Australian Ilmenite Resources

Rehabilitation Management Plan

Proposed Rehabilitation Methods

Australian Ilmenite Resources Pty Ltd

SILL80 Project, Mining Lease Application 27422

DW090024

January 2012

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Document Control Record

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REVISION STATUS

Revision No.	Description of Revision	Date	Approved
A	First Issue	02/12/11	Casey Hawkey
B	Issue for review by Station Manager	21/12/11	Moira Lanzarin
C	Internal Review	11/01/12	Jeff Richardson

Recipients are responsible for eliminating all superseded documents in their possession.

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Executive Summary

Australian Ilmenite Resources Pty Ltd (AIR) SILL80 Project is a proposed open cut mine and processing facility to be constructed in the Roper River region of the Northern Territory. AIR intends to produce 200,000 tonnes of refined ilmenite at the mine per annum, with an expected mine life exceeding 20 years.

To stabilise mined land and mitigate potential erosion and sedimentation issues, progressive rehabilitation to pastoral production will occur. Pastoral production is the preferred end land use that has been nominated by the land owners. Specifically, the land will be rehabilitated to a healthy perennial grass rangeland with a diverse mix of plants, both native and introduced (i.e. non-declared species).

The objectives of the rehabilitation work are to:

- Achieve stable landforms;
- Reduce incidence of weed infestation and spread;
- Reduce risk of erosion and sedimentation;
- Progressively rehabilitate over the life of mining;
- Prevent non-essential access to rehabilitation areas;
- Maintain natural drainage and hydrology of land as much as is practicable;
- Rehabilitate the access tracks and roads that are not required post-construction and mining;
- Comply with all regulatory requirements, approvals and any other applicable legislation; and
- Implement monitoring and performance evaluation measures that are practical and measurable.

Mined areas will be rehabilitated in a co-ordinated program between AIR staff and station managers, in order to develop the area as a perennial grass rangeland for cattle grazing. Processed spoil will be returned to mined pits, which will then be broadcast with perennial grass seeds and covered with weed free pasture hay. Cattle will be introduced to the area for a short and controlled period to initiate sowing of seeds and stimulate ground preparation. As a perennial grass rangeland develops, the area will by grazed systematically, for a short duration (6-12 hours) every six or more months, as determined by a Grazing Plan, to promote growth. Native grasses, forbs, small shrubs and trees will also be encouraged.

Photo monitoring will also be conducted within the rehabilitation areas, with permanent reference points established.

Success or failure will be determined through the use of photo monitoring, weeds occurring at equivalent or lower densities than surrounding areas, and presence/absence of erosion and sedimentation. In general terms, it is expected that 80% desired groundcover will be achievable and will indicate success. In addition, retention of moisture in the soil, displayed by 'healthy' pasture, particularly towards the end of the dry season, will also be an indicator of success.

Annual reporting on rehabilitation methods and monitoring will be presented in the Annual Environmental Review, required as part of the Environmental Management Plan and reported to the Department of Mines.

A mine closure plan will be developed once the major mine expansions have been finalised in accordance with industry best-practice guidelines and the NT Department of Resources *Mine Close Out Objectives* (DoR 2008).

Contents

Figures

Acknowledgements

We would like to thank Moira Lanzarin, Numul Numul Station Manager, for her valuable input and time. Moira's knowledge and experience in grazing management and appropriate pastoral management for the Northern Territory was invaluable in development of this Rehabilitation Management Plan, including review of drafts and supply of images for the plan.

We would also like to thank Traditional owners of the region for their support in development of the Rehabilitation Management Plan.

1 Introduction

1.1 Background

The SILL80 Project is a proposed open cut mine and processing facility to be constructed in the Roper River Region of the Northern Territory. The main objective of the proposed facility is to extract and process ilmenite concentrate for sale to foreign markets.

Australian Ilmenite Resources Pty Ltd owns the SILL80 Project, which comprises MLA27422, totalling 1225 hectares. AIR intends to produce 200,000 tonnes of refined ilmenite at the mine per year, with an expected mine life exceeding 20 years.

1.2 Location

The SILL80 deposit is located 120 km east of Mataranka on the Roper Highway (Figure 1-1). 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.

