Australian Ilmenite Resources

Erosion and Sediment Control Plan

Australian Ilmenite Resources Pty Ltd

SILL80 Project, Mining Lease Application 27422

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Executive Summary

This Erosion and Sediment Control Plan (ESCP) outlines strategies for works to be undertaken as part of the AIR SILL80 project to minimise soil erosion and the discharge of sediment to land and waterways as a result of mine development or operations. Specifically, this plan details the following:

- Stormwater Management Controls; and
- Maintenance and Monitoring Programs.

The overall objectives of this ESCP are to:

- Control soil erosion and sediment generation from areas disturbed by construction and mining activities; and
- Minimise potential project related activities resulting in decreased water quality (particularly suspended solids) in downstream local watercourses.

Construction design and management will comply with the NRETAS *Erosion and Sediment Control Plan Content* (2006). As such, principles of effective erosion and sediment control will be employed to minimise the extent and duration of any erosion and sediment generating activities and ensure the prompt stabilisation of land.

Where possible, stormwater will be diverted around any active or rehabilitated mine areas. This will minimise both the flow rate and volume of runoff to be handled by on-site water management facilities and enable them to perform more effectively.

Water quality analyses will be performed with results used as indicators of success for the construction and operational phases. Should deterioration in water quality be evident, remedial actions will be triggered.

The integrity of receiving water bodies will not be adversely impacted as a result of this development, provided that the sediment control measures described herein are implemented.

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1 Introduction

1.1 Background

EcOz Environmental Services was engaged by Australian Ilmenite Resources Pty Ltd (AIR) to prepare an Erosion and Sediment Control Plan (ESCP) for the SILL80 project within MLA27422 in the Roper River Region. This ESCP has been prepared for clearing of the mining lease and construction of the processing plant and open cut mining operations, to address key risks outlined in the *Guidelines for the Preparation of a Public Environmental Report, SILL 80 Project, Roper River area, NT, Australian Ilmenite Resources Pty Ltd, April 2011* as prepared by the Northern Territory Department of Natural Resources, Environment, The Arts and Sport (NRETAS).

Figure 1-1 shows the location of MLA27422. The area to be cleared encompasses approximately 800ha from a total of 1225ha within the Mining Lease.

