MINING & RESOURCE EXTRACTION

- **EROSION & SEDIMENT CONTROL**
  - **ACCESS ROADS**
  - **DEVELOPMENT SITE PLAN**
  - **DUST CONTROL**
  - **GRADING SEASON & PRACTICES (TAHOE)**
  - **DRILLING PADS**
  - **EXCAVATION STABILIZATION**
- **STORMWATER MANAGEMENT**
  - **DIRECTIONAL DRILLING**
  - **DIVERSION DIKE**
  - **RUNOFF INTERCEPTOR TRENCH OR SWALE**
  - **SETTLING PONDS**
  - **SURFACE RUNOFF MANAGEMENT**
- **WASTE MANAGEMENT & RECLAMATION**
  - **MINE WASTE STORAGE**
  - **NONTOXIC DRILLING FLUIDS**
  - **PRODUCED WATER MANAGEMENT**
  - **RESERVE PITS**
  - **CHEMICAL USE MANAGEMENT**
  - **STOCKPILES**
  - **SITE RECLAMATION**

- **WASTE HANDLING**
- **TAILINGS**
- **WASTE ROCK DUMP MANAGEMENT**
- **MINERAL EXPLORATION**
- **IMPOUNDMENT MANAGEMENT**
- **RECLAMATION**

EROSION & SEDIMENT CONTROL:

ACCESS ROADS

DEFINITION

Roads to provide needed access to an area should be constructed in such a way that the quality of runoff water is preserved.

PURPOSE

To provide a route for vehicle travel, for moving equipment, supplies and products, and for providing access for proper operation and management of conservation enterprises without disturbing the quality of runoff water.

APPLICABILITY

Where roads are needed to provide access from a county, state or federal highway or to provide planned travelways within an area.

PLANNING CRITERIA

1. **Location**: Roads should be located to serve the purpose intended and to facilitate the control and disposal of surface water.

2. **Gradient, Vertical and Horizontal Alignment**: The gradient and alignment should be adapted to the development of which it is a part.

3. **Width**: The recommended minimum width of the road bed is 14 feet for one-way traffic and 20 feet for two-way traffic. The tread width for two-way traffic should be increased approximately five feet for trailer traffic. The recommended minimum shoulder width is two feet on each side of the tread width. Widths less than recommended minimums may be used where topography or other natural conditions restrict the width.

4. **Side Slopes**: All cuts and fills should have side slopes that are stable for the soil or soil material involved. Typically side slopes should not be steeper than 2:1 (50% slope).

5. **Drainage**: Culverts, bridges, or grade dips should be provided at all natural drainageways. **Design of these structures should be conducted by a qualified engineer in keeping with sound engineering practices for the class of vehicle or equipment used on the road.**

Roadside ditches should be adequate to provide surface drainage for the roadway and deep enough to serve as outlets for subsurface drainage.

6. **Erosion Control Measures**: Erosion control measures should be provided for road ditches, cut slopes, fill slopes, and cross drains.

7. **Surfacing**: Access roads should be given a wearing course or surface treatment when required for traffic needs, climate, erosion control, or dust control. The type of treatment will depend on local conditions, available materials and the existing road base. Where these factors and the volume of traffic are not a problem, no special treatment of the surface is required. **Sound engineering practices must be followed to insure that the road will meet the requirements for its intended use**.

8. **Intersection with Public Highways**: Traffic safety should be a prime factor in selecting the angle of intersection with public highways. Any access roads that connect to a state highway must be approved by the State Highway Department.

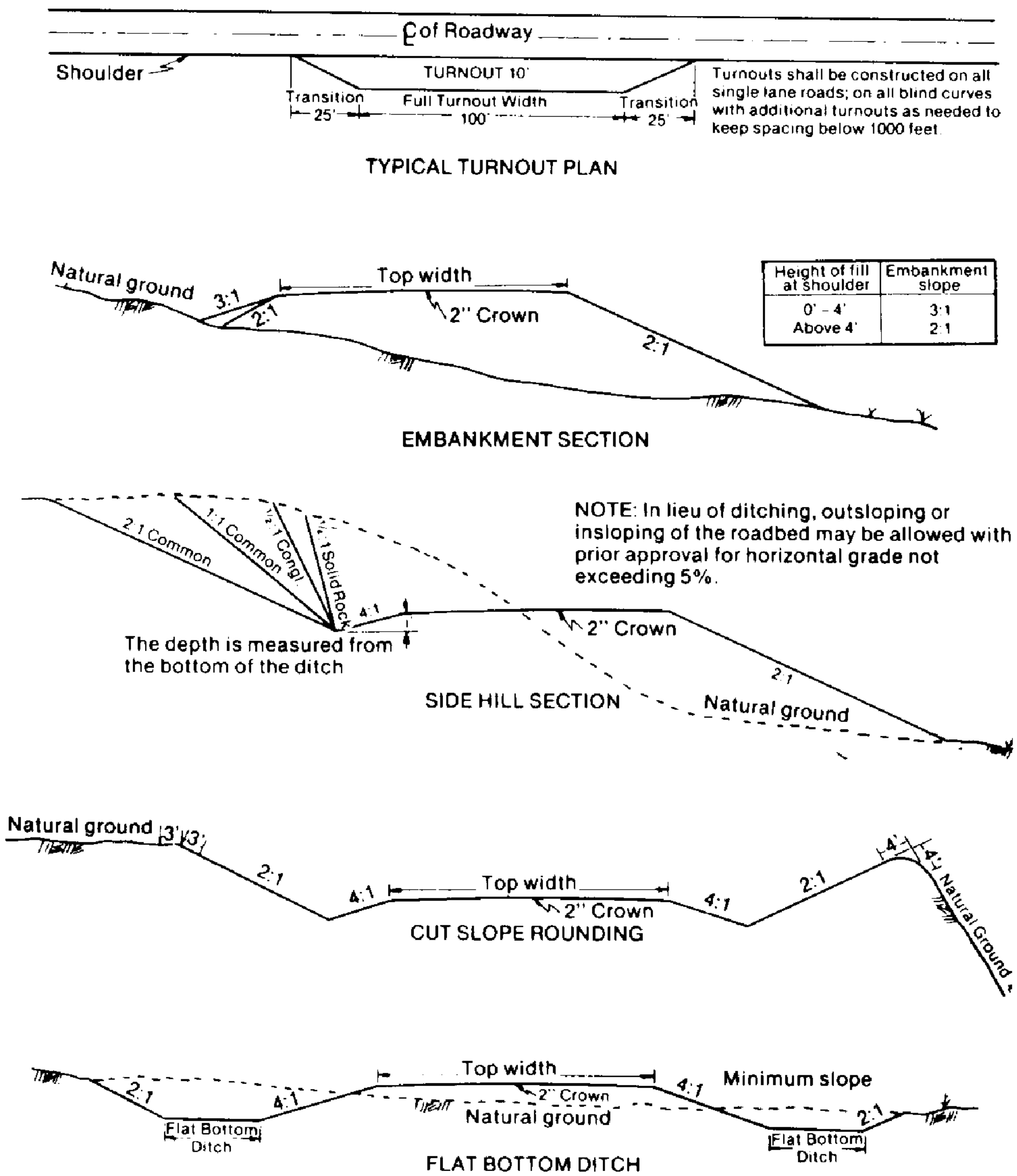
MAINTENANCE

Roadways, drainage structures and erosion control facilities must be maintained on an as needed basis given the site specifics of the access road to keep them operational. Proper and regular maintenance will minimize soil erosion and the degradation of surface and ground water resources.

EFFECTIVENESS

Proper installation and maintenance of access roads can be effective in reducing soil erosion and minimizing impacts to water quality.

TYPICAL ACCESS ROAD CROSSECTIONS
FIGURE 1-1



DEVELOPMENT SITE PLAN

DEFINITION

A site plan identifies the physical features of the site, the location of proposed development, and the location of temporary and/or permanent BMPs.

PURPOSE

The development site plan provides basic information about the physical characteristics of the site including: topography, access, surface water courses, etc.. By utilizing a development site plan the proposed development can be situated to minimize impact to natural resources, the land, and to enable water quality protection measures and runoff conveyance measures to be properly located.

APPLICABILITY

Site plans are required in a variety of situations, especially when development results in a land disturbance.

PLANNING CRITERIA

The first step in development site planning is to identify the physical features of the site.

1. Topography - A topographic map that shows the existing topography and site conditions at a scale appropriate to the project.

2. Drainage - The topographic map will help indicate which way water will flow across the site. On the map identify points where runoff will enter and leave the site. Mark all existing streams and drainageways on the map. Perform a drainage analysis for the site as it exists before development.

3. Vegetation - Show the existing locations of the trees and shrubs on the map.

4. Identify land capability boundaries, including boundaries of stream environment zones, flood plains, and other natural hazards.

5. Identity significant features such as rock outcrops, survey monuments, existing roads or other impervious coverage.

METHODS AND MATERIALS

After the physical features of the site have been identified, locate the proposed development in order to minimize land disturbance.

1. Minimize earth movement - Fit development to the terrain. Minimize cuts and fills.

2. Minimize impervious coverage - Make paved areas, such as driveways and parking pads consistent with other design and regulatory requirements.

3. Minimize vegetation removal - Preserve trees, grass, and other native vegetation in order to maintain site stability and reduce BMP costs. Locate structures and driveways to minimize the need for site clearing.

4. Avoid steep slopes - Confine construction activities to the least critical parts of the site. Once these areas are disturbed by construction, the resulting erosion may be very difficult to stop. In addition, any construction activities on steep slopes will require installation of costly BMPs.

5. Align roads and driveways along slope contours - Locate driveways parallel to slope contours rather than up and down slopes. Runoff down long or steep driveways tends to channelize flows and can cut deep gullies along the driveway.

6. Retain the natural drainage system - Avoid confining any natural drainage system by placing it in a buried culvert or forcing it to a new location on-site. Accommodate all drainages entering the site, whether natural or established by man.

After the proposed developments have been located, identify the erosion and sediment control measures (BMPs) to be installed both during and after construction.

MAINTENANCE

The development site plan should be updated and kept current based upon any physical changes to the site. Periodic reviews of the site plan should be conducted.