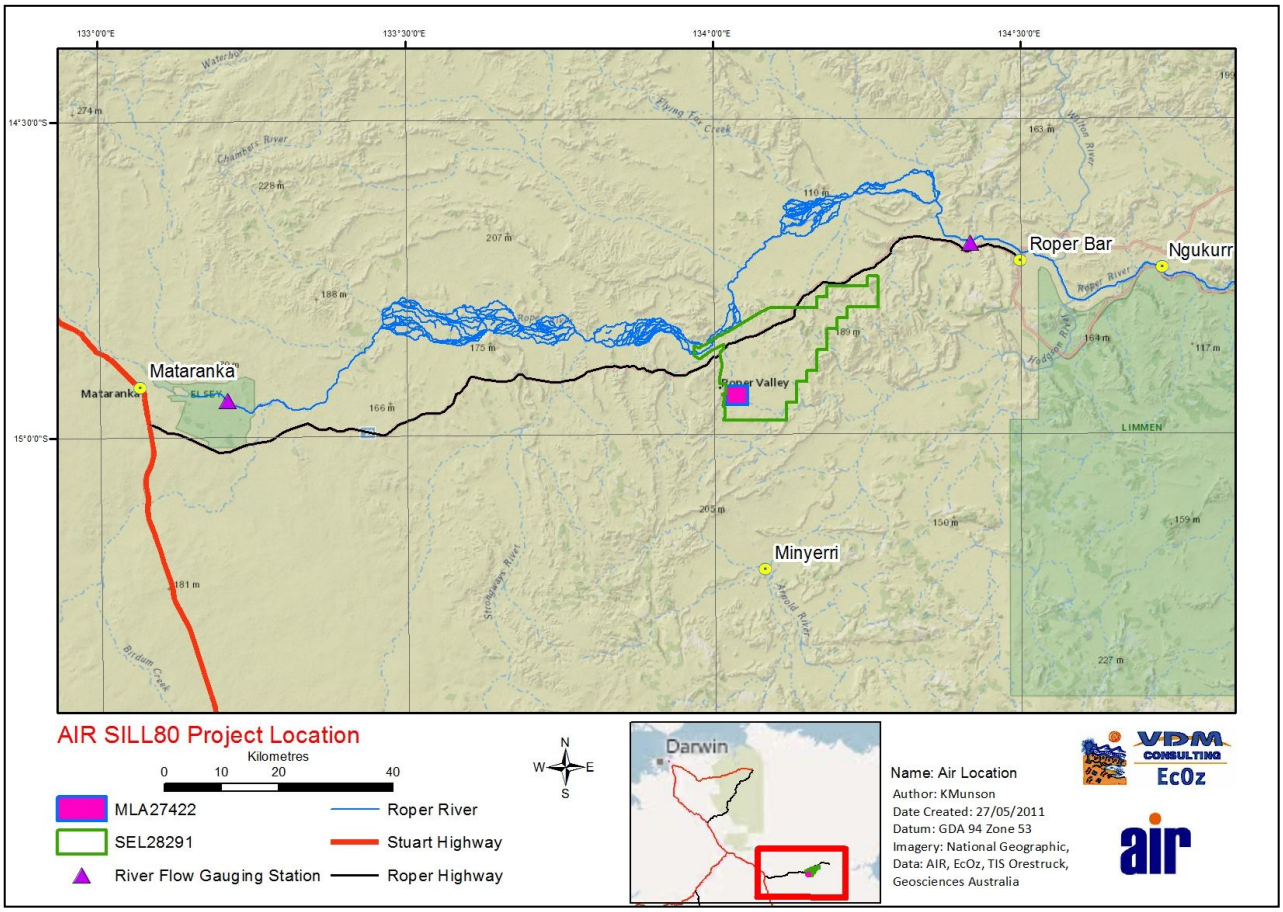

Figure 1-1. MLA 27422 location with reference to surrounding communities

1.3 Potential Impacts

Negative impacts that may occur on MLA27422 due to the operation of the mine include:

- Large areas of exposed earth available for weed colonisation and/or erosion and sedimentation;
- Spread of existing weed infestations due to disturbance and vehicle traffic;
- Unstable landscape post mining;
- Reduced quality of surrounding water resources;
- Gradual decline in landscape function;
- Untidy and bare infrastructure areas;
- Altered drainage and hydrology; and
- Impact on potential for future pastoral land use if contaminants (e.g. heavy metals) and other potential hazards are not properly identified or managed.

In order to ensure successful rehabilitation of the mine site and surrounding pastoral lands, the management of weeds is of the highest priority.

To minimise potential weed infestation or spread resulting from AIR's operations within MLA27422, the company will manage classified weeds in accordance with the *Northern Territory of Australia, Weeds Management Act 2001*. Further information on weed management can be found in the Weed Management Plan (PER Appendix I).

1.4 Consultation

Early consultation was carried out to identify the various options available for post mining land use and rehabilitation. Progressive rehabilitation is preferable to enable stabilisation of the land to protect it from potential issues associated with erosion and sedimentation. Progressively rehabilitating the land will also allow for adaptation of rehabilitation objectives, should they require revision in response to monitoring results and/or changes in stakeholder expectations.

Consultation with current sub-lease holders (Coodardie Pty Ltd: the O'Brien family - Numul Numul Pastoral Lease) and Traditional Owners (Namul-Namul Aboriginal Corporation) resulted in agreement to progressively convert the land to improved pasture, using both native and exotic grasses combined with reintroduction of plants currently found in the area.

AIR will implement an ongoing rehabilitation program to minimise colonisation opportunities for weed species. The rehabilitation program will focus on establishing the pasture species 'sabi grass' (*Urochloa mosambicensis*) and 'stylo' legumes (i.e. *Stylosanthes hamata* and *Stylosanthes scabra*) in disturbed areas post-mining works. Further detail on preferred species and methods of rehabilitation were obtained from consultation with the managers of the Numul Numul Pastoral Lease, specifically Moira Lanzarin (nee O'Brien).

