

Mine Rehabilitation and Closure

6



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6 MINE REHABILITATION AND CLOSURE

6.1 INTRODUCTION

This section describes the proposed rehabilitation and decommissioning strategies for the Eastern Leases Project (the project). These strategies will be guided by the rehabilitation practices at the existing mine, which are also described in this section. This section draws on, and describes, the *Geochemistry Report* (Appendix A) and the *Soils Report* (Appendix B) that were prepared for the EIS.

6.2 REHABILITATION AT THE EXISTING MINE

6.2.1 Statutory Requirements and Corporate Guidelines

Progressive rehabilitation at the existing mine is undertaken in accordance with requirements from:

- The NT *Mining Management Act*, which requires that mining companies pay a security deposit to provide for the rehabilitation of mineral leases. The value of the deposit is dependent on the size of the disturbed area. The security deposit is held by the NT Department of Mines and Energy (DME) and can be relinquished once the DME has issued a certificate of closure confirming that rehabilitation meets the agreed closure criteria.
- The Mining Agreement under the Commonwealth *Aboriginal Land Rights (Northern Territory) Act 1976* (ALRA) between the Anindilyakwa Land Council (ALC) and the proponent. This includes a clause stating that “GEMCO shall ensure that the Project is designed and conducted so as to, as far as reasonably practicable restore quarried areas to a condition reasonably compatible with the surrounding environment”.
- A framework of existing internal documents and procedures, including corporate requirements prepared by the proponent, and various internal GEMCO procedures that govern individual activities undertaken as part of mine rehabilitation. Key documents include a Rehabilitation Standard, Rehabilitation Planning Manual, Land and Biodiversity Management Plan, and a Closure Plan. The proponent also has individual procedures relating to specific rehabilitation activities including vegetation clearing; topsoil management; topsoil ripping; seed collection; aerial seeding; sowing seed by hand; and weed management.

6.2.2 Rehabilitation Objectives

Key rehabilitation objectives and guiding principles are outlined in Table 6-1. This section only refers to rehabilitation of areas directly associated with mining activities, and the table is consequently restricted to guiding principles relevant to these activities. The proponent has prepared objectives and guiding principles for other kinds of activities (e.g. the town of Alyangula, Milner Bay Port Facility etc.) and these are documented in the existing framework, as discussed in Section 6.2.1.

Table 6-1 General Rehabilitation Objectives

OBJECTIVE	GUIDING PRINCIPLES
Safe for humans and wildlife	■ Mine voids will be backfilled to the most practicable and cost effective extent during operations. ■ Areas of unstable ground will be stabilised as appropriate to ensure that there is no risk to humans or animals. ■ Hazardous materials will be removed or treated.

OBJECTIVE	GUIDING PRINCIPLES
Non-polluting	■ Leachate will be managed to prevent mobilisation from sources of potential contaminants such as tailings. ■ Contaminated land will be remediated to prevent runoff and seepage.
Stable	■ All residual slopes will be stable, where possible. ■ Slopes will have vegetative cover preventing erosion.
Able to sustain an agreed post-mining land-use	■ The post mining landform (areas previously mined, excavated, dumped over or topsoil stripped) will be reseeded with local native tree and shrub species.

Source: Rehabilitation Standard: GEM–STA–22700 GEMCO (2014)

6.2.3 Rehabilitation Techniques

Rehabilitation is designed to restore mined land to a self-sustaining open woodland, similar to the pre-mining environment and the surrounding undisturbed land. Mine rehabilitation at the existing mine includes the following activities:

- Backfilling quarries with overburden. In areas that have been rehabilitated to date, the post-mining landform that has been created is similar to the pre-mining landform, with no elevated overburden emplacement areas.
- Contouring the post-mining landform to allow for adequate drainage of surface water, and installing any necessary erosion control works.
- Spreading topsoil, generally at a depth of between 300 to 400 mm. Wherever possible, topsoil that has been stripped ahead of mining is placed directly onto rehabilitation areas, avoiding the need for stockpiling of topsoil. In instances where this is not possible, topsoil is stockpiled for later use. The optimum time for replacement of topsoil is just prior to the onset of the wet season (i.e. early-mid December). Further detail on topsoil management proposed for the project, including stockpiling, is provided in Section 6.3.2.
- Ripping the topsoil, with the aim of:
 - Minimising the impact of compaction from machinery;
 - Promoting root, water and nutrient penetration;
 - Reducing the risk of erosion over the surface of ripped topsoil; and
 - Preventing runoff from the site and the loss of seeds.
- Undertaking revegetation following topsoil spreading and ripping. Revegetation practices include:
 - Use of local, native species in revegetation. Based on the diversity, abundance and distribution of vegetation on Groote Eylandt, the proponent, in collaboration with Traditional Owners and the NT government, has identified and categorised the native flora species on the island as either “key”, “primary”, “acacia” or “other”. The proponent’s rehabilitation strategies focus on key and primary species, as acacia and other species tend to be short-lived and typically do not form part of the dominant vegetation on the island. Key species include *Eucalyptus miniata* (Darwin Woollybutt) and *Eucalyptus tetradonta* (Darwin Stringybark).
 - Sourcing seed material from within the proponent’s Mineral Leases. The proponent collects, dries, cleans and stores seed in accordance with procedures that are designed to ensure that the seed will remain viable for rehabilitation.
 - Use of aerial seeding as the primary seeding technique. Aerial seeding is undertaken as close as possible to the start of the wet season (early-mid December). Seed may also be sown by hand in some circumstances.

- Seeding rehabilitated areas at a high rate to establish a dense native vegetation cover and reduce the ability for weeds to establish.
- Undertaking any necessary weed control using selective herbicides or physical removal of weeds.

6.2.4 Monitoring and Remediation

The proponent has developed detailed completion criteria for rehabilitated areas and undertakes annual monitoring of rehabilitation against the completion criteria. The rehabilitation monitoring program includes a network of analogue sites (i.e. undisturbed areas representative of the landform and vegetation prior to mining) and rehabilitation sites. Data recorded during the monitoring program includes:

- Soil profile chemistry and geochemistry;
- Ground cover (i.e. proportion of litter, grass and bare ground);
- Species composition and abundance, with a focus on woody species that have been nominated as key and primary species;
- Diameter of trees and shrubs;
- Canopy cover;
- Fauna activity; and
- Presence of weeds.

Photo-point monitoring of monitoring plots is also undertaken annually to provide a visual reference and qualitative indicator of vegetation growth over time. A record of the impact of fire on each monitoring plot is also made.

The data from each monitoring plot is used to determine whether the rehabilitated area is on the expected trajectory for its age and to classify the rehabilitated area into the completion criteria classification codes as listed in Table 6-2.

Table 6-2 Completion Criteria Classification Codes

CODE	CLASS	AGE (YEARS)	DESCRIPTION
GIS1	Under review – for remediation	0-1	Does not currently meet completion criteria or trajectory for age and requires remediation or intense replanting.
GIS2	Under review – juvenile	2-3	Rehabilitation that is under 3 years of age. Must meet the minimum density range for both key and primary species of seedlings and saplings that have regenerated. Rehabilitation is acknowledged to lack resilience.
GIS3	Under review – pre-maturity	3-5	Rehabilitation that is between 3-5 years of age. Must meet the minimum density range for both key and primary species of seedlings and saplings that have regenerated. Rehabilitation is acknowledged to lack resilience.
GIS4	Established rehabilitation, incomplete criteria	5-10	Rehabilitation that is between 5-10 years of age and is considered on track to meet an overall level of 60% of internal completion criteria ¹ . Rehabilitation is acknowledged to be of a low level of resilience and may require additional work e.g. planting key and primary species, fire protection or weed management.

CODE	CLASS	AGE (YEARS)	DESCRIPTION
GIS5	Established rehabilitation, near success	10-15	Rehabilitation that is between 10-15 years of age and is considered to meet an overall level of 75% of internal completion criteria ¹ . The rehabilitation meets the minimum range for key and primary tree species diversity as well as standing tree basal area. It is considered resilient to natural disturbance factors and may only require additional time or protection from fire or weeds.
GIS6	Successful rehabilitation	>16	Rehabilitation that is older than 16 years and meets 80% to 100% of internal completion criteria ¹ and is considered suitable for handing back to the Traditional Owners. It can be demonstrated that both key and primary tree species diversity along with standing tree basal area fall within the upper range and are reflective of successful rehabilitation.

¹ Internal completion criteria include extent of ground cover, seedling regeneration, sapling regeneration, woody species (for both key and primary species), basal area, canopy cover and weeds.

The frequency of monitoring is dependent on the completion criteria code. GIS1 to GIS4 rehabilitation is monitored annually, whereas rehabilitation that is established (GIS5) or successful (GIS6) is monitored less frequently (every three years).