DUST CONTROL

DEFINITION

The control of windblown soil or other materials to reduce dust.

PURPOSE

To prevent excess movement of soil or other materials by wind, to reduce on-site and off-site damage, and to reduce health and traffic hazards.

APPLICABILITY

This practice applies to open areas subject to wind erosion, including cropland, hay and pastureland, construction sites, surface disturbance areas such as mine sites, waste dumps and mill tailings, livestock concentration areas and similar sites.

PLANNING CRITERIA

1. In construction, mining and land development work, plan and schedule work to open the least amount of land possible at one time. Surface disturbances should be stabilized or reclaimed before additional land is disturbed.

2. Plan and install temporary erosion control measures during construction, mining or development operations.

3. Install permanent erosion control measures as soon as construction, mining or development work is completed.

4. For new agricultural lands, or surface disturbances the irrigation water supply should be developed before land is opened so that water is available for establishing crops or cover crops.

5. When possible, schedule farming, construction, mining and development operations during months with the least wind erosion hazard. This is usually during late summer through fall.

METHODS AND MATERIALS

1. Stone and gravel mulches can be used for stabilization of surface disturbances.

2. Irrigation - Irrigate as needed to keep the surface moist but not saturated for temporary control of dust.

3. Vegetative Cover - Establish cover using native and adapted plant species.

4. Barriers - Establish temporary and permanent barriers as nearly as possible at right angles to the prevailing winds. The barrier(s) should be located upwind of the site in the best location(s) to retard the majority of the prevailing winds. Depending upon the specifics of the site and wind behavior the number and height of wind barriers should be considered. Board fences, snow fences, burlap, plastic netting, bales of hay or straw or earth ridges can be used for barriers. Use hedges of tall grasses, or shrubs; or tree and shrub windbreaks for barriers (See BMP-3-5 Windbreaks).

5. Emergency Tillage - Tillage to roughen the soil surface can be used for temporary control. Tillage should be at right angle to prevailing winds and performed to leave a ridged, cloddy surface.

MAINTENANCE

Regular maintenance is critical to effective dust control, whether temporary or permanent measures are being utilized. Regular water applications are necessary given specific site conditions. Mulches should be replaced or reapplied as necessary. Vegetative cover should be established and maintained on surface disturbance areas. Keep windbreaks and barriers in good condition by repairing or replanting any openings. Protect sensitive areas from additional surface disturbance.

EFFECTIVENESS

Dust control will reduce sediment delivery by runoff waters, control degradation of water in nearby streams and lakes from windblown sediments and minimize the loss of topsoil.

GRADING SEASON & PRACTICES (TAHOE)

DEFINITION

The Lake Tahoe Basin grading season runs from May 1 through October 15 as long as conditions are dry. Outside of the grading season, construction sites must be winterized and all soil disturbing activities (excavating, backfilling, etc.) are prohibited unless a Grading Season Exception (GSE) is issued by Tahoe Regional Planning Association. GSE's are only approved for projects where an emergency exists and the grading is necessary for the protection of public health and safety, for erosion control purposes, or for the protection of water quality.

Grading Season Exceptions are not issued to excavate a new foundation.

The following activities do not require a GSE, even outside the grading season:

- Up to 3 cubic yards of soil disturbance (when not part of a larger project) if completed within 48 hours and the site is stabilized to prevent erosion.
- Paving, if all grading and base compaction is already completed.

REQUEST PROCESS

Gather information about the property. In order to complete the form, you will need the permit number (TRPA, County, or City permit) and either the property address or APN. Photographs are required for review of your GSE request.

Required photographs include:

- Driveway (Paved access is required)
- Proposed work area
- Temporary BMPs
- Stabilization

Register for a TRPA account with their online records service in order to access online applications:

https://aca-prod.accela.com/TRPA/Default.aspx

Sign into your account, click "Building", and click the link "create an application." Step-by-step guide for using online portal

Pay fees. The online form requires payment by credit card. If you wish to pay by cash or check, call or visit our office to submit payment. The fee is required for review of your request and does not guarantee approval. No refunds will be issued if your request is denied.

Once your request is submitted, a confirmation e-mail will be sent to the address provided. An inspector will review your request and will send e-mail notification within 3 business days to let you know if your request has been approved.

Occasional e-mail updates may be sent out regarding weather conditions or other important news related to your grading season exception.

FEE AMOUNTS

Residential projects: $60
All other non-residential projects: $148
EIP projects: contact inspector for more information
All grading/soil disturbing activities must be suspended during periods of precipitation or when the soil is covered in snow, saturated, or muddy.

CONDITIONS OF APPROVAL

Temporary BMPs must be installed and fully functioning at all times.
All grading/soil disturbing activities must be suspended during periods of precipitation or when the soil is covered in snow, saturated, or muddy.
The property owner/contractor is responsible for checking the National Weather Service forecast daily to determine if weather conditions are appropriate for grading/soil disturbing activities.
The property owner/contractor must be able to winterize the construction site within 12 hours, in case weather conditions change suddenly.
No sediment or waste materials may be discharged from the construction site.
Upon completion of the grading/soil disturbing activities, the entire site must be winterized in accordance with the TRPA Winterization Guidelines. Failure to comply with the conditions of the Grading Season Exception and Winterization Guidelines may result in a penalty of up to $5,000 per violation per day.

DRILLING PADS

DEFINITION

A drilling pad is a location which houses the wellheads for a number of horizontally drilled wells.

PURPOSE

The benefit of a drilling pad is that operators can drill multiple wells in a shorter time than they might with just one well per site.

PLANNING CRITERIA & IMPLEMENTATION

Geologists should work with their selected drilling contractor to ensure the ideal drill pad dimensions for both safety and productivity. The depth of the hole can also affect pad size and organization of the equipment for mud and cuttings management, drill rod staging, and the storing of consumables. Placement of the boreholes on the drill pad should ensure at least three meters (10 feet) of clearance around the drilling equipment. The drill pad layout plan should address space for the placement of all of the equipment, site and equipment access, and staging area for consumables or installation materials (if a laydown yard isn't available) to strategically optimize the drill pad for safety and productivity. If surface disturbance permits or environmental permits are required, a consultation with a drilling contractor on drill pad size prior to applying for the permits will save time and mitigate any risks.

Other considerations when drill pad planning include:

- Access road
  - Width
  - Berms
  - Grades
  - Overhead clearances
  - Location of water and fuel

- Road conditions
  - Berms
  - Width
  - Grades
  - Distance from pad
  - Access to the mud or fuel tank from the pad around other equipment

- Sumps
  - Right size
  - Position near rig, hole, and mud tank
  - Ramped
  - Guarded
  - Space between splitter and sump and return hose

    - Access to remove muds when sump is full if undersized

- Communications
    - Radio
    - Cell
    - Satellite

- Drainage
    - Environmental controls
    - Runoff

- Ground control conditions
    - Sloped banks
    - Rocks in face

- Surveyed hole layout complete
    - Hole location
    - Direction
    - Front/back site

- Power lines and utilities
    - Minimum distances away from overhead lines based on voltage
    - Known locations of subgrade utilities from locating services and local owners

EXCAVATION STABILIZATION

DEFINITION

Stabilization of mined surfaces to prevent erosion, sedimentation and the degradation of surface and ground water quality.

PURPOSE

To prevent discharge of sediments or other pollutants into stream channels, drainage ways or waters of the state.

APPLICABILITY

Stabilization practices are applicable to surface disturbances resulting from mining activities that are subject to forces of erosion.

PLANNING CRITERIA

The Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation regulates mineral exploration and mining operations within the state of Nevada. Federal land management agencies and some local governments also regulate mineral exploration and mining operations. **The applicable agencies must be contacted and coordinated with before initiating mineral excavations within the state of Nevada.**

Nonpoint source impacts to surface and ground water quality from mine excavation activities may be prevented or minimized by properly designing and implementing stabilization and reclamation practices. The majority of potential water quality impacts can be averted by upfront planning before land disturbance is initiated. Planning elements to consider include: design and siting of the mine site, facilities, haul and access roads; mining operations and maintenance; design and implementation of sediment and erosion controls prior to surface disturbances; proper mine closure procedures; and for concurrent and final reclamation activities consistent with federal and state regulations.

Various methods are available for stabilizing mine surfaces. Decision as to the appropriate type should be based on careful consideration of the specifics of the site including: magnitude of problem, installation requirements, local conditions, and future maintenance requirements. Topsoil should be stockpiled in conjunction with any disturbance to assist in reclamation efforts.

METHODS AND MATERIALS

General BMPs for mine excavations are described below. Site specifics may require more detailed design and engineering. **A qualified professional engineer should be consulted where appropriate**. A variety of BMPs may be required as described in the following sections of this document.

- Road and Construction Site Practices
- Erosion and Sediment Controls
- Soil Stabilization Practices
- Slope Stabilization Practices
- Infiltration Systems
- Watershed Management
- Waste Management
- Miscellaneous

1. Open Pit Backfilling & Stabilization

Depending upon the type of deposit, the geochemistry of the rock, and water (if present) in the pit, backfilling or partial backfilling, can be a viable means for stabilization and reclamation. Backfilling will typically be compatible with post-mining land uses and management objectives, reduce visual impacts and minimize the impoundment of surface water.

There are three types of backfilling which can be accomplished concurrently or at the end of mining.

Total Backfilling - Potentially extends the duration of the project and may not be economically feasible, but this is balanced against returning the landform more nearly to its original configuration.

Partial Backfilling or Screen Slope Backfilling - This practice is typically done to modify or conceal visual impacts and to increase slope stability of the pit walls. Sometimes utilized as a compromise to total backfilling.

Concurrent Backfilling - Commonly done at mine sites with multiple pits where production schedules can accommodate direct placement of waste rock in an open pit. This method is advantageous because it is cost effective, reduces the size, extent and reclamation of waste rock dumps and allows for a productive post-mining land use.

2. **Highwall Stabilization**

The configuration of a highwall including: the highwall, the overall slope angle, and the bench heights/widths should be designed based upon site specific factors such as rock alteration(s), rock types(s), structure, rock competency and the individual weathering characteristics of each lithologic unit. Slopes created by a mining operation are required by Nevada state law, to be in a stable condition at final reclamation.