2 Objectives and Targets

2.1 Existing Land Use and Condition

As the area encompassing MLA27422 is currently a pastoral station, existing land 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 post wet season grading. Extensive fencing for stock management and multiple stock dams exist within the lease area.

The Roper River Region is sparsely populated. Only 3,500 people live in the catchment, of which 70% are Indigenous. The largest population centres are Mataranka (600), Ngukurr (1589), and Minyerri (340) (Northern Territory Government 2007), respectively located about 105 km east, 80 km west, and 65 km south of the Project area. People of the Jawoyn, Mangarayi, Ngalakan, Ngandi, Nunggubuyu, Mara, Alawa and Yangman language groups live in the region (AIATSIS 2000). English is not the first language for the majority of the Indigenous population and Kriol is commonly spoken.

In such a remote region, which experiences wet/dry seasons and has a sparse population, industrial and economic options can be limited. Pastoralism, mining, conservation and indigenous tourism-based industries are the main areas of activity within the Region.

There is a 67% indigenous population within the Mataranka Basin (Stoeckl et al. 2007), therefore traditional practices and connections to land and water are high.

2.2 Post-Mining Land Use

It is proposed that the post mining land use will be a combination of native and introduced pastoral species in a healthy and productive state. Rehabilitation will avoid a blanket monoculture of introduced species.

As the quality and composition of the grasses increase, so too will the production capacity. This will make the land more economically viable than it is currently and is supported by both the Namul-Namul Aboriginal Corporation (Traditional Owners) and sub-lease holders, the O'Brien family, who currently manage the property as a cattle station.

2.3 Objectives

Performance and management of rehabilitation will be the obligation of AIR. As such, it will be AIR's responsibility to demonstrate successful rehabilitation before return of the security bond from the Department of Resources on completion of mining. It is envisaged that AIR will most likely engage local land holders, managers and contractors to achieve successful rehabilitation.

The objective of the rehabilitation work is to utilise grazing to establish the desired future land use of a diverse and healthy perennial grass rangeland system, with well covered soil that has effective water absorption and nutrient cycling.

In general terms, the objectives of the rehabilitation work are to:

- Achieve stable landforms;
- Reduce incidence of weed infestation and spread;

- Reduce risk of erosion and sedimentation;
- Progressively rehabilitate over the life of mining;
- Prevent non-essential access to rehabilitation areas;
- Maintain natural drainage and hydrology of land as much as practicable;
- Rehabilitate access tracks and roads that are not required post construction and mining;
- Improve economic viability of the land;
- Establish and maintain a healthy and productive state of vegetation;
- Comply with all regulatory requirements, approvals and any other legislation; and
- Undertake monitoring and performance evaluation measures that are practical and measurable.

2.4 Targets

- Increase in the economic viability of the land;
- No new channels will be created and no evidence of significant erosion, either within the mining area or in surrounding environment (resulting from mining activities);
- Occurrence and density of declared or undesirable weeds within post mining areas, tracks or roads no greater than surrounding areas;
- No negative impact on nearby waterways;
- 80% total groundcover is achieved, assessment made at the end of the wet season, determined through the use of photo monitoring and aerial photography and other monitoring tools (e.g. caged exclusion plots); and
- Lease relinquishment conditions are met within 24 months of cessation of mining.

3 Rehabilitation Plan

The purpose of this plan is to outline a method for rehabilitation that will be subject to regular review, detailed monitoring and reporting and, most importantly, modification as required. The plan will follow the basic adaptive management framework of Plan – Monitor – Control – Replan (Figure 3-1). It is expected that as knowledge increases through experience and experimentation with planting and stocking rates, timing and recovery period, that the plan will evolve and shift to something which can be used as a guide, not only for Numul-Numul Station, but for other areas within the Northern Territory and similar climes.