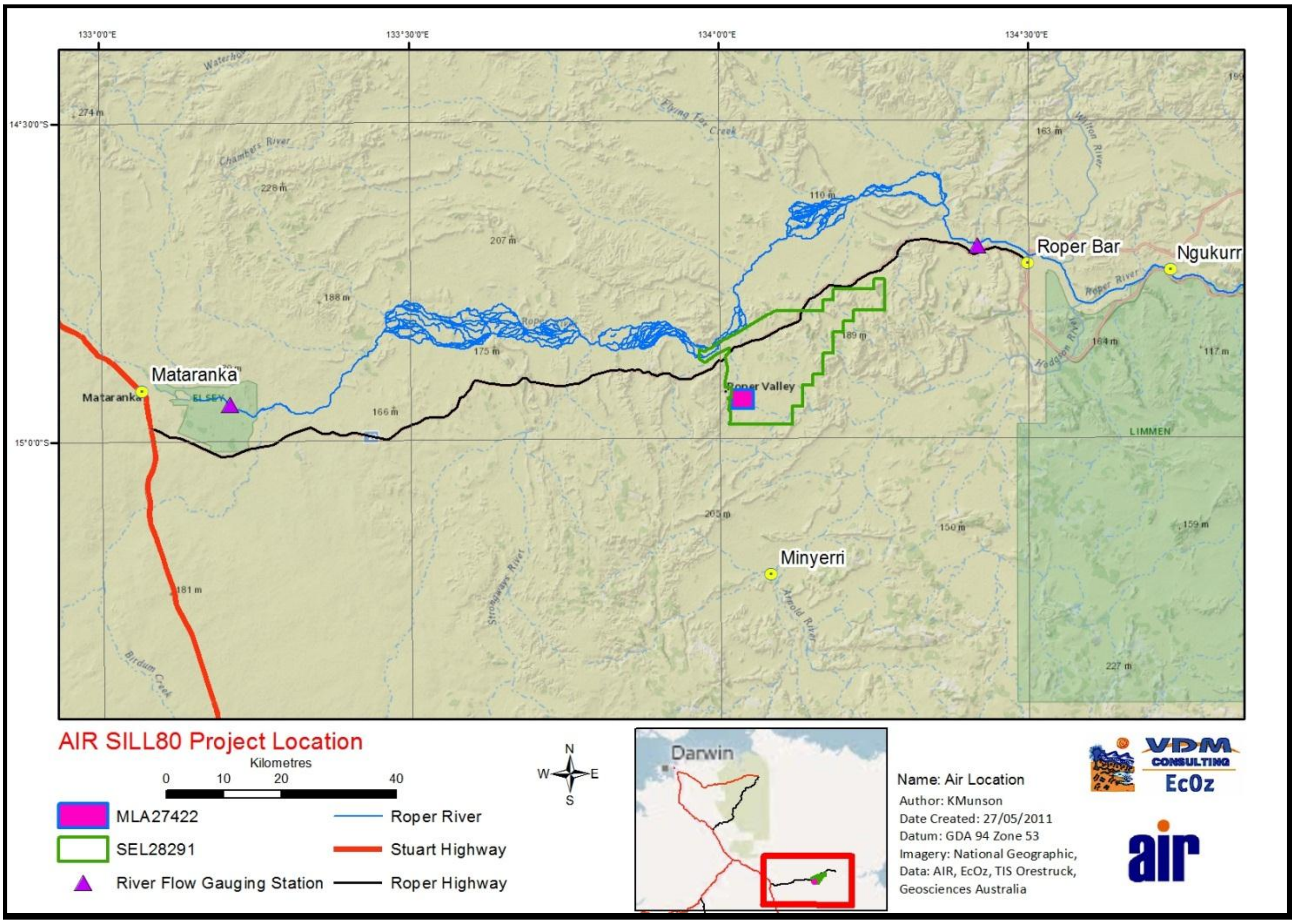

Figure 1-1: Location of SILL80 Project, MLA27422

1.2 Scope

This ESCP outlines strategies for works to be undertaken as part of the AIR SILL80 project to minimise soil erosion and the discharge of sediment to land and waterways as a result of mine development or operations. Specifically, this report details the following:

- Stormwater management controls; and
- Maintenance and monitoring programs.

To minimise the impact of the proposed development on the surrounding environment, this ESCP shall be developed and implemented throughout the life of the mine. To avoid significant and/or sustained deterioration in downstream water quality, this ESCP may be amended as required, in response to the Maintenance and Monitoring Program described herein (Section 3.3).

1.3 Objectives

The overall objectives of this ESCP are to:

- Control soil erosion and sediment generation from areas disturbed by construction and mining activities; and
- Minimise potential project related activities resulting in decreased water quality (particularly suspended solids) in downstream local watercourses.

1.4 Relevant Legislation and Guidelines

The following legislation and guidelines were used to prepare this ESCP:

- *Water Act* (NT);
- *Waste Management and Pollution Control Act* (NT);
- *Soil Conservation and Land Utilisation Act* (NT);
- NRETAS *Erosion and Sediment Control Plan Content* (2006);
- Department of Health and Families *Guidelines for preventing mosquito breeding sites associated with mining sites, NT* (2005);
- IEAust. *Soil Erosion and Sediment Control Engineering Guidelines for Queensland Construction Sites* (June, 1996); and
- Managing Urban Stormwater Soils and Construction Volume 2E Mines and quarries. Department of Environment and Climate Change NSW.

1.5 Performance Criteria

In accordance with NRETAS requirements, the following performance criteria have been set for the AIR SILL80 Project development:

- Stable embankments and drainage lines;
- No obvious accumulation of sediment within natural watercourses or drainage lines outside of the construction area;
- No unnecessary disturbance of earth or vegetation outside areas to be cleared or disturbed;
- No new biting insect breeding habitats created and no increase in mosquito numbers; and
- All batters or embankments to have slopes greater than 1:4.

2 Site Characteristics

2.1 Locality

AIR proposes to develop its SILL80 Ilmenite Project, within Mining Lease Application MLA27422, located within the Roper Gulf Shire, Perpetual Pastoral Lease 1161, Land Parcel NT Portion 4970 Chatterhoochee (Numul Numul). The Traditional Owners of the land are the Namul-Namul Aboriginal Corporation who sub-lease the area to the O'Brien family, who manage the property as a cattle station. The property is located in the Roper River Region of the Northern Territory, 8 km south of the Roper Highway. The major townships in the area are Mataranka Township (Population ~ 600) 105km to the East and Ngukurr (Population ~ 1,600) 80km to the West. The proposed mine site is approximately 10km south of the Roper River, 4 km south-east of the Kewulyi Aboriginal Community Outstation (old Roper Valley Homestead) and 3 km south-west of Numul Numul homestead.

2.2 Proposal

The SILL80 Project forms part of AIR's larger Roper Heavy Minerals Project. MLA27422 contains an estimated ilmenite (FeTiO3) resource of approximately 4.5 million tonnes. Based on this, the life of the mine is expected to be in excess of 20 years.

The ilmenite mineralisation results from the weathering of dolerite sills within the top three metres of regolith. As such, ilmenite recovery will require strip mining using excavators to remove the regolith to a maximum depth of four metres. Pits will be constructed 300m long and 200m wide. Once the ilmenite has been removed from regolith through the processing plant, residual material will be used to backfill pits allowing for successive rehabilitation of mined strips.