The stabilization or reclamation of pit highwalls may range from leaving the highwall stand, to scaling it down or backfilling it to some extent. Fencing or berming is typically incorporated into final reclamation to protect the safety of the public.

3. **Trenches & Bladed Areas**

The stabilization of trenches and bladed areas includes the following elements.

* Topsoil should be stockpiled separate from any subsoil or bedrock materials.

* Utilization of mechanical hoes results in less surface disturbance than bulldozers.

* Trenches should be reclaimed immediately or stabilized by reducing the slope of the walls. If the trench is not immediately reclaimed sediment and erosion control measures should be implemented, and hazards to people, livestock and wildlife addressed.

* The reclamation of trenches and bladed areas includes backfilling, regrading to the original slope and contour, spreading of the stockpiled topsoil and revegetating the disturbed area.

4. **Placer Operations**

Placer operations typically involve the disturbance of stream management areas, including the stream bed. The control of sediment and erosion becomes more difficult and requires the design and installation of sediment and erosion control structures, usually in series. Impacts to riparian and aquatic vegetation, fisheries and wildlife habitat all become concerns which must be addressed. **Coordination with federal, state and local regulating agencies is necessary**. **Qualified professionals are recommended for the design and implementation of placer operations**.

MAINTENANCE

A comprehensive maintenance program should be developed for all mine excavation operations. Regular maintenance is necessary throughout the life of the mine, design, development through closure and reclamation. The project area must be left in a stable condition for long term recovery as required by state and federal law.

EFFECTIVENESS

When properly designed, installed and maintained mine excavation and stabilization practices should be an effective means to control erosion, prevent soil loss, and protect water quality.

NOTE:

For specific guidance on excavation stabilization refer to U.S. Soil Conservation Service Technical Guides, U.S. Forest Service Handbooks, U.S. Department of the Interior - Bureau of Land Management Mining Regulations and handbooks, and the Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation.

<u>STORMWATER MANAGEMENT</u>

DIRECTIONAL DRILLING

DEFINITION

BMP guidance that applies to drilling water wells and utilities, environmental protection and monitoring wells, and geotechnical borings that use machinery in the drilling.

PURPOSE

Drilling activities can expose soil and contaminated soil. These activities may cause the discharge of stormwater contaminated with sediments and other contaminates. This risk increases when drilling in areas with contaminated soils. A pollutant control approach can reduce sediment runoff from drilling operations.

PLANNING CRITERIA & IMPLEMENTATION

- When drilling in areas of known or suspected soil contamination, test and characterize soil cuttings and accumulated sediment to determine proper management and disposal methods. If applicable, generator knowledge may be used to characterize the soil cuttings and accumulated sediment.
- Obtain permits for drilling activities, and for clearing and grading the access routes and the work site.
- Protect environmentally sensitive areas (streams, wetlands, floodplains, floodways, erosion hazards, and landslide hazards) within the area of influence of the work site.
- Mitigate potential impacts to surrounding areas and/or the drainage system.
- For horizontal directional drilling, take measures to capture and contain drilling fluids and slurry.
- Equip the driller to quickly respond to unusual conditions that may arise.
- Locate and prepare access roadways to minimize the amount of excavation and the potential for erosion.
- Contain accumulated uncontaminated water and sediment on site and pump into a storage tank or direct through a geotextile filtration system (or equivalent system) before discharging to the surrounding ground surface. Contaminants may include, but are not limited to, hydraulic fluids, contaminants in the soil and/or groundwater, polymers, and other drilling fluid additives.
- Keep all sediment-laden water out of storm drains and surface waters. If sediment-laden water does escape from the immediate drilling location, block flow to any nearby waterways or catch basins using fabric, inlet protections, sandbags, erosion fences, or other similar methods. Immediately notify the local jurisdiction if sediment-laden water impacts the storm sewer system or surface waters.
- Divert any concentrated flows of water into the site using sandbags or check dams up-slope from the site.
- Dispose of soil cuttings and accumulated sediment appropriately. If cuttings or other soils disturbed in the drilling process are to be temporarily stockpiled on site, they must be covered

and surrounded by a berm or filter device.

- Stabilize exposed soils at the end of the job, using mulch or other erosion control measures.
- Contain spent drilling slurry on site and allow it to dewater, or haul to an appropriate, approved disposal site.
- Restore disturbed areas with mulch and seeding or hydroseeding.

MAINTENANCE

- Regularly assess site practices and environmental controls to make sure that they are mitigating or reducing environmental risk to an acceptable level.
- Ensure that no discharge is occurring. Adjust practices or controls if they are not working efficiently.
- Monitor drilling fluid volume in the containment pit to ensure that it is sized appropriately.
- Regularly inspect and clean out sediment controls and secondary catchpit protection.
- Regularly sweep up any sediment or dust and dispose of it appropriately so that it will not become airborne or enter surface water.
- Once works are complete remove environmental controls. Inspect stormwater catchpits and remove any contamination associated with site works.

DIVERSION DAM

DEFINITION

A structure built to divert part or all of the water from a waterway or stream into a different watercourse, an irrigation canal or ditch, or a waterspreading system.

PURPOSE

The purpose of a diversion dam is:

- To divert part or all of the water from a waterway in such a manner that it can be controlled and applied to a beneficial use; or
- To divert periodic damaging flows from a watercourse to another watercourse having characteristics which reduce the damage potential of the flows and thus protect the watershed.

APPLICABILITY

This BMP includes structures of a permanent nature, constructed of materials having an expected life span consistent with the purpose for which the structure is designed. It does not include Floodwater Diversion, Floodwater Retarding Structure or Erosion and Sediment Control Structures. The BMP applies:

1. Where a diversion dam is needed as a integral part of an irrigation system or for a water spreading system which has been designed to facilitate the conservation of soil and water resources.
2. Where it is desirable to divert water from an unstable watercourse to a stable watercourse.
3. Where the water supply available is adequate for the purpose for which it is to be diverted.
4. Where the construction of a dam and the diversion of water are permitted by applicable federal, state, and local statutes and regulations.

PLANNING CRITERIA

- Determine through topographical mapping the length and degree of slope, contributing watershed and associated drainage ways. Baseline soils data should be gathered and analyzed for stability and erodibility.
- Materials - All materials to be used in construction of the diversion dam and appurtenances should have the strength, durability and workability required to meet the installation and service conditions at the site.
- Outlet works - Where partial diversions are required, the outlet works should provide for positive control of both maximum and minimum diversions consistent with the purpose for which the diversions are made. Where all the flow is to be diverted, the outlet works should provide for safe diversion of all expected flows based on site conditions.
- By-pass works - The by-pass works should be capable of passing all flows needed to satisfy downstream priorities and all flows in excess of diversion requirements. This may require a combination of orifices, and gates designed to meet the requirements of the site.
- Special purpose works - Where debris or sediments are present under flow conditions subject to diversion, provision should be made to bypass or remove those materials which may be

detrimental to the functioning of the outlet works, to other portions of the works, or areas to which diversion is made. This may involve the use of settling basins, debris traps, trash guards of sluiceways depending on the site conditions.

- Federal, State, & Local Laws - Laws concerning water use must be complied with.
- **Depending on the magnitude of the project and the expertise of the proponent, utilize a qualified engineer to design the size, capacity, length and location of the diversion dam.**

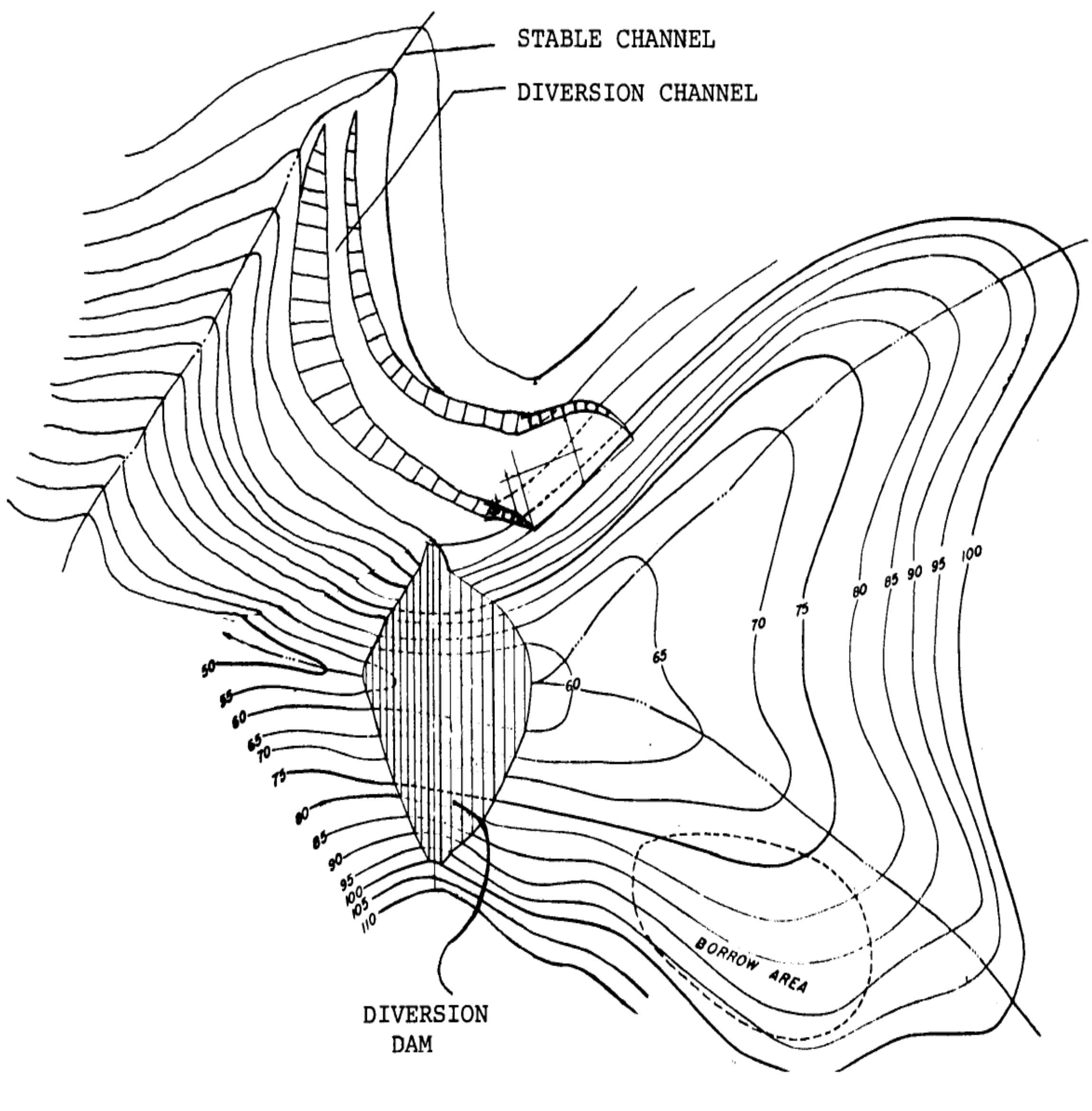
MAINTENANCE

A regular inspection schedule is necessary to ensure that the structure has not developed any faults and that sediments or debris are not interfering with its functioning. Inspections should also occur after precipitation or runoff events and identified repairs made before the next storm event.