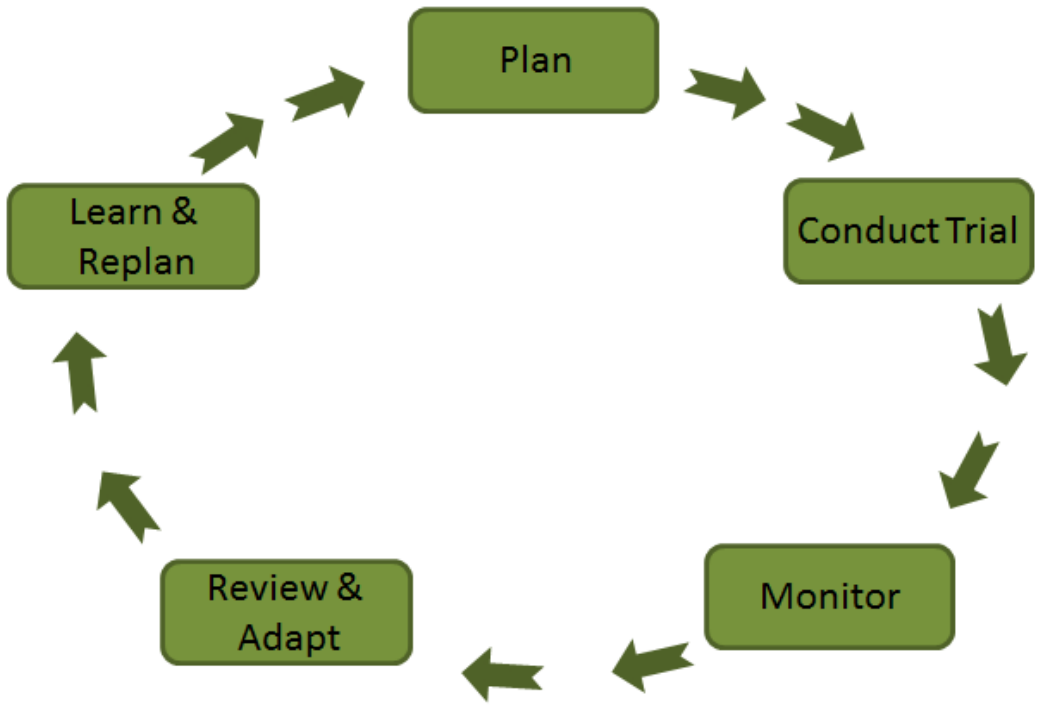

Figure 3-1. Adaptive Management Framework.

3.1 Mining method

Ilmenite recovery will require strip mining using excavators to remove the regolith to an average depth of 1.2m (maximum 4m), in order to recover 200,000 tonnes of ilmenite concentrate per annum, at a grade of between 10% and 25%. Between 400,000 and 1 million tonnes of regolith will be excavated per year.

Excavations will progress along strips up to 300m long and 200m wide. After the initial strip is mined, the ore is processed and the residual material (about 75 – 90% of the original material) is stockpiled, dewatered, and placed back into the pit as excavations move to the next strip. This will allow areas to be rehabilitated in a progressive manner. Where topsoil is available, it will be stockpiled for later use in spreading over filled pit

areas and managed to prevent infestation with weeds. However, very little top soil is expected, as the ilmenite mineralisation generally extends to the surface with minimal overburden.

To assist in the development of top soil and reintroduction of local native plants, the timber cleared from the site will be stockpiled, put through a mulcher, re-stockpiled and distributed over the site post mining.

Prior to excavations, the vegetation will be cleared and soil ripped to a depth of approximately 1m for ease of ore removal by a single CAT325DL excavator or similar.

3.2 Topography

The project area lies mainly 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, and volcanics and carbonate rocks. Local relief is variable ranging from 20 to 120 metres.

3.3 Drainage and hydrology

The Roper River catchment is one of the largest in the Northern Territory with an area of 81,794 km^2 (Faulks 2001). It is fed by nine rivers (Phelp, Hodgson, Arnold, Wilton, Mainoru, Jalboi, Strangways, Chambers and Waterhouse), and three major creeks (Maiwok, Flying Fox and Elsey).

The region is generally considered poor in groundwater (Zaar, 2009). Groundwater resources in the area of the SILL80 Project are typical for the catchment, comprising fractured and weathered rocks with bores yielding less than 1 L/s.

The extremely high evaporation rate (mean annual rate about 2400 mm), greatly exceeds annual rainfall, even in the wettest years. Conversely, during the wet season flooding in the lower lying areas of the Roper catchment can be extensive, and flooding can occur in the area of the proposed mine.

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. Velocity of water from rainfall events is expected to be 0.4ms^{-1}.

3.4 Erosion Control

Erosion and sedimentation control measures will be employed throughout the site to control stormwater and protect areas undergoing rehabilitation. 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. Stormwater will be diverted around any active or rehabilitated mine areas.

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.

More information is provided in the Erosion and Sediment Control Plan in PER Appendix H.

3.5 Topsoil Management

Where available, topsoil and vegetation will be retained and spread back over the re-contoured areas progressively upon completion of mining. Topsoil will be stockpiled, for use in rehabilitation, in an area not subject to flooding or sheet flow, which will ensure that the topsoil is not lost or subjected to damage from erosion. Topsoil stockpiles will be constructed no more than 2m in height to maintain soil health. The seed bank in the topsoil will be sufficient to supplement additional grass/pasture seed to be introduced in the rehabilitation areas. Topsoil will be monitored for weeds and actively maintained, particular care will be taken to avoid introduction of declared weeds (refer to the Weed Management Plan, PER Appendix I). Cleared vegetation will be mulched and made available for revegetation to help create the post mining topsoil.

3.6 Species Selection

3.6.1 Desirable Introduced Species

The following species are recommended (Partridge 2004) for intensive grazing in the tropical and sub-tropical regions of the NT. Descriptions are taken from *Better Pastures for the Tropics and Subtropics* by Ian Partridge (2004).