2.3 Topography

The Project Area lies principally within the physiographic province of the Gulf Fall, a dissected terrain from which almost all of the old Tertiary land surfaces have been eroded. This terrain is characterised by broad alluvial valleys between low rubbly hills and prominent strike ridges of resistant Roper Group strata. The flat-floored ridges form part of the vast Roper River floodplain and its associated tributaries (Wilton, Maiwok, Flying Fox and Jalboi Rivers) and are largely developed on incompetent shales, fine-grained sediments, volcanics and carbonate rocks. Local relief is variable ranging from 20 to 120 metres. The target dolerite sills are prominent in their deep red soil colour and rounded boulder-strewn outcrops.

2.4 Soils

The AIR SILL80 Project is confined to the Roper Group, specifically targeting the ilmenite-bearing dolerite sill horizons and their possible erosional transport trails. The strata are generally flat lying to undulating although secondary folding and reactivation of older faults result in steepening of dips and stratigraphic dislocation in places; west-north-west trending Urapunga Tectonic Ridge in the central area and north-south trending Strangeways Fault in the southwest.

MLA27422 has an absence of Cambrian flood basalts and only remnant outliers of Cretaceous sandstones, both of which are extensive to the south, west and north of the project, suggesting a significant exposure to uplift and erosion within the area permitting exposure of the underlying Proterozoic sediments and dolerite sills. Extensive deposits of Quaternary to Recent sediments comprising alluvium, colluvium, unconsolidated gravel and sand overlain by mud-rich soils are mapped in the project area and reflect material derived from prolonged weathering and erosion during the Tertiary.

Sills of the Derim Derim Dolerite were emplaced at various stratigraphic horizons from a primary magma source at depth. Extensive lateritised outcrops, sub-crops and regolithic soils of the dolerite have been mapped throughout AIR tenements. The dolerite outcrops as low-relief medium to coarse grained, variably altered and weathered ('onion-skin' weathering) rounded boulders. Composition is dominated by plagioclase (40%), clinopyroxene (40%), amphibole (7%), opaques (ilmenite & magnetite 5%) and clay (7%). The associated regolith soils are deep red-purple-brown, clay-rich and contain abundant liberated ilmenite and, locally, with accessory titanomagnetite, magnetite and haematite grains. In some areas these dolerite sills have only been recently exhumed (at higher elevations) and in other instances, larger areas of dolerite sills have been exposed for a longer geological time resulting in pisolitic laterite formation and attendant erosion (at lower elevations). These areas are considered highly erodible, especially the sloping red soils.

The following images were taken within each of the quadrats that were surveyed as part of a biological survey of the project area; Quadrat A (QA) through to Quadrat F (QF) (Figure 2-1).

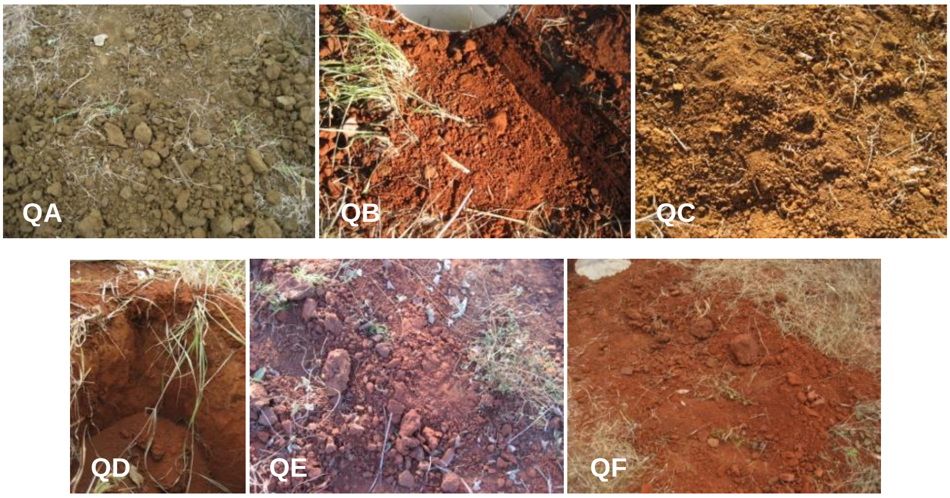

Figure 2-1. Soils Types Within ML 27422

2.5 Land Systems

Land system classification and mapping (1:250,000 scale) of the project area and surrounds was undertaken by Aldrick and Wilson (1992). Three land systems were identified (Table 2-1 below) within the project area footprint. Figure 2-2 shows the location of each land system within the project area and Table 2-1 describes each system and details the percentage of the total area that is represented within the project area.