EFFECTIVENESS

Use of diversion dams are effective in diverting surface water flow when properly designed, installed, operated and maintained.

DIVERSION DAM
FIGURE 2-4



DIVERSION DIKE

DEFINITION

A runoff interceptor designed and constructed at the top of a cut or fill slope to divert surface flow.

PURPOSE

To divert overland runoff flow away from slopes, reduce the potential for surface erosion and reduce uninterrupted slope length.

APPLICABILITY

All slopes, cut or fill, which may receive runoff from upslope areas.

PLANNING CRITERIA

Diversion dikes should be designed and constructed to intercept all runoff flow from above cut and fill slopes and upon benches on large slope faces to prevent collected runoff from flowing onto slope faces below.

1. Determine through topographical mapping the length and degree of slope, contributing watershed and associated drainage ways.
2. Diversion dikes should be engineered and designed such that diverted runoff does not overtop the dike.
3. The outlet of the diversion dike should be designed to dissipate energy via dense and durable vegetation, or artificially stabilized with rock, matting or other material. Runoff flow can also be conveyed to a downdrain, chute or flume for conveyance down slope.
4. Discharge - Discharge should be to an area, mechanically and/or vegetatively stabilized, or to an established drainage system.
5. Depending on the magnitude of the project and the expertise of the proponent, utilize a qualified engineer to design the size, capacity, length and location of the diversion dike.

METHODS AND MATERIALS

The diversion dike consists of a trench and a dike. The trench may be constructed using mechanized equipment or hand tools. The dike should be compacted as specified in the engineering design. The trench, dike and the surrounding disturbance area should be stabilized and revegetated immediately after construction.

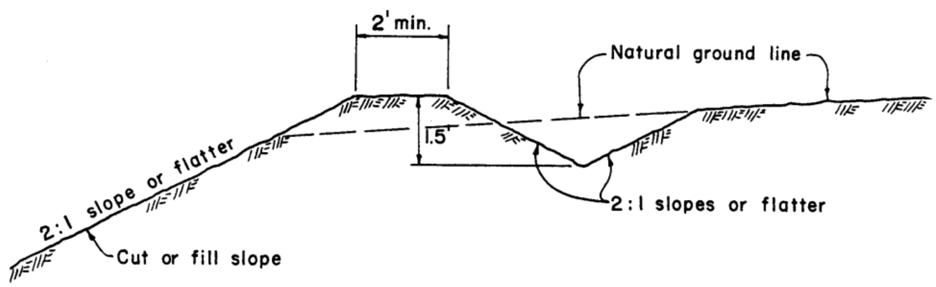
MAINTENANCE

Inspect after each major precipitation or storm event to identify any damaged areas. Repairs should be completed before the next storm. Any channel obstructions should be removed.

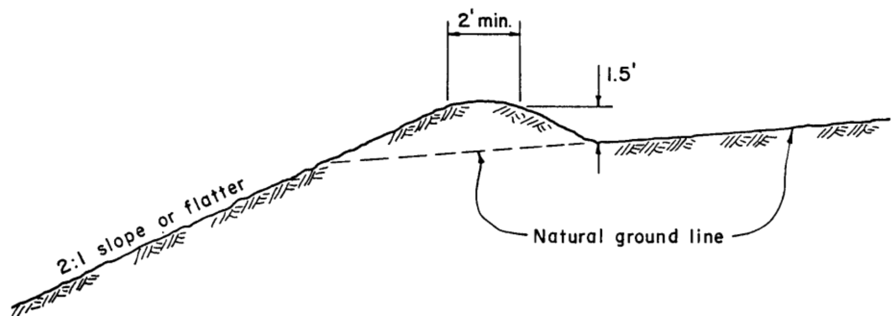
EFFECTIVENESS

Properly designed, installed and maintained a diversion dike will effectively reduce the transport of sediments, minimize erosion resulting from surface runoff and reduce the degradation of receiving water resources.

DIVERSION DIKE



SECTION
not to scale



SECTION
Dike constructed by dozer moving soil upslope and dumping at top of slope.

RUNOFF INTERCEPTOR TRENCH OR SWALE

DEFINITION

A trench or swale designed and constructed along the contour of a slope to intercept surface runoff.

PURPOSE

To decrease the uninterrupted slope length, store and divert surface runoff from the slope face and to reduce the erosion potential from concentrated surface runoff.

APPLICABILITY

Used on slopes with comparatively gentle gradients (3:1 or less), but having long uninterrupted slope lengths; e.g., abandoned dirt roads, easements, and gently sloping cuts and fills.

PLANNING CRITERIA

1. Determine through topographical mapping the length and degree of slope, contributing watershed and associated drainage ways.
2. Depending on the magnitude of the project and the expertise of the proponent, utilize a qualified engineer to design the size, capacity, length and location of the runoff interceptor trench or swale.
3. Identify and include in the design adequate runoff conveyance and discharge areas to receive the surface runoff captured by the trench or swale.

METHODS AND MATERIALS

Construct the trench along the slope contour including a conveyance to outlet flow to a level spreader or other stabilized discharge. Excavated materials should be placed on the downslope side of the trench or swale and spread to conform with the natural slope. The trench or slope and the surrounding disturbance area should be stabilized and revegetated immediately after construction.

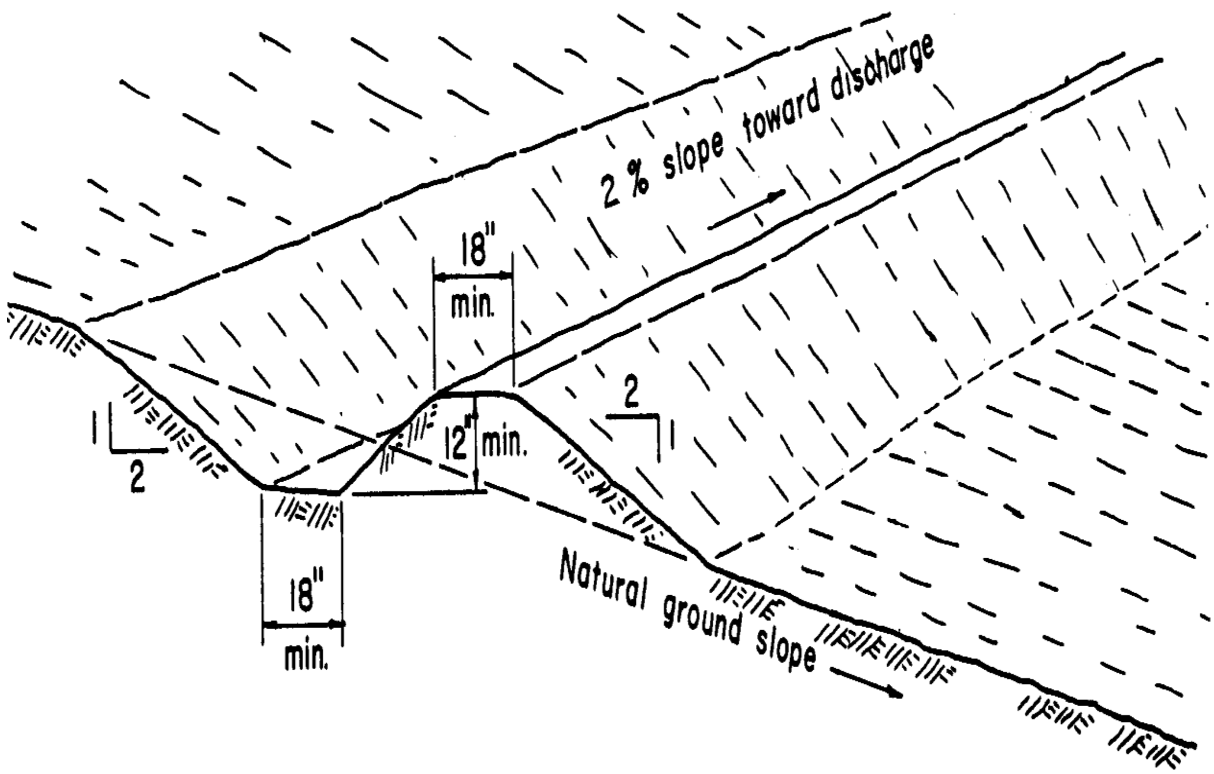
MAINTENANCE

Inspections should be conducted for damage after each major precipitation or runoff event. Repair damage immediately as required.

EFFECTIVENESS

Properly designed, installed and maintained a runoff interceptor trench or swale will effectively convey surface runoff, minimize soil erosion resulting from surface runoff and reduce the degradation of receiving water resources.

RUNOFF INTERCEPTOR TRENCH OR SWALE



ISOMETRIC SECTION

not to scale

SETTLING PONDS

DEFINITION

A settling basin, settling pond or decant pond is an earthen or concrete structure using sedimentation to remove settleable matter and turbidity from wastewater.