Sabi Grass – *Urochloa mosambicensis*

A perennial grass, either tufted or creeping with short stolons and low growth habit. Ideal for areas receiving 500 – 1,200 mm annual rainfall with a strong dry season. It grows quickly after rains, but, although drought-resistant, it hays off quickly once soil moisture runs out. It does not tolerate poorly drained soils subject to flooding. Sabi grass combines well with legumes, especially stylos (Seca and Verano). A small amount of Sabi seed sown with the legume seed may gradually increase with time to provide a more stable pasture.

Verano – *Stylosanthes hamata*

This plant grows well in the tropics with 600 – 1,700 mm rainfall. It is adapted to a wide range of infertile, sandy-surfaced and well-drained soils. Verano can grow up to 75 cm, but develops a flat crown under heavy grazing. If allowed to seed without grazing, it tends to behave as an annual, but 30 – 40% of plants will behave as a perennial under grazing, and continue to grow into the dry season after flowering. However, it generally behaves as a weak biennial, regenerating well from the reserves of seed in the soil in the next wet season, and can therefore survive fire which kill the parent plant.

Seca – *Stylosanthes scabra*

The shrubby stylos are extremely hardy plants ideal for extensive grazing. They establish easily, keeping green leaf into autumn, and persist through drought due to their deep tap roots.

Shrubby stylos are ideal for growth in tropical climates where they receive 600 – 1600 mm of rainfall. They will grow in a range of soils but do not tolerate waterlogging or heavy cracking clays. They will grow into

small erect shrubs of 2 m high if ungrazed, but under grazing conditions they will remain at 30 – 40 cm high with a closely eaten crown on a single stem.

The feeding value of the leaf and flowering heads is high, and is well maintained into the dry season. Seca regenerates well after fire, reshooting from the base or regenerating from seed in the ground.

3.6.2 Desirable Native Species

The following species were identified by Numul Numul Station Managers as desirable native pasture species to be included in the mix of pastoral species introduced for rehabilitation.

- Perennial Sorghum - *Sorghum x almum* Parodi, *Sorghum* spp. hybrids
- Bull Mitchell - *Astrebla squarrosa*; and
- Flinders Grass - *Iseilema membraceum*.

3.7 Rehabilitation

The annual area of disturbance at the SILL80 project is proposed to be between 13 and 40 hectares, and will vary with ore depth and production output. Excavations will be dug along approximately 300 x 200m wide strips to maximum depth of 4m where ilmenite-bearing soils occur.

Consultations with the Traditional Owners and Pastoral Lease owners sought input as to what their rehabilitation desires would be, and the proposed rehabilitation plan is based on this.

Mined areas will be rehabilitated in consultation with station managers in order to develop the area as a diverse and healthy perennial grass rangeland system. Processed spoil will be returned to the pit, which will then be broadcast with perennial grass seeds and covered with weed free pasture hay. Cattle will then be introduced to the area, at high density (Figure 3-2), for a short and controlled period to initiate sowing of seeds and stimulate ground preparation. As a perennial grass rangeland develops, the area will by grazed systematically, for a short duration (6-12 hours) every six or more months, to promote growth. Specific management will be determined through a Grazing Plan to be prepared by Numul Numul Station Managers.

Figure 3-2. High Density Stocking.

Very little top soil is present and the vegetation is sparse in areas (Figure 3-3) providing little brush cover available for protection of seedlings and soil. Effective rehabilitation may require a higher density of plantings to ensure long-term survival of individual plants and effective soil erosion prevention. Native grasses will also be encouraged and it is expected that some small shrubs and trees will also establish.

Figure 3-3. Sparse Vegetation within MLA27422.

A permanent fence (3 barbwires) grid, determined by AIR and the pastoral lease holders, will be put into place to facilitate the effective and safe management of the site.

Rehabilitation will generally follow the below steps:

- Excavations will be progressively backfilled with the residual material left over from ore processing (about 75 – 90% of the original material).
- Residual material will be dewatered prior to being placed back into the pit.
- Top soil (where available) will be stockpiled for later use in spreading over filled pit areas. However, very little top soil is expected, as the ilmenite mineralisation extends to the surface with very little overburden.
- Additional soil may be sourced from other areas within the Mining Lease, as required.
- Perennial grass seeds will be broadcast over rehabilitation areas – to develop a perennial grass rangeland.
- Hay or silage will be introduced to the paddock to provide additional fodder and mulch, along with mulch sourced from stockpiled cleared material.
- Cattle will be selectively introduced to the paddock for a short amount of time (possibly only 6 to 12 hours). This will be done at high density with electric tape or portable panels used to create the desired density. The cattle will mix the mulch through hoof action and add natural fertiliser in the form of faeces and urine. This will create “new” topsoil.

- If enough native residual seed does not germinate in the area a cross-selection of perennial grass species will be introduced at a later date.
- Re-introduction of cattle will be carried out at various times (for short periods and of varying density), carefully managed to promote growth of pasture without negatively impacting the environment and to promote the desired future landscape.
- Regular monitoring will occur to determine if the rehabilitation activities are achieving the desired result or if methodologies need to be modified.
- Access roads not wanted by landowners will be ripped and allowed to revegetate naturally.
- Prior to the completion of mining operations, consultation with landowners will be undertaken to determine the fate of all mining infrastructure, including the processing plant, concrete pad, sheds, office, roads and any other infrastructure in place.