Table 2-1. Land System Summary

Code	Land System	Description	% of Project Area
Ibc	Cliffdale	Gently undulating to undulating rises with abundant, often linear rocky outcrops and shallow sandy soils. Lithosols, minor siliceous and earthy sands. Mid-high open woodland of *Eucalyptus miniata*, *E. tetrodonta*, *E. ferruginea*, with *E. dichromophloia*.	~56%
Als	Seigal	Gently undulating to hilly terrain on basalt, dolerite, agglomerate and other volcanic and sometimes non-volcanic rocks. Lithosols with rock outcrop, euchrozems, red and black earths and red clays. Highly erodible, especially the sloping red soils. Mid-high open woodland of *E. tectifica* and *Erythrophleum chlorostachys*.	~1%
Tam	McArthur	Broad or narrow fluvial corridors conducting regional drainage across various land systems towards the coast. Grey and brown clays, red and yellow earths and siliceous sands. Mid-high open woodland of E. microtheca with some E. papuana and E. polycarpa. Tall fringing riparian vegetation often includes Melaleuca spp.	~0.5%
Ibn	Nutwood	Plains and low rises on basalt and associated basic igneous rocks. Brown, grey and red clays, euchrozems and brown and red earths. Mid-high open woodland of *Lysiphyllum cunninghamii* and *E. terminalis* with some *E. patellaris*.	~42.5%

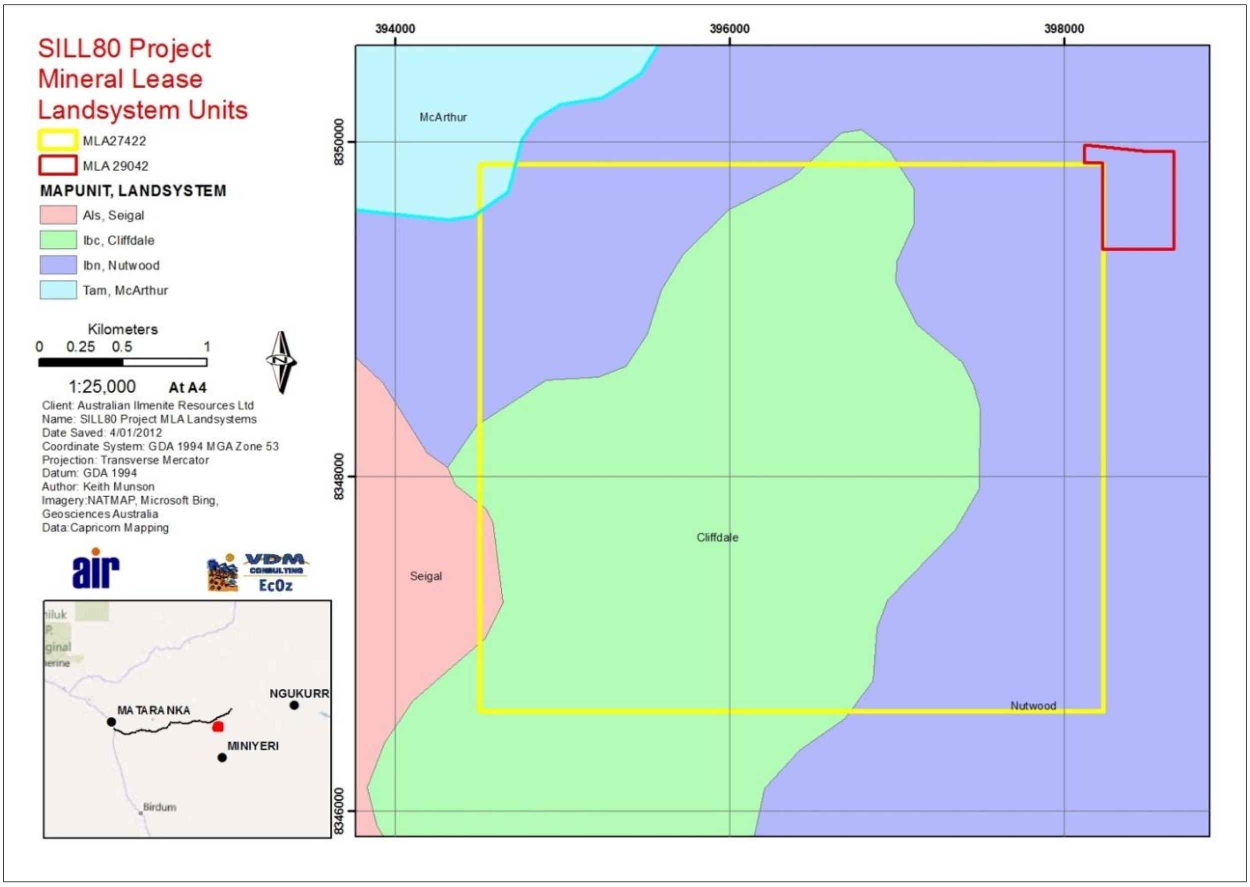

Figure 2-2: Land Units at the Proposed Development Site

2.6 Vegetation

Most of the site consists of native vegetation common to the region. EcOz Environmental Services performed flora surveys in the area in May 2011 (Flora and Fauna Report PER Appendix B). The major vegetation communities identified in the survey are as follows:

- Low *Eucalyptus pruinosa* open woodland, with or without *Corymbia terminalis*, over tall closed tussock grass;
- Medium height *Corymbia terminalis, Eucalyptus tectifica* open woodland, with or without *Corymbia confertiflora*, over tall mid-dense tussock grass; and
- Low *Corymbia terminalis, Eucalyptus tectifica* Woodland, with or without *Corymbia confertiflora* over medium height / mid-dense closed tussock grass.

2.7 Existing Disturbance

As the area encompassing MLA27422 is currently a pastoral station, disturbance through cattle stocking is evident (e.g. pugging and soil compaction). Weed species (e.g. *Hyptis suaveolens* and *Sida acuta*) are present throughout the property and laneways and tracks have been developed for mustering and maintenance purposes. The laneways and tracks are maintained annually through grading practices post-wet season. Extensive fencing for stock management as well as the development of multiple stock dams has occurred within the lease area.

3 Erosion and Sediment Control

The purpose of this section is to provide a set of best practice site management procedures to control the severity and extent of soil erosion and transport during the clearing and operational phases of the proposed development.

Open cut mining involves topsoil stripping, overburden removal, handling, and stockpiling, resulting in potential erosion and sedimentation issues, not only within the mining area but also into the surrounding environment. The slope of the mining lease is 0.98% and while relatively flat, there would still be a degree of runoff and sedimentation potential. Velocities of flows over land (chiefly stormwater) are expected to be $0.4ms^{-1}$.

Erosion and sedimentation control measures will be employed throughout the site to control stormwater. Any water which falls within the site will be directed to a sedimentation basin to allow settling of particles before either discharge to the environment or re-use back on site. Water flowing through or around the site will be controlled in such a way as to minimise the risk of erosion. The following sections detail erosion and sedimentation control measures, including construction design and management to comply with the NRETAS *Erosion and Sediment Control Plan Content* (2006). AIR will be responsible for the implementation, inspection, repair, and modification of the controls and will be subjected to annual internal audits as part of the Mining Management Plan.

3.1 Principles of Erosion and Sediment Control

The principles of effective erosion and sediment control for the proposed clearing activity on site are based on the following:

- Appropriately integrate the development into the site;
- Integrate erosion and sediment control issues into site and construction planning;
- Develop effective and flexible erosion and sediment control plans based on anticipated soil, weather and construction conditions;
- Minimise the extent and duration of soil disturbance;
- Minimise soil erosion;
- Maximise sediment retention on site;
- Maintain all erosion and sediment control measures in proper working order, at all times;
- Monitor the site and adjust erosion and sediment control practices to maintain the required performance standard;
- Control water flow from the top of and through the project area by diverting up-slope 'clean' water away from disturbed areas and ensuring that concentrated flows are below erosive levels and sediment is retained from disturbed areas;
- Conserve topsoil for later site rehabilitation or regeneration (in a stabilised stockpile); and
- Rehabilitate disturbed lands quickly.

3.1.1 Site Installation Sequence

Effective erosion and sediment control for the mine site requires appropriate activities to be carried out over the life of the project including:

- Planning and design;
- Operations; and

- Closure and rehabilitation.

Planning and Design Strategies:

The effectiveness of erosion and sediment controls during the operational and rehabilitation stages can be optimised through effective mine planning and design. Suitable strategies include:

1. Designing any drainage systems operating for the life of the mine so that they do not cause erosion. This may involve scour protection or open drains and energy dissipaters located at drain outlets;
2. Diverting runoff around the mine site where possible, to minimise water flowing from upstream catchments to operational areas;
3. Designing the final mine geometry to create a landform that allows free drainage of surface runoff while minimising erosion;
4. Staging open cut mining to minimise the operational area exposed at any one time. This helps to reduce the potential for erosion and the extent or capacity of erosion and sediment control measures required, especially where the operational area has the potential to drain a waterway;
5. Separately considering sediment-contaminated stormwater from other sources of polluted water such as mine water, or runoff from stockpiles of mined products. The streams should be either separated to optimise their treatment prior to discharge or combined as part of an integrated water-management strategy; and
6. Considering stormwater reuse as part of the overall water-management strategy for the site to avoid or reduce discharge of polluted water. There are commonly a range of non-potable water uses on a mine site such as dust suppression and irrigation of revegetation areas. This may be more cost effective than treatment of polluted runoff and will also reduce consumption from other water sources.