PURPOSE

The basins are used to control water pollution in industries such as agriculture, aquaculture, and mining.

PLANNING CRITERIA & IMPLEMENTATION

Wastewater enters the basin and very fine particles in the water are separated by means of gravity. The water must be in the basin long enough for the desired particle size to be removed. Smaller particles require longer periods for removal and thus larger basins. In some basins a flocculant may be added to help smaller particles stick together and form larger particles.

Translation of required settling time surface area to settling basin geometry requires consideration of short circuiting and turbulence induced by wind, bottom scour, or inlet and overflow design. Settling basin geometry is important as the effective time of settling within the basin will be the time a volume of water spends in non-turbulent conditions before reaching the settling basin overflow.

Settling basins with overflow structures near the entrance points may hold a large volume of stagnant water while newly admitted water rapidly reaches the overflow point before settling can occur. Effective surface area for settling seldom extends perpendicularly more than a tenth the distance of a flow line from basin entrance to overflow unless baffles are installed. Effective surface area and geometry may change as accumulating sediment fills part of the originally constructed volume. Short cut channels may rapidly form through heavier sediment accumulations near the entrance to the settling basin. Flow through shallow portions of the settling basin may cause turbulence resuspending sediment from the bottom of the basin. Two feet has been recommended as a minimum settling basin depth to avoid bottom scour.

MAINTENANCE

Over time, settling ponds, holding ponds and lagoons at industrial plants may accumulate sludge, silt and sediments. Consequently, accumulated materials reduce effectiveness and water storage capacity of the settling ponds. As a result, productivity and efficiency of the industrial plant is reduced. Regular pond dredging projects can ensure ongoing efficiency of the BMP.

Pond dredging may involve petrochemical sludge, fly ash pond (produced by burning coal) or desliming ponds in mining operations. Dredging of a pond can be performed using cutter suction dredgers when the materials have settled over a longer period and have become compact.

SURFACE RUNOFF MANAGEMENT

NOTE

Nevada is an authorized National Pollutant Discharge Elimination System state, and its stormwater program covers all active and inactive mine sites with a general stormwater permit; as such, mines are treated as point sources for purposes of the permit.

Areas **NOT** covered by this program are: haul roads constructed of conventional materials and not subject to spillage, parking lots, reclaimed areas released from bond, grassy areas, office buildings, and areas released from bond that are inadequately reclaimed.

Stormwater coming in contact with "industrial" areas of mine sites will be permitted. Examples of industrial areas include: industrial buildings, haul roads constructed of waste rock or spent ore or which are used to transport industrial materials, milling, concentrating and processing areas, waste rock dumps, spent ore dumps, chemical and fuel storage areas, and truck wash areas.

NPDES and stormwater general permits do not apply once the mining site has met closure and reclamation requirements.

BMPs should be implemented on all mining and mining related sites to prevent, control and minimize nonpoint source pollution and to protect water quality. BMPs throughout this manual are provided as guidance and should be selected and applied on a site specific basis appropriate to the goals and objectives of the project, existing environment and site management requirements.

DEFINITION

BMPs utilized to manage surface or stormwater runoff from mine sites and all ancillary facilities including areas being reclaimed, areas covered by NPDES permits and sites not subject to permit requirements.

PURPOSE

To prevent and control nonpoint source pollution impacts to surface and ground water from mine site stormwater runoff.

APPLICABILITY

Surface or stormwater runoff management practices are applicable to all mining industry related sites, active, inactive, temporarily closed or reclaimed.

PLANNING CRITERIA

Surface or stormwater management practices should be incorporated into permit requirements as per regulation, and should be accepted protocol for mining related sites, operations, designs and project planning. A mine site which had or has the potential for acid rock drainage, metal leaching or related water quality concerns should be particularly concerned with surface water management.

A risk identification and assessment of the potential pollution or contaminant sources should be completed. Data should be gathered for each contaminant source including: type, quantity, characteristics, toxicity, mobility and the potential for release to surface or stormwater flows. A contingency plan should also be developed which addresses each of the existing or potential contaminant sources. Monitoring may also be a necessary component to stormwater management. The gathering and compiling of baseline data on stormwater quality will clarify agency concerns and protect all involved.

Employee training on the components of the stormwater runoff management program, practices, good housekeeping and maintenance related to those practices should be implemented on a timely basis.

METHODS AND MATERIALS

The development of a stormwater runoff management program may require the expertise of a qualified professional engineer. Coordination with the appropriate federal and state regulatory agencies is also necessary. A variety of BMPs may be required as described in the following sections of this document.

- Road and Construction Site Practices
- Erosion and Sediment Controls
- Soil Stabilization Practices
- Slope Stabilization Practices
- Infiltration Systems
- Watershed Management
- Waste Management
- Miscellaneous

MAINTENANCE

A comprehensive maintenance plan should be developed and incorporated into the stormwater runoff management program. Regular maintenance particularly after contaminant spills, precipitation and storm events is necessary. Identified problems should be repaired immediately, prior to the next storm event.

EFFECTIVENESS

Stormwater runoff management practices when designed, installed and maintained properly are effective methods to treat nonpoint source pollution and minimize impacts to surface and ground water quality.

WASTE MANAGEMENT & RECLAMATION:

MINE WASTE STORAGE

DEFINITION

Tailings are finely ground muddy or sandy mine wastes left behind after the valuable metals and minerals have been extracted from the ore. Waste storage pons are an impoundment made by constructing an excavated pit, dam or embankment for the temporary storage of livestock or other agricultural wastes, wastewater, and/or polluted runoff. Depending on the design, waste storage ponds can be aerobic or anaerobic or a combination of both.

PURPOSE

Tailings waste are typically stored behind large dams that can reach hundreds of meters in height and are built progressively over many years out of the mine's own waste material. Waste storage ponds are utilized to store liquids, solid wastes and polluted runoff from concentrated livestock or waste areas until they can be safely utilized, evaporated, or otherwise disposed of.

APPLICABILITY

This practice applies generally in predominantly rural or agricultural areas, where there is a need for facilities to temporarily store agricultural wastes or polluted runoff, reduce pollution, minimize health hazards and improve the environment in predominantly rural or agricultural areas. Waste storage ponds must be designed and constructed to all applicable federal, state and local regulations.

PLANNING CRITERIA

Waste storage ponds should be designed, engineered and constructed by a qualified professional engineer. All federal, state and local laws, rules and regulations governing waste management, pollution abatement, public health and safety and environmental protection shall be strictly adhered to. A lining may be required if the potential for ground water contamination exists. The owner and operator is responsible for securing all required permits or approvals and for performing in accordance with such laws and regulations.

METHODS AND MATERIALS

A qualified professional engineer should be retained to design, engineer, construct, operate and maintain a waste storage pond.

MAINTENANCE

A comprehensive maintenance plan should be developed in conjunction with the design and construction of a waste storage pond. Storage ponds require regular inspection and maintenance to ensure safe operations and effectiveness.

EFFECTIVENESS

A properly designed, constructed and maintained waste storage pond will function effectively while minimizing impacts to the environment.

NONTOXIC DRILLING FLUIDS

DEFINITION

Drilling mud or drilling fluid is used in petroleum engineering and is a heavy, viscous fluid mixture used in oil and gas drilling operations.

PURPOSE

Drilling mud is a nontoxic option used to carry rock cuttings to the surface and also to lubricate and cool the drill bit. Drilling mud also helps prevent the collapse of unstable strata into the borehole and the intrusion of water from water-bearing strata that may be encountered.

Drilling mud is classified as exempt waste by the Environmental Protection Agency (EPA), and must be handled in accordance with city, state, and federal regulations. Exempt waste includes not only drilling mud, but also material such as drill cuttings, crude oil sediment from tank bottoms, brine used in fracking, spent filters and rigwash, and hydrocarbon-bearing soil and waste crude oil from primary field operations. Exempt waste such as drilling mud is generated by upstream companies in the oil and gas industry, which are responsible for handling it compliantly.

PLANNING CRITERIA & IMPLEMENTATION

A typical water-based drilling mud contains a clay, usually bentonite, to give it enough viscosity to carry cutting chips to the surface, as well as a mineral such as barite (barium sulfate) to increase the weight of the column enough to stabilize the borehole. Smaller quantities of hundreds of other ingredients might be added, such as caustic soda (sodium hydroxide) to increase alkalinity and decrease corrosion, salts such as potassium chloride to reduce infiltration of water from the drilling fluid into the rock formation, and various petroleum-derived drilling lubricants. Oil- and synthetic-based muds contain water (usually a brine), bentonite and barite for viscosity and weight, and various emulsifiers and detergents for lubricity.

Drilling mud is pumped down the hollow drill pipe to the drill bit, where it exits the pipe and then is flushed back up the borehole to the surface. For economic and environmental reasons, oil- and synthetic-based muds are usually cleaned and recirculated (though some muds, particularly water-based muds, can be discharged into the surrounding environment in a regulated manner). Larger drill cuttings are removed by passing the returned mud through one or more vibrating screens, and sometimes fine cuttings are removed by passing the mud through centrifuges. Cleaned mud is blended with new mud for reuse down the borehole.

Drilling fluids are also employed in the drilling of water wells.

MAINTENANCE & DISPOSAL

Drilling mud is usually collected by self-loading vacuum trucks, tanks, or boxes, and then removed and disposed of following specific procedures. It requires analytics before going to post-collection and is commonly routed to upstream landfills authorized to receive it. Some drilling mud can be treated, separated, and reused. For example, specialized Treatment Recovery and Disposal (TRD) facilities separate certain drilling muds into crude oil, wastewater, and solids. The resulting dry waste goes to a landfill, the recovered oil is sold, and the wastewater goes to saltwater wells or deep wells.

PRODUCED WATER MANAGEMENT

DEFINITION

Produced water is naturally occurring water that comes out of the ground along with oil and gas. Most oil- and gas-bearing rocks also contain water. When the oil or gas is extracted from these rocks, the water comes out as well. This produced water is a byproduct of almost all oil and gas extraction, though the amounts of produced water can vary widely in different places or over the lifetime of a single well.