Monitoring of fauna activity in rehabilitation areas has recently been initiated. Data gathered includes the presence or absence of ants and termites; bird counts; general signs of fauna activity (such as tracks, scats, burrows and nests); observations of fauna species in the rehabilitation sites; and assessment of habitat condition.

In the event that monitoring indicates that rehabilitation is not on trajectory to meet the closure criteria, the rehabilitation is subject to remedial works such as supplementary planting or extra weed control procedures. In extreme cases the remedial work can extend to a complete renovation of the rehabilitation site.

6.2.5 Rehabilitation Status

The proponent has rehabilitated approximately 1,000 ha within the existing mine, with the rehabilitation varying in age from a few months to over 30 years. Rehabilitation monitoring shows that sites are steadily being rehabilitated to open forest in accordance with the rehabilitation strategy. Several sites have been classified as GIS 6 (Successful Rehabilitation) and GIS 5 (Established Rehabilitation). These sites are acknowledged to have advanced forest rehabilitation, often with trees over 15 m tall and with an assortment of native plant species in the understorey and ground stratum. The majority of sites surveyed in the two to five year age class were within the rehabilitation trajectory and contained adequate key and primary species for rehabilitation.

The most common vegetation community mapped within rehabilitation sites is low open forest and all rehabilitation sites with an age class of 21+ years met the rehabilitation completion criteria for canopy cover. Older rehabilitation sites showed decreasing bare ground, a reduction of grass and an increase in litter coverage. Sites older than 10 years generally showed a relatively high coverage of litter. The increased litter cover relative to grass is a result of protection of rehabilitation from fires, which occur almost annually in surrounding natural vegetation. In the long term, when mining is complete and all sites are rehabilitated, it is likely that the resultant vegetation will experience similar frequencies of fire to those occurring in unmined areas. At that time, it is likely that the vegetation species composition and structure will more closely approximate the original forest type.

Fauna monitoring undertaken to date has focussed primarily on ants and birds in rehabilitation areas and it is intended that these groups will act as an indicator of how fauna species in general are responding to the rehabilitation. Monitoring of ants and birds indicates that a considerable diversity of species occurs in the older rehabilitation areas but that the assemblages of species differ from those in analogue sites. This is almost certainly due to the protection of rehabilitation from fires. It is predicted that on completion of all rehabilitation,

when fire is introduced into mature rehabilitation areas, faunal assemblages are likely to become similar to those in unmined forest areas.

There have also been some limited studies of other fauna groups in older rehabilitation areas for the purpose of this EIS, as reported in the *Terrestrial Ecology Report* (Appendix C). The assessment of all vertebrates within older rehabilitated areas verified that mammal, reptile and bird species are colonising these areas. The EIS study also found threatened species, including the Northern Quoll, Mertens' Water Monitor and Yellow-spotted Monitor using older rehabilitated areas.

Plates 6-1 to 6-3 show examples of rehabilitation sites at various ages and completion criteria.

6.3 PROJECT REHABILITATION

6.3.1 Introduction

This section describes the properties of the soils within the project site, and the geochemistry of the overburden material. It discusses limitations that these materials pose for project rehabilitation. This section also describes the rehabilitation and mine closure practices that will be adopted for the project.

6.3.2 Topsoil Management

Introduction

GTS Environmental undertook a baseline soils assessment of the project site and the full results of the study are provided in the *Soils Report* (Appendix B). The study included a desktop review and field investigation, mapping and description of the soils across the project site, and an assessment of the depth of available topsoil. This section provides a summary of this study, as well as a topsoil balance for the project and a description of topsoil management practices to be adopted for the project.

Soils Assessment Methodology

A desktop review of relevant regional data sources was used to prepare an investigation plan for the project site. The scale, density, layout and assessment methods were prepared with reference to relevant guidelines and best practice, including:

- McKenzie et al., (2008). *Guidelines for Surveying Soil and Land Resources*;
- National Committee on Soil and Terrain (2009). *Australian Soil and Land Survey Handbook*;
- Gunn et al (1988). *Australian Soil and Land Survey: Guidelines for Conducting Surveys*;
- Isbell (2002). *Australian Soil Classification*;
- Lynch (2012). *Land Systems of the Northern Part of the NT*; and
- Department of Minerals and Energy (1995). *Technical Guidelines for Environmental Management of Exploration and Mining in Queensland*.

In total, 122 soil investigation sites, incorporating 27 detailed sites and 95 observation sites were surveyed (Figure 6-1).

