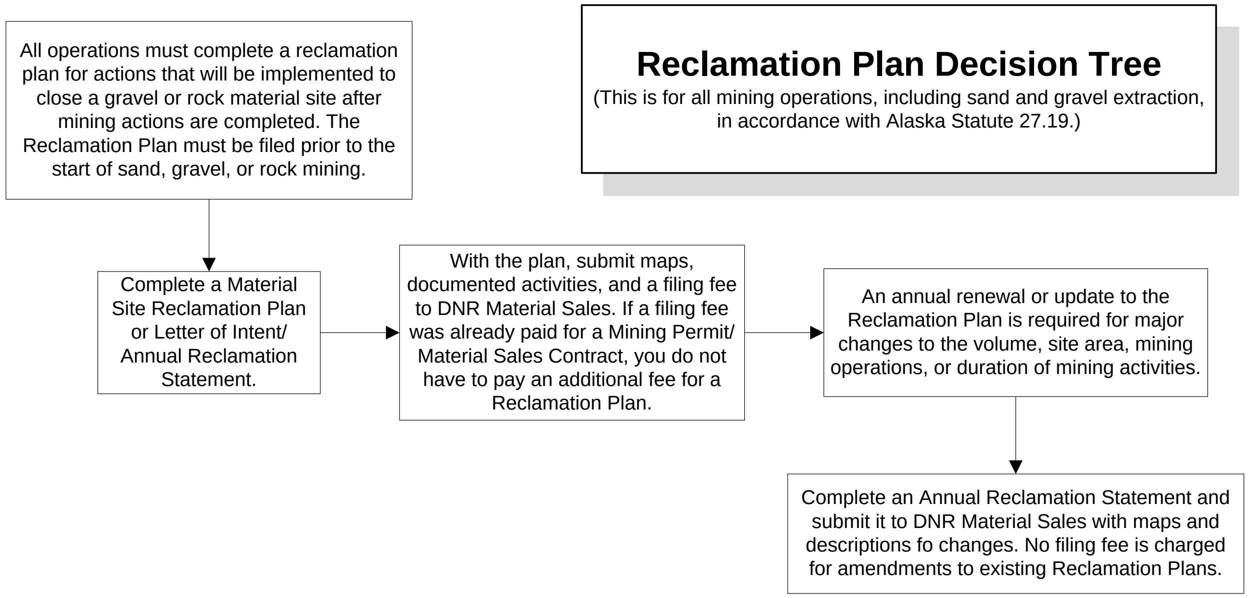
1 – DEC's APDES Multi Sector General Permit for Stormwater Discharges from Industrial Activities = MSGP
http://dec.alaska.gov/water/wnpspc/stormwater/MultiSector.htm

2 – DEC's APDES Construction General Permit for Stormwater Discharges from Construction Sites = CGP
http://dec.alaska.gov/water/wnpspc/stormwater/Index.htm

Mining Permit/Material Sales Application for Extraction Activity on State Lands Decision Tree

(This is for extraction activity and mining on State of Alaska owned lands.)




Reclamation Plan Decision Tree
(This is for all mining operations, including sand and gravel extraction, in accordance with Alaska Statute 27.19.)
All operations must complete a reclamation plan for actions that will be implemented to close a gravel or rock material site after mining actions are completed. The Reclamation Plan must be filed prior to the start of sand, gravel, or rock mining.
Complete a Material Site Reclamation Plan or Letter of Intent/ Annual Reclamation Statement.
With the plan, submit maps, documented activities, and a filing fee to DNR Material Sales. If a filing fee was already paid for a Mining Permit/ Material Sales Contract, you do not have to pay an additional fee for a Reclamation Plan.
An annual renewal or update to the Reclamation Plan is required for major changes to the volume, site area, mining operations, or duration of mining activities.
Complete an Annual Reclamation Statement and submit it to DNR Material Sales with maps and descriptions fo changes. No filing fee is charged for amendments to existing Reclamation Plans.

Appendix E – Best Management Practice Index

This appendix presents an alphabetical index of best management practices found within this manual. These BMPs have been selected for specific application to mining operations in Alaska. There are, however, many "general reference" BMPs that can also be useful. Recommended websites include the following:

National Menu of Best Management Practices for Stormwater Phase II, United States Environmental Protection Agency, http://cfpub.epa.gov/npdes/stormwater/menuofbmps/menu.cfm, December 1999;

Water Related BMP's in the Landscape, Watershed Science Institute, http://www.abe.msstate.edu/csd/NRCS-BMPs/, October 2001;

Stormwater Management Manual for Western Washington, Volumes 1-5 Washington State Department of Ecology, http://www.ecy.wa.gov/biblio/9911.html, June 2001.

Also see Appendix C– Resources for Information.

BMP INDEX