PURPOSE

Produced water contains soluble and non-soluble oil/organics, suspended solids, dissolved solids, and various chemicals used in the production process. The ratio of produced water to oil varies from well to well and over the life of the well. Generally, this ratio is more than 3 and can be more than 20 in some parts of the world. Not only does the flowrate of the produced water change over time, but so does the composition. The composition of produced water also varies widely from well to well.

PLANNING CRITERIA & IMPLEMENTATION

The degree of produced water treatment depends on the site's treatment requirements-typically deep well injection, reinjection, evaporation ponds, or surface water discharge. New water treatment technologies and new applications of existing technologies are being developed and used to treat shale gas produced water for reuse in a variety of applications.

MAINTENANCE & SAFETY CONSIDERATIONS

Minimizing the amount of water that enters the wellbore is often a cost-effective approach when much of the water is coming from sections of the wellbore that can be shut off. Down-hole separation of the water and gas with the water injected to a water-disposal formation also reduces production costs and environmental impacts of dealing with water on the surface. Most water that is produced at the surface is injected in water disposal wells or injected into producing fields to maintain reservoir pressure. In addition, many technologies are available to remove impurities so that produced water can be reused for industrial, agricultural and domestic use.

RESERVE PITS

DEFINITION

Reserve pits are storage pits dug near drilling sites for the purpose of holding drilling mud and wastewater from drilling operations.

PURPOSE

This prevents the harmful additives in the wastewater from seeping into the earth and contaminating groundwater. The reserve pits are lined with a special pit liner that prevents contaminants from seeping into the ground.

On completion of drilling activities, the reserve pit is fenced to prevent access to wildlife or livestock until the pit is reclaimed.

PLANNING CRITERIA & IMPLEMENTATION

The contents of reserve pits depend on the type of drilling mud used, the formation drilled, and other chemicals added to the mud circulation system during the drilling process.

Reserve pits can contaminate soil, groundwater, and surface water with metals and hydrocarbons if not managed and closed properly. As reserve pit fluids evaporate, water-soluble metals, salts, and other chemicals become concentrated. Precipitation, changes in shallow groundwater levels, and flooding can mobilize these contaminants into adjacent soils and groundwater.

MAINTENANCE & SAFETY CONSIDERATIONS

1. **On-site Disposal and Burial of Reserve Pit Wastes**
   On-site disposal and burial involves allowing reserve pit fluids to dry and encapsulating the remaining solids with the reserve pit synthetic liner and burying the wastes in place. Oil operators are allowed from 30 days to one year after well completion to close a reserve pit.
2. **Solidification of Drilling Wastes**
   If reserve pits are used, cost-effective technology exists to solidify pit fluids immediately following well completion. Solidification can add to the waste volume but prevents mobilization of potential contaminants into the soil and/or groundwater. Solidification involves the removal of the free liquid fraction of reserve pit fluids and then adding solidifiers such as commercial cement, fly ash, or lime kiln dust. Removal and off-site disposal of liquids removes most of the water-soluble metals, salts, and chemicals from the drilling waste material.
3. **Pitless or Closed Loop Drilling**
   Pitless drilling or closed-loop drilling can reduce the amount of drilling waste, recycle drilling fluids, and reduce drilling costs. Pitless drilling can also reduce the volume of waste substantially. Pitless drilling also conserves water and prevents soil contamination. Pitless drilling systems are equipped with a “chemically-enhanced” centrifuge that

separates drilling mud liquids from solids. The separated drilling mud solids are stored in a steel tank and then transferred to a synthetically-lined clay pad for drying. The pads are designed to prevent the runoff of any liquids. The drill cuttings are either buried on site or are transferred to an approved commercial disposal facility for disposal. The drill cuttings can create environmental problems and pose a risk to wildlife if the trench or excavated burial pit collects water from snowmelt or rainfall. Ponded water in the trench or burial pit may become contaminated with hydrocarbons present in the drill cuttings. Immediate burial of drill cuttings and contouring of the site should prevent the ponding of snowmelt orrainwater. Sheens, oil, and sludges in the disposal pit will pose a risk to migratory birds and other wildlife. Additionally, if the pits are not lined, soil and groundwater contamination can occur if the drill cuttings contain leachable concentrations of hydrocarbons and metals.

4. **Treatment and Reuse of Drilling Fluids**
   Operators may use new technology to treat and reuse drilling fluids. Drilling fluids are treated using a patented combination of fluid and thermal dynamics to remove oil and salts. The treatment separates the drilling fluid into fresh water, heavy brine, condensate, and methanol. The condensate is recovered and sold. The methanol and brine are reused in drilling fluids. The fresh water is either reused at other drilling locations or is used for the benefit of livestock or wildlife.
5. **Down-hole Disposal of Drilling Fluids**
   Another disposal option is to inject the drill cuttings underground after the solids are finely ground and mixed with a liquid to form a slurry This disposal technique is typically used in conjunction with pitless drilling. Open earthen reserve pits are not used to temporarily store the drilling fluids. The elimination of open pits removes the mortality threat to migratory birds and other wildlife. Slurry injection of drilling wastes also poses less environmental impacts when properly managed and monitored as the wastes are disposed deep underground and isolated from aquifers.

CHEMICAL USE MANAGEMENT

DEFINITION

A chemical management system is a framework for improving overall environmental and chemical performance while achieving the goal of zero pollutant discharge.

PURPOSE

Chemical management is an important part of facility management for businesses and entities that transport, manage, and store hazardous materials. Unlike many other types of assets and materials, chemicals must be closely monitored to reduce the likelihood of safety issues related to compatibility or unexpected leaks.

PLANNING CRITERIA & IMPLEMENTATION

The best way to control chemical hazards at your workplace is to develop a consistent chemical management procedure.

The four key steps to a Chemical Management Procedure are:

Step 1: Identify

- Clearly identify each chemical you use in your workplace and gain an understanding of both their health hazards and physiochemical hazards.

Step 2: Assess

- Conduct a risk assessment on each of the hazardous chemicals (think how they are received, dispensed, used and stored). Take into consideration what accidents or hazardous events could occur and the possible consequences.

Step 3: Control

- Using the Hierarchy of Controls, introduce changes in the workplace to eliminate or minimize exposure to the hazard.

Step 4: Sustain

- Have a system in place to review all your control measures as well as identify, assess and control any new chemicals that are introduced to the workplace.

STOCKPILES

DEFINITION

Waste stockpiling is the temporary storage of waste prior to disposal, or as part of recycling, reprocessing, recovery, or reuse activities.

PURPOSE

Stockpile management is implemented to prevent air and stormwater pollution from stockpiles of soil and sand, paving materials, and other loose materials used during the construction process.

Management practices are based on the type of material being stored.

APPLICABILITY

Stockpile management is applicable on all construction sites where materials are stockpiled. Materials include, but are not limited to, the following:

- Soil
- Sand
- Construction debris
- Mulch
- Topsoil
- Asphalt
- Aggregate base and subbase
- Pressure treated wood

Controls typically used to manage stockpiles include:

- Stockpile duration restriction
- Plastic sheeting cover
- Sediment control fence
- Diversion of runoff
- Biodegradable erosion control logs
- Soil stabilization

PLANNING CRITERIA

1. If stockpiles are permitted onsite, a designated stockpile area should be identified in project planning phase.
2. Stockpile locations should be located away from concentrated flows of stormwater, drainages, and inlets, water bodies, and other sensitive environmental areas.
3. All stockpiles, inactive or active, should have the proper BMPs implemented until stockpiling activities cease.
4. Stockpiles of contaminated soils should be managed in accordance with the Soil and Groundwater Management Plan.

5. Include construction plan note indicating the duration that inactive stockpiles are permitted. This is dependent on-site conditions and stockpile needs.
6. Identify permitted stockpile material and prohibit stockpiling of any material not previously permitted.

SITE RECLAMATION

DEFINITION

Reclamation is the combined process by which adverse environmental effects of industrial activities such as surface mining are minimized, and lands are returned to a beneficial end use.

PURPOSE

End uses may be open space, wildlife habitat, agriculture, or residential and commercial development. Some components of reclamation include practices that control erosion and sedimentation, stabilize slopes, and avoid and repair impacts to wildlife habitat. The final step is usually topsoil replacement and revegetation with suitable plant species. Reclamation is often phased to be concurrent throughout the life of the industrial project.

PLANNING CRITERIA & IMPLEMENTATION

A reclamation plan is included in the Surface Use Plan of Operations and should discuss plans for both interim and final reclamation. Reclamation is required of any disturbed surface that is not necessary for continued production operations. The operator should submit a new reclamation plan with the Notice of Intent to Abandon (NIA) or Subsequent Report Plug and Abandon (SRA) using the Sundry Notices and Reports on Wells Form 3160-5 when abandoning wells and other facilities that do not have an approved reclamation plan or when the operator would like to update the plan. The BLM will forward the request to the FS or other surface management agency as appropriate. Additional reclamation measures may be required based on the conditions existing at the time of abandonment and made a part of the conditions of approval of the NIA or SRA. Earthwork for interim and final reclamation generally must be completed within 6 months of well completion or plugging (weather permitting).

MAINTENANCE & CONSIDERATIONS

The reclamation process involves restoring the original landform or creating a landform that approximates and blends in with the surrounding landform. It also involves salvaging and reusing all available topsoil (whatever soil is on top) in a timely manner, revegetating disturbed areas to native species, controlling erosion, controlling invasive nonnative plants and noxious weeds, and monitoring results. Reclamation measures should begin as soon as possible after the disturbance and continue until successful reclamation is achieved. With proper reclamation measures, over time, local native species will become re-established on the site and the area will regain its original productive and scenic potential.

TAILINGS

DEFINITION

Tailings are a by-product of mining. After ore containing an economically-recoverable commodity is mined from the earth, that commodity is extracted in a processing plant or mill. After the commodity of value is extracted from the ore material, the resultant waste stream is termed “tailings”. Typically, mill tailings range from sand to silt-clay in particle size.

PURPOSE

After processing, tailings are impounded so that their effect on the environment is minimized. There are several methods currently used in the mining industry for constructing tailings facilities, including:

- Conventional tailings facility, including in-pit disposal methods;
- Paste tailings including underground backfill; and
- Filtered tailings.