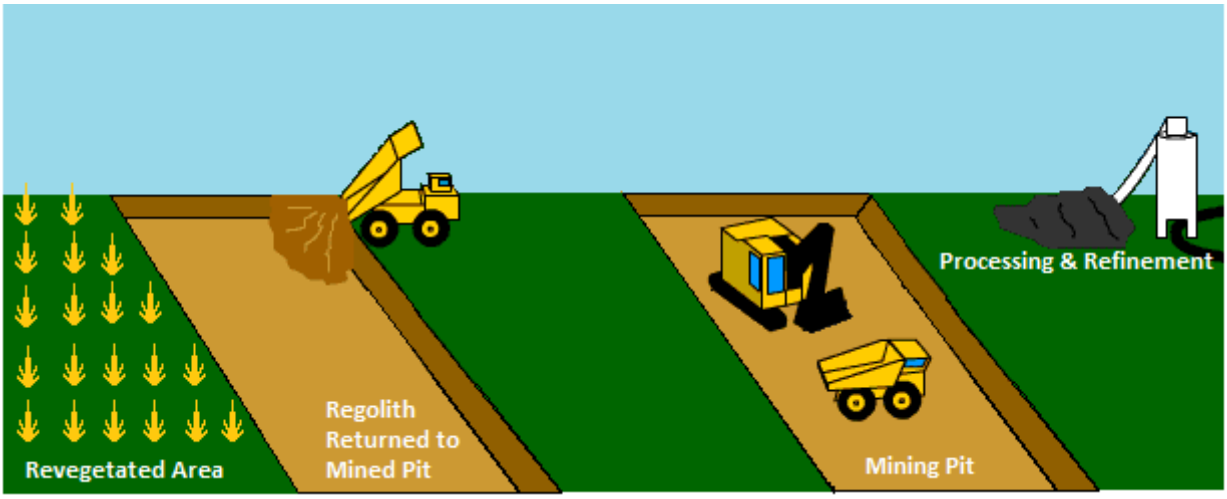

Figure 3-4. Schematic Representation of the Process of Mining and Rehabilitation.

Mining will progress in the first twelve months over an area not exceeding 40 hectares. In year two, mining will move to a second resource area and rehabilitation can commence over the year one mining area (Figure 3-4). Initially hay and/or silage will be spread over the ground along with topsoil, mulch and desired perennial seed.

Photo and cage monitoring (also known as exclusion plots) will be used to help determine success rate through per cent ground cover; this is discussed in more detail in Section 4.

Timber stacks resulting from vegetation clearing will be used for producing mulch. This will have the added benefit of introducing seed naturally during the rehabilitation process.

Success of rehabilitation will be determined through the use of baseline data (e.g. photograph prior to mining), monitoring and the use of control sites (discussed further in section 4).

Water and Fertiliser

Stock will most likely be watered using a trailer trough, with water sourced from a hydrant at the AIR processing plant and taken to the cattle occupied paddock for the duration of grazing.

The pasture will not require addition of water, although there may be the need for supplementary fertiliser and advice will be obtained from the Northern Territory Agriculture Association.

Timing

Timing of grazing will vary but in general, the paddocks will be used for weaners (May – July) and sale bulls (prior to May). Further detail will be provided in the Grazing Plan, which will outline the timing and type of livestock used and what will be most effective strategy in achieving the desired goals. During the non-growing period (late dry season) the paddocks will be able to tolerate high stocking. The cattle will knock down and re-mulch old plants to assist in creation of an additional mulch layer. Improved pasture has a much faster recovery rate (approximately 30 days) than native pasture, although it may be necessary to protect slower growing plants, and this can be achieved with the use of cages. Cages can also be used for monitoring and is discussed further in section 4.

Figure 3-5. Cattle Grazing on Improved Pasture

It is anticipated that the growing season will extend in each subsequent season as management is refined. There will not be a set rotation, as this will have to be determined based on growth rate and recovery period required, weather and other variables. Cattle rotation will be driven by vegetation growth rates, but this can be variable over weeks and months and will need to be closely monitored and managed by the station managers and as per the Grazing Plan to be developed for the site.

Weeds

Weeds will be managed in accordance with the AIR Weed Management Plan (PER Appendix I). If weeds are an issue within a paddock, stock is one tool which can be utilised to help control them through introduction of cattle at a time when the weeds are vulnerable, breaking them down, eating and trampling on them. Perennial grasses, given adequate time to recover between grazing, will generally out-compete weeds and again the timing of grazing will be critical for management (M Lanzarin 2011, pers. comm., 29 November). Other tools such as mechanical, chemical or fire will also be considered and the technique most appropriate for the given circumstances will be used.

Wildlife

Wildlife corridors will be encouraged within the rehabilitation areas, with larger shrubs and trees encouraged in areas where they may assist in formation of mosaic or checkerboard wildlife corridors.

