13. Mine Infrastructure

Water is essential for many aspects of a mining operation. As well as the core function of extracting the ore, virtually every other part of the mining infrastructure uses water in some way. After coming in contact with the operations, this water can pick up contamination. It is important to be aware that this contamination can exist, and of ways to minimise it. Water used in these support functions needs to be managed in the same way as other water on the site.

This section examines three main areas of an operation where good water management is essential. It is important to ensure that all operators are aware of the potential environmental impacts from failure to follow procedures, and that they are adequately trained in the operation of all pollution control systems.

13.1 Process Plant

Water used in a process plant is normally confined within its designated piping and storage facilities. It is only through washdown, pipe ruptures, spillages and overflows from process water tanks and dams that significant volumes of process water can enter receiving waters.

The quality of surface runoff from the process plant is dependent on the type of ore being processed and the metallurgical process adopted, eg. flotation, beneficiation, cyanide leaching.

A risk analysis and the associated contingency plans should be undertaken at the planning stage. Engineering solutions should be commensurate with the level of acceptable risk, safety hazards and environmental harm which could result from an event.

13.1.1 CHARACTERISTICS

The process plant and associated ore stockpile area can be a source of the following contaminants:

- suspended sediment;
- oils and greases;
- process reagents;
- increased dissolved and particulate metals resulting from the dissolution of metalliferous minerals;
- strong mineral acids and bases such as sulphuric acid and lime; and
- nutrients from residual nitrates from blasting.

13.1.2 CONTAINMENT AND TREATMENT TECHNOLOGIES

Remedial measures and technologies available for the containment and treatment of contaminants from the process plant include:

- improved housekeeping strategies to identify the locations of spillage (eg. conveyor transfer points) and the implementation of appropriate remedial measures;
- bunding of all process chemical storage areas and the interception and treatment of all stormwater from within these areas;
- drainage of all process plant runoff to a central treatment facility (eg. sedimentation or evaporation pond);
- provision of quiescent conditions in retention ponds to enable settlement of fine grained sediment. More rapid settling can be achieved using a flocculent such as alum;

- pH correction using lime dosing or other suitable material may be necessary if the retention pond water is acidic or incompatible with receiving water quality; and
- interception and treatment of stormwater runoff containing hydrocarbons through a oil-water separation facility or alternatively, materials contaminated with hydrocarbons may well be suited to treatment using Bioremediation Technology (Fact Sheet No.9).

The treatment of soluble contaminants is dependent on the volume and quality of the waste stream. Wastewater or contaminated runoff can be diverted to a retention pond, tailings storage facility or evaporation pond. Some waste streams may require more advanced forms of treatment such as activated carbon or ion exchange.

13.2 Industrial and Workshop Areas

The industrial area and its associated workshops can be a frequent source of contaminants such as lubrication oils, greases, solvents, surfactants (water and solvent based products), suspended solids from vehicles, atmospheric sources, spillage, and metal shavings from lathes. Stormwater runoff is the major transport route of these pollutants to local watercourses and receiving waters.

13.2.1 CONTAINMENT AND TREATMENT TECHNOLOGIES

Fuel Storage Areas

General principles for the design and operation of storage areas include:

- bunding to the appropriate Australian Standards in order to contain spillages;
- frequent inspection of storage tanks and piping for corrosion and any above ground and underground leaks;
- construction of the facilities to collect and contain minor spillages outside the bunded area during refuelling operations; and
- diversion of oil contaminated bund water collected during rain events through oil interception or separation facilities.

Workshop and Truck Washdown Areas

General principles of design and operation of these areas include:

- better control of hydrocarbons, eg. central bulk storage and reticulation throughout the workshop rather than the use of 20 or 200 L drums;
- design of dispensing facilities to prevent drips and spillage;
- covering of the working area to prevent storm water picking up contaminants;
- installing a drainage system to separate clean and contaminated water streams from within and surrounding all workshop areas;
- diversion of oil contaminated water to a separation system, which can range from simple concrete sumps through to more sophisticated mechanical systems such as coalescing plate separators, skimmers and centrifugal separators;
- use of dry cleaning methods such as industrial vacuum cleaners and absorbents rather than water to clean floors and other surfaces;
- phasing out of solvents for cleaning applications in favour of new generation water-based detergents, suitable for the cleaning of hydrocarbons soiled equipment (solvents are more difficult to treat and remove in wash water than heavy lubricating oils); and
- more effective dispensing, mixing and use of detergents by operators, which can also reduce consumption.

13.3 Haul Roads

Controlled drainage from haul roads is essential for the maintenance of the road integrity for haul truck usage. The drainage systems have environmental impacts in terms of both the structures adopted and the quality of the drainage waters collected for disposal. Both surface and groundwater drainage issues should be addressed.

13.3.1 ENVIRONMENTAL ISSUES

Haul roads are potentially a source of contamination in water, notably from suspended particulate matter. Any spillage of mined material onto the road surface is a source of these particulates and, depending on its nature, also a source of chemical contamination. Any pyrite present in the ore or waste could oxidise, leading to acid drainage and mobilisation of heavy metals.

It is important to ensure that, wherever possible, haul roads are constructed of material which will not lead to further environmental impacts.

There are recorded instances where materials used in the construction of haul roads have led to environmental contamination along the entire length of a road.

13.3.2 SURFACE WATER DRAINAGE

The important elements in surface water drainage on haul roads include:

- water must be cleared from the pavement or wearing surface quickly to avoid excessive soaking of the surface base course layer and without creating deeply incised scour paths. Generally; maximum cross fall slopes of 3% will facilitate both these criteria (Figure 13.1);
- side drains are required to catch surface water from the pavement and runoff from cut bank slopes. The side drains should be sized such that the design flow depth is no higher than the underside of the pavement top course or base course layer. This will minimise the potential for saturation of this layer (Figure 13.1).

  It is preferable to direct drains off the haul road at cut and fill interfaces or otherwise down batter slopes at designated locations via erosion protected chutes;
- if the grade of the road exceeds 2-3%, erosion protection along side drains may be required to prevent undercutting of the pavement layers. The erosion protection may be in the form of lining (rocks, concrete, synthetic materials) or barriers for inducing flatter slopes; and
- haul road drainage crossings should be through culverts, with attention given to upstream and downstream erosion protection. Appropriate slopes and surface level designs are necessary to facilitate sediment movement without deposition and consequent culvert blockages.

13.3.3 GROUNDWATER DRAINAGE

Groundwater investigations will reveal the necessity for any groundwater drainage systems. The primary purpose of groundwater drainage systems associated with haul roads is to minimise the potential for saturation of the haul road sections and possible failure. The environmental consequences of such failures can extend to washouts of the road with excessive sediment loads and destruction of the integrity of the surface water drainage systems.

Typical groundwater protection mechanisms include:

- slotted pipes in gravel beds;
- rock fill “pipes”;
- rock fill blankets to facilitate both the construction and haul road operation;
- synthetic geotextile materials to separate layers and provide strength; and
- dewatering by mechanical means (pumps) in extreme cases.

FIGURE 13.1: **Drainage Considerations on Haul Roads**