Each of these tailings impoundments utilizes a dam and engineered containment to minimize seepage of solutions into the environment. Generally, a pump system is used to collect any errant seepage and return it to the process or impoundment.

PLANNING CRITERIA & IMPLEMENTATION

1. Conventional Tailings Facility

Tailings slurry, typically containing 1 to 2 parts of finely ground solids to 1 to 2 part of water, is pumped or otherwise conveyed directly to a tailings facility, which consists of a dam and an engineered containment system. Solution decants (is poured) from the solids and is usually recycled back to the processing plant.

A variation of this type of tailings facility would be the placement of tailings into all or a portion of a mined out pit. As with other methods, care is taken to account for any migration of contaminants that may occur. On some occasions, backfilling a pit with tailings can reduce or eliminate the production of acid rock drainage from the pit walls.

2. Paste Facility

In the final process before storage, water is separated from tailings slurry in special tanks called thickeners to make a “paste”. Depending on the amount of water in the tailings, usually less than 1 part of water to 3 parts of finely ground solids, the resultant material may have the texture of toothpaste. The paste is pumped to a storage facility. There usually is a small amount of decant solution that is pumped back to the process.

Sometimes paste and cement are mixed and pumped back into an underground mine for storage, which actually helps the miners by filling voids and providing ground support. It also reduces the amount of area on the surface that would be used for the paste tailings facility.

3. Filtered Tailings

Tailings are pumped into high pressure filters that produce a rinsed filter cake product containing about 1 part water to 5 parts of finely ground solids. The filter cake can be transported by conveyors or trucks and stacked in a tailings facility. Usually, the size of the starter dam required to ensure slope stability is much smaller than conventional tailings facilities but is highly project-specific. Ideally, there is usually very little solution left in the tailings, which may be moved and shaped in a pile by mechanical equipment such as bulldozers. A protective organic cover may be added after placement to effectively seal the tailings in a ground structure that may grow vegetation.

MAINTENANCE & CONSIDERATIONS

All modern tailings facilities must submit and obtain local, state and federal regulatory approval of an operating, closure and remediation plan. Tailings management during mine operation and afterward are the responsibility of mining companies. Government agencies regulate tailings and set minimum design standards. Tailings management and storage facilities are engineering projects which comply with safety and environmental control requirements. Water management and dust management are also important considerations.

WASTE ROCK DUMP MANAGEMENT

DEFINITION

The management, handling and construction of waste rock dumps comprised of waste rock generated by mining activities.

PURPOSE

To provide guidance for waste rock management for the expressed purpose of preventing and controlling erosion, improving slope stability and reclamation success, and minimizing impacts to surface and ground water quality.

APPLICABILITY

Mine waste rock management and waste rock dump construction practices are applicable to all active, inactive, or potential mine sites and mine sites in temporary closure.

PLANNING CRITERIA

The proper management and handling of waste rock and the proper design and construction of waste rock dumps has a direct effect on slope stability, closure and reclamation success. Generally speaking, a reduction in the degree of waste rock dump fill slopes results in improved slope stability and improved revegetation potential. **Mining operations and associated waste rock dumps are regulated by the Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation (NAC 445.242 to 445.24388 and NAC 519A).** Final waste rock configurations, stability and revegetation are all components of the mining operations reclamation permit as defined by NAC 519A. Waste rock should be sampled and characterized for acid generation potential, reactivity, metals and other parameters that might be of concern, so the material can be handled, stored, disposed and reclaimed successfully.

Upon completion of waste rock characterization the selective placement and construction of waste rock dumps must be considered. This should be completed during the mine planning, design and environmental analysis or pre-disturbance phase of the project. The design and construction of waste rock dumps should consider topography, drainage ways or streams, slope stability, dump surface drainage, reclamation and revegetation aspects. Waste rock dumps should blend with the existing topography to minimize visual impacts. Waste rock can also be utilized to backfill open pits, construct mine roads or haul roads and other areas where material may be needed.

METHODS AND MATERIALS

The management and handling of waste rock, including the design and construction of waste rock dumps requires the expertise of a qualified professional mine engineer. There are also numerous publications regarding mining and mine waste rock available from the federal land management agencies, mineral research centers and universities.

The most common types of mine waste rock dumps include: Head of Valley Fills; Cross Valley Fills; Side Hill Dumps; and Flat Land Pile Dumps.

MAINTENANCE

Mine waste rock area management and mine dump design and construction should be included within the overall mine site maintenance program. Regular inspections are necessary, particularly after precipitation or storm events and repairs should be made immediately. Surface and ground water quality monitoring is recommended and often a permit is required.

EFFECTIVENESS

When properly designed, installed and maintained, mine waste rock management practices are effective means of reducing or preventing erosion, sedimentation and contaminant mobilization, improving reclamation success and reducing public safety risks.

MINERAL EXPLORATION

DEFINITION

Best Management Practices (BMPs) utilized in the management of exploration or development drill sites.

PURPOSE

To minimize erosion, sedimentation and other environmental pollution which is generated during mineral exploration or development drilling operations.

APPLICABILITY

Applicable to all mineral exploration or development drilling activities where a surface disturbance occurs.

PLANNING CRITERIA

The Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation regulates mineral exploration and mining operations within the state of Nevada. Federal land management agencies and some local governments also regulate mineral exploration and mining operations. **Before any mineral exploration is initiated, the appropriate federal, state and local permits should be obtained**. The Nevada Division of Water Resources regulates drilling and drill hole plugging activities. Specific regulations govern these activities and any proposed mineral exploration project should review the applicable requirements. Drill holes are potentially direct conduits to ground water sources and as such, represent a significant threat to ground water quality. The proper closure and abandonment of drill holes is a high concern.

Selection of BMPs for mineral exploration or development drilling are governed by the specifics of the site (i.e. topography, elevation, precipitation, vegetation, etc.). Activities typically involved in exploration projects may include: road building, drainage crossings, drill pad construction, trenching, mud pit construction, and heavy equipment transport and use. A variety of BMPs may be required as described in the following sections of this document.

* Road and Construction Site Practices
* Erosion and Sediment Controls
* Soil Stabilization Practices
* Slope Stabilization Practices
* Infiltration Systems

* Watershed Management
* Waste Management
* Miscellaneous

Proper mineral exploration or development drilling activities require comprehensive pre-disturbance planning, project engineering design and installation specifications, a conscientious commitment to proper maintenance and reclamation practices. Project management scheduling and management typically lend themselves to concurrent reclamation as phases of the drilling are completed.

METHODS AND MATERIALS

A qualified professional should be selected to assist in the project design through reclamation phases. Close coordination with the applicable federal, state and local agencies is necessary. BMPs selected should be properly designed and installed per the engineering specifications.

MAINTENANCE

A site specific maintenance and repair program should be developed with a mineral exploration or development project. Proper maintenance is critical to the effectiveness of selected BMPs and the minimization of erosion and sedimentation.

EFFECTIVENESS

A well planned, designed, implemented and reclaimed mineral exploration project can be successfully completed with minimal impacts to surface and ground water quality.

IMPOUNDMENT MANAGEMENT

DEFINITION

The management of tailings ponds and dams, fresh water impoundments, dewatering infiltration ponds and impoundments, and any other mining facility impoundment.

PURPOSE

To design, install and manage mining impoundments in a manner which prevents erosion and sediment mobilization, controls surface runoff and minimizes pollution impacts to surface and ground water quality.

APPLICABILITY

Proper impoundment design, installation and management practices are applicable to all active, inactive, or potential mine sites and mine sites in temporary closure. **Mining operations and mineral exploration projects are regulated by the Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation (NRS Chapter 445 and NAC Chapter 445.242 through 445.24388. Additionally dams designed and constructed within the state, water wells and related drilling practices are regulated by the Division of Water Resources, State Engineers Office**.

PLANNING CRITERIA

The design, construction and management of an impoundment requires the expertise of a qualified professional engineer. Additionally, comprehensive site specific investigations are necessary including: geological, hydrogeological, soils, hydrologic and related environmental analysis.

Depending upon the specifics of the site, surface water diversions are typically designed and constructed in conjunction with the design and construction of an impoundment facility. Surface diversions are utilized to decrease the amount of runoff water entering the impoundment and to reduce the potential for stormwater or a storm event damaging the facility. Surface diversion BMPs include: diversion dikes/berms, interceptor dikes/berms, interceptor trenches and related sediment and erosion control treatments.

Ground water related concerns include the migration of impoundment fluids into the ground water and the seepage or incursion of ground water into the impoundment area. Practices to prevent these potential concerns include the following:

1. Installation of a liner or liners to prevent leachate and/or process chemicals from coming into contact with ground water. Liners may include recompacted soils, impervious clay, synthetic materials (i.e. polyvinyl chloride-PVC, high-density polyethylene- HDPE, etc.) or a combination there of.

2. Installation of a drainfield and/or collection system under the liner to prevent seepage from building up between the liner and saturated soil underneath the impoundment.

Air quality concerns regarding fugitive dust are a common problem with tailings impoundments which are in temporary closure, closure or abandonment. NDEP, Bureau of Air Quality is responsible for fugitive dust management (NAC 445.734 Fugitive Dust). Typical treatments to control fugitive dust include the application of water and/or chemical tacifiers, compaction, or covering the site with larger size material such as waste rock.

Typical management practices for impoundments include the following components.

* Routine inspections
* Established monitoring as required by permit
* Regular maintenance as specified in a comprehensive maintenance program
* Erosion prevention and control measures
* Dust management
* Controlled access through fencing or other measures
* Emergency contingency plans
* Concurrent reclamation and revegetation

METHODS AND MATERIALS

Impoundments and tailings ponds must be designed, installed and maintained according to approved engineering plans and specifications specific to the site. **Engineering plans and specifications should be prepared by a qualified professional engineer**. Throughout the construction phase regular inspections and documentation is necessary. As built plans which accurately represent the final project, should also be prepared.

MAINTENANCE

A comprehensive maintenance program should be developed in conjunction with the project. The impoundment facilities must be inspected and maintained on a regular basis, particularly after precipitation or storm events. Identified problems must be repaired immediately, prior to the next storm event.