Stock movement

Stock movement will be carried out using “low stress” stock handling techniques.

3.7.1 Roads and Tracks

When the mine is nearing closure, consultation will be undertaken to determine what infrastructure is removed and rehabilitated or will remain for the benefit to ongoing management of the cattle station. The areas that are not required will be ripped and revegetated to bush or pasture depending on location/needs. If a given area is to be added to pasture areas, it will be treated in the same way as the paddocks. If natural bush is favoured, then they will be ripped and allowed to naturally revegetate whilst maintaining weed control.

Indications from consultation carried out to date are that access tracks will be kept due to their value in assisting running the cattle station.

3.7.2 Timeframes

Initial rehabilitation will not take place until after the completion of the first year of mining. It is expected that around 30 – 40 hectares of land will be mined in the first year. This is an ideal area for the techniques outlined in section 3.7. Each year, a paddock of approximately the same size will be made available for rehabilitation. At the end of mining there will be approximately 15 perennial pasture paddocks, including paddocks used to grow hay or silage which will be used to support the intensive grazing plan.

3.7.3 Training/Site Induction

The general site induction will include detail on the rehabilitation strategy being employed to assist employees in understanding the importance of maintaining fencing integrity, access requirements during both grazing and non-grazing periods, weed management/control, and movement of stock within the mining lease.

3.7.4 Fire control

Fire should not be required to aid in the rehabilitation, and measures will be taken to ensure that unwanted fire does not occur in these areas. Fire tolerant pasture species are not favoured by pastoralists, and it is likely that fire would promote the growth of undesirable weeds. Fire breaks will be established around the mining lease to ensure protection of mining infrastructure and rehabilitation areas.

3.7.5 Carbon Sequestration

The clearing of vegetation for mining activities will result in the removal of approximately 800 ha of existing woodland. This comprises the processing and general work area, open cut pits and access roads. Land clearing contributes to Greenhouse Emissions via the use of machinery to remove vegetation but importantly, it is recognised that removal of vegetation generally contributes to a loss of a carbon sink. The rehabilitation proposed should improve the overall ability of the land to sequester carbon. Recent studies

(e.g. Chan et al. 2009 & Tyrchniewicz Consulting 2006) indicate that improved pasture and grazing management can lead to increased Soil Organic Carbon (SOC) sequestration potential and reduction in greenhouse gas emissions (when compared to traditional grazing practices and unmanaged grazing).

Methods for measuring carbon sequestration are being developed (M Lanzarin 2012, pers. comm., 10 Jan.) and will enable estimates to be made of the effectiveness of this type of rehabilitation in creating an offset for mining. It will also enable comparisons to be made between the different rehabilitation strategies to determine the most effective. A "control" area will be established to provide baseline data on the current land practice and its ability to sequester carbon for later comparison to various rehabilitated sites.

3.7.6 Fodder Conservation

A paddock will be set aside as a fodder conservation area, although the location and timing of this will be determined based on the best available technology and local expertise. The paddock will be planted specifically for the purpose of growing a fodder/silage crop to be used to support the proposed rehabilitation and ongoing management of the lease.

3.7.7 Mine Closure

Mine closure planning will be conducted in consultation with land owners and other stakeholders to ensure that the final stages of rehabilitation and mine closure objectives incorporate their requirements (e.g. retention of certain infrastructure or a specific alternate land use).

The mine closure plan will be developed according to the following objectives developed from the NT Department of Resources *Mine Close Out Objectives* (DoR 2008):

- Protect human health and safety;
- Reduce the need for long term monitoring and maintenance through design of and construction of landforms that are geotechnically and geochemically stable;
- Develop landforms that are consistent with the surrounding landscape;
- Develop an environmental monitoring and reporting program which is focused towards demonstrating the achievement of closure outcomes;
- Undertake progressive rehabilitation of the site during operations;
- Ensure that the full cost of decommissioning and rehabilitation is understood and that a mechanism for funding exists; and
- Ensure that residual risks and liabilities are identified and controlled to an acceptable level.

Following demolition of infrastructure and site clean-up, the remaining disturbed sites will be regraded to re-establish existing drainage lines.

4 Monitoring and Maintenance

4.1 Operation Phase Monitoring and Maintenance

Prior to commencement of mining, a series of photographs will be taken, which will establish a baseline condition for the land and will be the minimum acceptable end condition for the rehabilitation. This will also assist in providing a reference for current weed species/infestations so that new species or problems can be identified and remedied quickly.

Photo monitoring will also be conducted within the rehabilitation areas, with reference points set up and flagged. Photos will be taken periodically (minimum quarterly) over the same area of rehabilitation to determine success/failure. Photo point locations may be demarked in such a way as to ensure no damage by cattle (Figure 4-1).

Figure 4-1. Marker embedded into the ground to prevent damage by cattle.