In addition, erosion and sediment control will be considered as part of the overall water management strategy for the site, to optimise cross-benefits such as the reuse of stormwater runoff.

Operational Phase Strategies:

Activities will vary throughout the life of the mine, and it is expected that erosion and sediment control measures and activities will evolve over time. Erosion control strategies for mines should normally comprise the following:

1. Minimisation of extent and duration of disturbed areas draining to waterways, and prompt revegetation of non-operational disturbed areas (using temporary revegetation if required);
2. Ensuring both temporary earthworks and permanent land-shaping provide a landform which minimises erosion hazard;
3. Prompt stabilisation of land following land reshaping (both temporary and permanent); and
4. Design of temporary surface-water collection, conveyance and disposal systems in a manner which minimises erosion.

Where possible, stormwater should be diverted around any active or rehabilitated mine areas. This will minimise both the flow rate and volume of runoff to be handled by on-site water management facilities and enable them to perform more effectively.

The following sediment and erosion control devices and stormwater management controls will be implemented on the site;

- Construction Entry/Exit Shake Down – Used to prevent the tracking of sediment from tyres of vehicles to public roads;

- Catch drain – Used to convey flow within disturbed areas to sediment basins;
- Sediment Basin – Used to trap and retain sediment via settlement of suspended particles;
- Mulch Bund (Batter) – Used to reduce the velocity of treated water discharged from the sediment basins in addition to providing a further degree of treatment; and
- Silt fences.

3.2 Erosion and Sediment Controls

The following erosion and sediment controls will be adopted for the proposed development.

3.2.1 Construction Entry/Exit Shake Down

A construction entry/exit is used to prevent the tracking of sediment from the tyres of vehicles to public roads. Only one construction entry/exit should be provided for the site unless site access or topography requires more. Any sediment transported onto roadways must be removed and corrective measures applied so as to ensure no recurrence.

Figure 3-1 below represents a typical construction entry/exit shake down area used to prevent the transport of sediment off site.

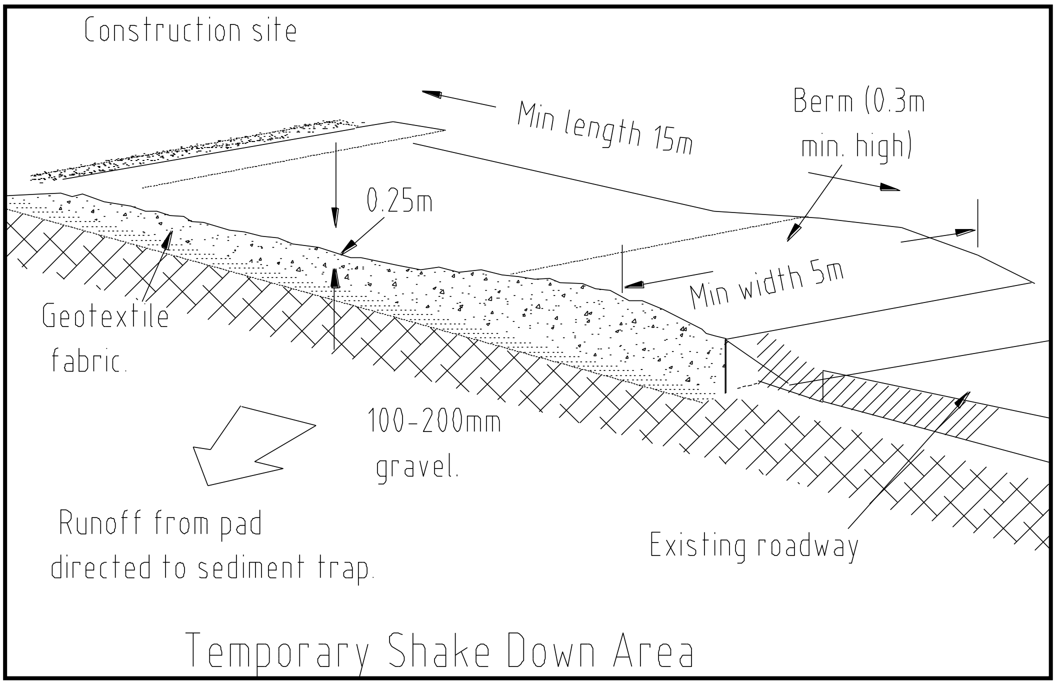

Figure 3-1: Typical Construction Entry/Exit Shake Down area

3.2.2 Catch Drain

Catch drains are used to convey flow within disturbed areas to sediment basins and divert clean water around disturbed areas. Catch drains should be regularly inspected and any damage from onsite vehicles should be repaired immediately. Any build-up of sediment should be removed as soon as practicable. Figure 3-2 below shows a typical cross-section of a catch drain.