EFFECTIVENESS

Appropriate management practices developed site specifically for impoundments and tailings ponds are a very effective means of pollution prevention, erosion control and surface and ground water quality protection.

RECLAMATION

DEFINITION

The reclamation of surface disturbances associated with mineral exploration and extraction including the practices of planning, designing, engineering, grading, stabilization, growth medium application, and revegetation. Reclamation provides for physical stabilization of the land surface, but does not include the chemical stabilization of mined lands which is addressed in mine closure activities.

PURPOSE

To prevent, control and minimize erosion and sedimentation, stabilize affected or created slopes, restore surface drainage ways, revegetate surface disturbances, prevent and minimize impacts to surface and ground water quality and to meet post mining land use objectives of the site (i.e. wildlife, recreation, livestock grazing, etc.).

APPLICABILITY

BMPs for the reclamation of surface disturbances associated with mineral exploration and extraction activities are applicable to all active, inactive, or potential mine sites and mine sites in temporary closure. **Mining operations and mineral exploration projects are regulated by the Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation (NRS and NAC Chapter 519A)**.

PLANNING CRITERIA

Mineral exploration and extraction activities should not be the final use of the land. A goal for reclamation activities is to incorporate reclamation into all phases of a mining project, from planning and permitting through closure, to return the subject lands to a safe, stable productive post mining land use consistent with land management objectives. In Nevada a regulatory and permit process is in place for mineral exploration projects and mining operations to ensure that: reclamation is accomplished concurrently, or as soon as possible; exposed soil surfaces, soil loss and erosion are minimized; surface and ground water quality is not degraded; the land is returned to a condition of productivity, consistent with its pre-mining land use and land use objectives; public safety is maintained and visual impacts are minimized; and the costs of reclamation are secured through a surety process.

The following are generally recognized principals of reclamation that should be utilized as guidance for the mineral industry:

a) Reclamation should be incorporated into mineral activities up front and throughout the life of a project, not as an after thought.
b) Contaminants or hazardous/toxic materials should be controlled to prevent impacts to the environment.
c) Surface and ground water quality should be protected.
d) Topsoil or growth medium should be stockpiled and conserved so it can be utilized in the reclamation of disturbed areas.
e) The reclamation of disturbed areas should occur concurrently or as soon as possible to minimize exposed soil surfaces, soil loss, erosion and water quality impacts. Interim reclamation should be incorporated for projects lasting more than one growing season.
f) Final project site grading and shaping should be designed prior to initiating surface disturbances, consistent with sound watershed principles and the productive post-mining land use.
g) The final land morphology should be physically stable to prevent further soil loss, erosion, storm runoff damage and to provide an environment for successful revegetation.
h) A holistic or "watershed" approach should be utilized to analyze the physical, chemical and climatic characteristics of the site to formulate the reclamation plan. Test plots should be developed to test reclamation practices and procedures proposed for the site.
i) The proper equipment should be selected for the site based upon the site specific characteristics (i.e. soils, slope gradients, access, etc.).
j) Successful revegetation requires completion of several primary components including: seed bed preparation, appropriate plant species selection (native, adapted, diversity criteria) which meets post mining land use goals, proper seeding methodology for the site, available moisture or irrigation, and site protection until seedling establishment.

METHODS AND MATERIALS

The field of disturbed site reclamation is evolving rapidly as research and field trials expand. A variety of technical manuals are available from the federal land management agencies, agricultural research agencies, plant materials centers and western universities. The Bureau of Mining Regulation and Reclamation, Division of Environmental Protection can also provide technical assistance and guidance.

A qualified professional should be consulted regarding the design, development and implementation of a comprehensive mine reclamation plan. The following discussion outlines the primary phases of a reclamation plan, but depending on the specifics of the site, additional data collection and analysis may be necessary.

Pre-Disturbance Planning -

The first step is tied closely to the federal and state permitting process and environmental analysis.

Given the fact that the vary nature of mineral exploration and recovery varies significantly as drilling information is gathered, a project may evolve significantly over time both in physical size, location and magnitude. While a "best guess" mine plan is the starting point to build a reclamation plan, changes in the mine plan over time require that the reclamation plan be a dynamic tool and regularly updated. Baseline data must be gathered on the project site including but not limited to: topography, soils, geology, surface and ground water quality and quantity, vegetation, wildlife, precipitation, existing land uses and post mining land uses. The baseline data is then utilized to develop a reclamation plan which can be implemented concurrently with the mine plan in a coordinated and economically feasible manner.

Growth Medium/Topsoil Management -
The future productivity and success of disturbed area reclamation is strongly influenced by the amount and quality of growth medium or "topsoil" salvaged. In the arid west many areas have little or no "topsoil" but many subsoils do provide adequate growth medium. Soils must be tested and salvaged accordingly. Depending upon the specifics of the site the management or stockpiling of growth medium may vary significantly to keep the growth medium biologically viable. The initiation of test plots upfront can not be overemphasized to determine the best methods for revegetation.

Sediment, Erosion and Stormwater Control Measures -
The basic activities of mineral exploration and mining operations involve significant surface disturbances and the creation of dumps, impoundments and other exposed slope surfaces. Exposed soils and subsurface materials are primary sources of sediment. The proper control of sediment, erosion and the management of stormwater is critical to prevent and minimize degradation of surface and ground water quality and air quality. **Designed, engineered, constructed and maintained sediment and erosion control structures by qualified professionals is a necessity prior to surface disturbances**.

Shaping and Grading -
Topographic compatibility is necessary between pre-mining and post-mining land forms for several reasons including physical stability, public safety, revegetation and visual aesthetics. The final land form configuration should be designed up front, prior to surface disturbance and designed in such a manner to be consistent with existing topography, facilitate and improve revegetation efforts, minimize surface and ground water quality impacts, control surface drainage and provide for the overall stability of the site. Graded slopes should include a plan or design for water harvesting. Water harvesting techniques include contour furrows, moonscaping, terracing or "cat tracks" along the contours. Pre-planning will significantly improve the economic viability of the project.

Revegetation -
Revegetation activities are comprised of growth medium/soils testing, plant species selection, seed bed preparation, seeding, fertilizing, mulching, irrigation and site protection.

Growth medium/soils testing - The growth medium or soils proposed for reapplication should be tested for viability, toxic constituents, nutrients, pH and productivity. Test results will guide selection of the type and quantity of soil amendments.

Plant species selection - The selection of proper native and adapted plant species is critical to revegetation success and the productivity of post-mining land use. Close coordination is necessary with the federal land manager or the private land owner to select plant species which meet land use objectives, stabilize the surface, are compatible with the growth medium and the specifics of the site, and prevent sedimentation and erosion. Pre-mining vegetation diversity should be a primary component in plant species selection. Plant species with rhizomatous root systems are proven effective in controlling surface erosion.

Seed bed preparation - Surface disturbances and created slopes should be recontoured to approximate the original landform preserving natural drainages or reestablishing them. Final graded surfaces should be ripped to relieve compaction and growth medium reapplied to the maximum depth possible. Seeding should immediately follow, but if it is not possible, the surface may have to be disced or tilled depending on the amount of surface crusting that occurs. Ideally, seed bed preparation will immediately proceed seeding during the fall to early winter of the year.

Seeding - The proper seeding methodology must be selected based upon the specifics of the site, the size, type and depth requirements of the seed and the other revegetation components utilized. Typical seeding methodologies include: broadcast seeding, drill seeding, and hydroseeding. Each has specific requirements, benefits and constraints which should be evaluated. Seeds must be drilled to the proper depth or covered with soil and/or mulch to prevent wind migration and consumption by avians. The most favorable time to seed in Nevada and the arid west is the fall to early winter. Seeds lay dormant until spring until soil moisture and temperatures are optimal for germination and growth.

Fertilizing - Fertilizer and/or soil amendments should be added to the growth medium given the specifics of the site, soil testing results and plant species requirements. Slow release fertilizers haven proven very effective and minimize the potential for over application.

Mulching - Mulching has proven effective in improving reclamation success. Mulching assists in erosion control and soil stabilization, creates a micro climate which moderates temperatures and retains moisture, and it protects seedlings until plant establishment (See Soil Stabilization - Chapter 3). Straw mulches are the most commonly used in revegetation and are either blown on mechanically or spread by hand at approximately two tons per acre. Mulches must be crimped into the soil, utilized under netting or applied with tackifiers, otherwise they are subject to wind migration.

Irrigation - While not commonly utilized in mining applications, temporary irrigation is by far the best method for ensuring plant species establishment. Temporary irrigation can provide plant species germination and establishment water requirements when nature may not. While temporary irrigation represents additional costs, the benefits of improved plant germination and establishment, rapid soil and slope stabilization and earlier return of sureties out weigh costs. Irrigation water application, (amount and timing), must also be carefully planned to the fall and early winter seasons. Seeding and irrigating earlier in the season is feasible as long as irrigation continues throughout the growing season. If not applied correctly there is a potential for plant growth and die off due to poor weather conditions and lack of water.

Site protection - Revegetation areas must be protected from disturbance until plant species establishment. Site protection is typically provided by fencing, berming and signing to prevent intrusion by livestock, wildlife, motor vehicles and the public.

It is important to emphasize that individual components of a mining operation or exploration project may require specifically designed reclamation treatments. Reclamation must be closely coordinated with closure activities to address potential chemical, hazardous or toxic conditions. Chemical stabilization and closure must occur prior to revegetation efforts so plant species are not negatively impacted.

MAINTENANCE

Maintenance is a primary component of any reclamation plan no matter what the size. A maintenance program must be comprehensive and address all aspects of reclamation throughout the life of the mining plan or exploration project. Maintenance inspections and repairs should be conducted regularly and after all precipitation or storm events. Surface drainage ways, sediment and erosion controls, site protection facilities and revegetation components all require maintenance. Revegetation areas may require reseeding, fertilizing and mulching depending upon the adequacy of the initial treatments.

EFFECTIVENESS

A well designed, implemented and maintained reclamation plan will significantly reduce impacts to existing natural resources, control sediment and erosion and minimize impacts to surface and ground water quality.