The following guidelines will be utilised when undertaking photo monitoring:

- Photos should be taken from the same location and in the same direction, preferably with a reference point visible in the photo. This might be a star picket which is painted or has a number or unique identifier on it. It should be robust enough to ensure cattle do not damage or knock it over;
- Photos should be taken on cloudy but bright days, if this is possible, to avoid the creation of too many shadows which can make it difficult to distinguish between plant species and skew perception of ground cover;
- Photos should be taken quarterly in line with mid dry season, end of dry season, mid wet season and end of wet season;
- The photo point should be easy to find and therefore easy to replicate in subsequent years;

- Photo data sheets should also be used to record date and any other features that may not be obvious in the photos, such as species type and density, what stocking rate has or will be used, amount of time cattle have or will be present etc.; and
- Close up photos can be taken in the same location using caged quadrats, one of which should be protected from damage by cattle (to allow comparison of "natural" regeneration compared to regeneration after cattle) and at least one other used to inspect annual/perennial composition/density, ground cover, soil and animal activity.

It is expected that interpretation of monitoring will take place through continued discussion with Government officials, experienced holistic managers and other relevant parties.

The use of paddock grass cages is useful to check and determine grass recovery times and changes in fast/slow growth. The increase in sugar reading on a Brix Meter against the control will be another possible monitoring tool used to check progress and drive changes in strategy.

Sample grid or point data will be used annually to determine ground cover and plant composition. All results will be compared to a "control" area which will be nominated prior to the commencement of mining. This area will remain in similar condition to the current land condition and will be ideal for measuring (and establishing baseline) carbon sequestration.

If changes within the paddock are rapid, it may be necessary to take more frequent photos at specific times. In particular, it may be beneficial, in this case, to take photos prior to introduction of cattle, immediately post removal of cattle (likely to be the same day as previous photo) and then monthly or quarterly depending of rapidity of change.

Initially, each paddock may be treated slightly differently from the last to help determine the most successful rate of stocking, species selection, and depth of mulch, type of mulch (hay/weed/pasture/silage and ratios used) and length of recovery permitted before re-introduction of cattle. Comparison can be made between the paddocks and monitoring and management adapted accordingly. The Grazing Plan may be updated periodically to reflect any changes in management based on results of monitoring. The Grazing Plan is the responsibility of Numul Numul Station Managers (Figure 4-2).

Figure 4-2. Preparing a Grazing Plan.

It will be important to establish early indicators of failure. This could be infestations of undesirable plants, soil compaction, or slow growth. Strategies will be developed over time to identify and remedy these indicators through changes in management and careful documentation of success.

Weeds are a critical factor which will need to be closely monitored and controlled. Reference should be made to the AIR Weed Management Plan (PER Appendix I).

Fencing will be established post mining and prior to the rehabilitation work. Fencing will be regularly checked and maintained to ensure integrity; any damage will be fixed as quickly as possible. As cattle are likely to intensively graze for only very short periods of time, station managers will be present; this will have the added benefit of ensuring that no damage is sustained by the fence and can be fixed quickly.

Management of stock will be closely monitored and adapted by Numul Numul Station Managers as required.

4.2 Reporting, Review and Recommendations

This type of rehabilitation has not been trialled extensively in the Northern Territory, therefore it is expected that strategies will change over time, adaptation dependent on success and failure. As discussed above, several strategies will be trialled over subsequent rehabilitation areas, using higher or lower density of stock, longer or shorter periods within the rehabilitation area and changes to species selection and protection/encouragement of alternative species (including some shrub and trees). The success of the earlier trials will drive which strategies are used in the longer term.

However, it should be noted that similar techniques have been trialled in other areas (e.g. Daggett 2005, Donovan n.d., Coodardie 2011 & Henggler et al 2012), most notably by the O'Brien family on Coodardie station, and have shown that this type of rehabilitation is very successful when managed appropriately.

Adaptive management will be pursued (see Figure 3-1). Should initial trials prove less than successful, further strategies will be explored, such as different site preparation and planting methods e.g. manual seeding and the use of machinery, changes to species composition, timing of stock introduction etc.

Success and failure will be determined through the use of photo monitoring, the presence/absence of weeds, presence/absence of erosion and sedimentation. In general terms, it is expected that more than 80% total groundcover of diverse and healthy perennial grasses along with well covered soil and effective water absorption and cycling, will indicate success.

Annual reporting on rehabilitation methods will be presented in the Annual Environmental Review required as part of the Mining Management Plan and reported to the Department of Mines.

5 Definitions

Dewatered	To remove water
Kriol	Kriol is an English-based creole language spoken by many Aborigines in Australia
Monoculture	The cultivation of a single crop
Overburden	Rock or soil overlying a mineral deposit
Perennial	An enduring plant that lasts longer than two years, sometimes dying in the off season and regrowing in the on season
Progressive Rehabilitation	Rehabilitation that takes place on areas as they become available rather than waiting for the end of mining before rehabilitating
Regolith	The layer of unconsolidated solid material covering the bedrock of a planet
Silage	Green fodder compacted and stored in airtight conditions, typically in a silo, without being dried, used as animal feed in the winter
Topsoil	The upper part of the soil, which generally contains the seed bank

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