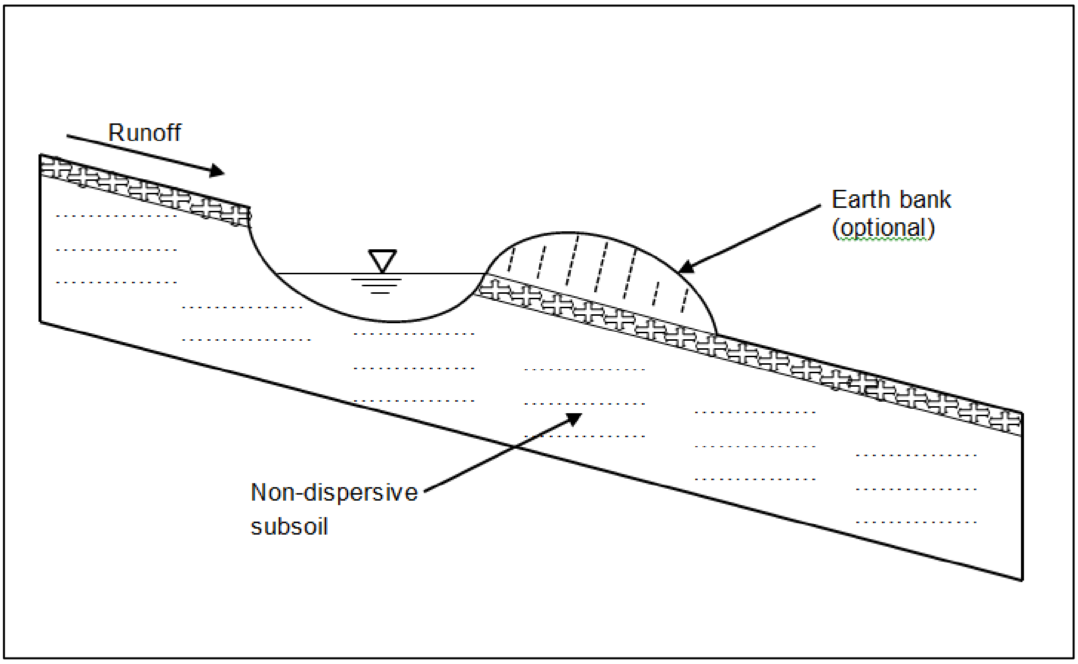

Figure 3-2: Typical Cross-Section of a Catch Drain

3.2.3 Sediment Basin

Sediment basins are generally required where:

- The disturbed area is greater than 1 ha;
- The disturbed solids are dispersive; and/or
- Where there is a need to control runoff, suspended solids and/or turbidity.

As the subject site is greater than 1 ha, sediment basins will be required.

The size of the sediment pond will be designed to retain expected quantities of contaminated water plus stormwater for a 1 in 10 year storm event, at any one time. It is not expected that the sediment pond will overflow except in extreme weather events. Silt fences will be installed down slope of the sediment basin as a contingency to overtopping of the basin. The sediment pond will be located down slope of the processing plant and will receive stormwater runoff.

Chemicals and hydrocarbons used on site will be captured in bunded areas to ensure spills are contained to reduce the likelihood of contaminated water entering the environment. Water collected from these bunds will be directed to the sediment pond.

Bunds within the site can also act to restrict flow velocities across the site reducing the likelihood of erosion issues within the site. The bunds will be subject to regular inspection with any damage or deterioration identified quickly and repaired immediately.

The sediment pond will be fenced to limit access by native or feral animals.

Any release of water from the sedimentation pond will be tested prior to discharge if possible, to ensure water meets water quality guidelines (e.g. ANZECC 2000).

It is unlikely that a Waste Discharge Licence will be required as water will only discharge from the sediment catchment basin during high rainfall events and there are no nearby waterways likely to be impacted by the discharged water.

Further detail on site management of stormwater and contaminated water will be detailed in the Mining Management Plan. Management and prevention of pollution will be carried out in compliance with relevant Northern Territory legislation.

Figure 3-3 below shows a sediment basin in use at a construction site.

Figure 3-3: Example of a Sediment Basin (photo: http://krominco.com/)

3.2.4 Mulch Bund (Batter)

Mulch bunds are used to temporarily reduce the velocity of contaminated sheet flow and to induce gravitational settlement of sediment. Regular inspections and maintenance are required to repair damage caused by the movement of on-site vehicles or stockpile material.

3.2.5 Silt Fences

Stockpiles will be confined to a designated area that will be surrounded by silt fences for the downslope areas. Sediment basins will be present in the catchment area adjacent to stockpiles.

3.3 Maintenance and Monitoring Program

3.3.1 Construction Phase Monitoring

Prior to construction on site, AIR will undertake a series of data collection exercises to define the existing stormwater quality. This will comprise the collection of water samples after the following rainfall events:

- 3 storm events of greater than 25 mm; and
- 3 smaller rainfall events.

Samples will be analysed for total suspended solids (TSS), pH, dissolved oxygen (DO) and hydrocarbons with the results being used as water quality indicators for construction phase monitoring. Monitoring during the construction phase will be conducted to determine the impact of activities on the subject site only. Sampling by the proponent will be undertaken in accordance with procedures set out in the Environmental

Protection Authority's Water Quality Sampling Manual. A NATA (National Association of Testing Authorities) registered laboratory will be used to perform the analysis of collected samples. Monitoring reports will be compiled upon request or as part of the annually reviewed Mining Management Plan.

3.3.2 Investigation Indicators

The following indicators are used to identify if the objectives of the ESCP are being met:

- Visible evidence of deterioration of water quality of downstream watercourses that is directly attributable to the site (e.g. high turbidity);
- Visible significant erosion; and/or
- Failure of control measures.

The triggering of an investigation indicator will require the following remedial actions:

- Locate source of water quality deterioration;
- Prevent continuing deterioration with temporary controls;
- Repair existing controls, construct additional controls or modify procedures to prevent future deterioration in water quality; and
- During the operational phase of the development, if there is a significant deterioration in water quality, the management plan and strategies will be reviewed.

4 Conclusions

This study has reviewed the potential impact of the proposed development on erosion and sediment processes within MLA27422. Based on this study, the following erosion and sediment control measures have been developed:

- Construction Entry/Exit Shake Down;
- Catch Drains;
- Sediment Basins;
- Mulch Bunds (Batters); and
- Silt Fences.

In accordance with the Institute of Engineers Australia Soil Erosion and Sediment Control Guidelines, sediment basins will be required for the site since the area to be disturbed is greater than 1 ha.

Prior to construction on site, AIR will undertake a series of data collection exercises to define the existing stormwater quality. This will comprise the collection of water samples after the following rainfall events:

- 3 storm events of greater than 25 mm; and
- 3 smaller rainfall events.

Samples will be analysed for total suspended solids (TSS), pH, dissolved oxygen (DO) and hydrocarbons with the results being used as water quality indicators for construction phase monitoring.

In summary, it is expected that the integrity of receiving water bodies will not be adversely impacted as a result of this development provided the sediment control measures described herein are implemented.

5 Glossary

Average Reoccurrence Interval (ARI)	The average number of years within which an event will be equalled or exceeded. If the frequency of an event is 1 in 10 years, its probability is 0.1 (1/10) and its percentage probability is 10% which means that there is a 10% probability of the event being equaled or exceeded in each and every year.
Bunding	Liquid containment facilities that prevent leaks and spillage from tanks and pipes.
Embankment	An artificial bank raised above the immediately surrounding land to redirect or prevent flooding by a river, lake or sea. an elongated naturally occurring ridge or artificially constructed fill or wall, which regulates water levels.
Erosion	Materials are removed from the surface and changed into something else. It only works by hydraulic actions and transport of solids (sediment, soil, rock and other particles) in the natural environment, and leads to the deposition of these materials elsewhere.
ESCP	Erosion and Sediment Control Plan.
Gradient	The gradient of a slope is expressed as a ratio between the height (rise) of the slope and the length of the slope (run).
NATA	National Association of Testing Authorities.
Open Cut Mining	A method of extracting rock or minerals from the earth by their removal from an open pit or borrow. Open-pit mines are used when deposits of commercially useful minerals or rock are found near the surface.
Overburden	Overburden is the material that lies above an area of economic or scientific interest in mining and archaeology; most commonly the rock, soil, and ecosystem that lies above a coal seam or ore body. It is also known as 'waste' or 'spoil'.
Regolith	A layer of loose, heterogeneous material covering solid rock. It includes dust, soil, broken rock, and other related materials.
Sediment	Naturally occurring material that is broken down by processes of weathering and erosion, and is subsequently transported by the action of fluids such as wind, water, or ice, and/or by the force of gravity acting on the particle itself.
Slope	The slope describes the steepness of an incline or decline in the landscape. It is generally expressed as a percentage (derived from change in height or elevation over a set distance). The slope is generally calculated for an area where the slope is relatively consistent.
Topsoil	The upper, outermost layer of soil, usually the top 2 inches (5.1 cm) to 8 inches (20 cm). It has the highest concentration of organic matter, including seeds, and microorganisms.

6 References

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