Detailed sites were used to describe the range of soil profile morphological attributes as per the *National Committee on Soil and Terrain guidelines* (2009) including soil colour as per *Munsell Soil Colour Charts*, (2009). In addition, landforms, slope, surface conditions, rock cover and major vegetation were described. At each detailed site an assessment was made of the quality, depth and quantities of reusable topsoil that may be excavated in the future. Soil samples collected from five detailed sites underwent laboratory analysis.

Observation sites were used to confirm the soil map unit (SMU) type and to refine mapped soil boundaries. Basic soil attributes were recorded to confirm the SMU type. Surface conditions including rock, slope percentage, landform type and position, major vegetation and land condition were also noted.

Soil Mapping Units

Based on field and laboratory data, six SMUs were identified and their boundaries mapped (Figure 6-1). The SMUs are summarised in Table 6-3, and were grouped according to basic soil morphology, position in the landscape, and parent material.

Table 6-3 Summary of Soil Mapping Units

SMU	DESCRIPTION	MAJOR VEGETATION
B1	Dark brown to reddish brown loamy sands on undulating plains	Darwin Stringybark (<i>Eucalyptus tetradonta</i>), Darwin Woollybutt (<i>Eucalyptus miniata</i>), Northern Cypress Pine (<i>Callitris intratropica</i>), Long-fruited Bloodwood (<i>Eucalyptus polycarpa</i>)
B1v	Light brownish grey to yellow brown loamy sands on undulating plains	
B2	Brownish black loamy sands on level to undulating plains	Darwin Stringybark
V1	Very dense rocky undulating plain with dense vegetation	Monsoonal Vine Thicket
Q1	Rugged uplands on quartz sandstone with minor leptic rudosols	Darwin Stringybark, <i>Corymbia ferruginea</i>
A1	Alluvial floodplains and gully areas in level to gently undulating plains	Broad-leaved Paperbark (<i>Melaleuca viridiflora</i>), Long-fruited Bloodwood

No evidence of acid sulphate soils was found during the field surveys. The risk of acid sulphate soils occurring within the project site is considered to be extremely low, given the geological origins, elevation and landforms found within the project site.

Topsoil Resources

An assessment of the suitability of the different soil types for stripping and reuse in rehabilitation was undertaken. Several factors, including pH, electrical conductivity, cation exchange capacity, and the soil's dispersive qualities were used in assessing the suitability for rehabilitation and stripping depths.

Table 6-4 and Figure 6-2 provide the depth of available topsoil resources in each SMU within the project site.

Table 6-4 Maximum Topsoil Available for Reuse

SMU	DEPTH OF AVAILABLE TOPSOIL (mbgl)	ESTIMATED MAXIMUM TOPSOIL AVAILABLE FOR REUSE (m ³)
B1	0.40	4,720,313
B1v	0.20	-
B2	0.15	367,665
V1	0.00	-
Q1	0.00	-
A1	0.15	10,316
	TOTAL (m³)	5,098,294

It is estimated that a total of 5.1 million m³ of topsoil is available within the project disturbance footprint for use in mine site rehabilitation. The available topsoil is considered to be in good condition, and able to support native vegetation. No specific topsoil amelioration measures are therefore required.

The topsoil material will be used during the progressive rehabilitation of the quarries and also for the final rehabilitation of the project site at the end of mining. Topsoil will be placed on rehabilitated areas at a minimum thickness of 0.3 m. This is consistent with rehabilitation practices at the existing mine, and is proven to be a suitable depth of topsoil recovery to promote quality regeneration. Approximately 4.3 million m³ of topsoil will be necessary to complete the proposed rehabilitation program associated with the project, assuming topsoil is placed at 0.3 m thickness. Therefore, there is surplus topsoil available within the project site to complete the rehabilitation works.

Topsoil Stripping and Stockpiling Management Measures

Topsoil management, including techniques for the stripping, handling and storing of topsoil resources, will be broadly similar to practices employed at the existing mine. Topsoil management practices proposed for the project are outlined below, and are designed to prevent excessive soil deterioration:

- Topsoil stripping depths will be guided by the depths stated in Table 6-4 with the final stripping depth determined following an inspection by mine environmental personnel.
- Topsoil will be stripped when dry in order to avoid physical damage such as loss of structure, compaction and the creation of anaerobic conditions.
- In order to minimise damage to soil structure, root material and seeds, topsoil will be stripped in depths of at least 150 mm.
- Where possible, stripped material will be placed directly onto the area to be rehabilitated and spread immediately (if mining sequences, equipment scheduling and weather conditions permit) to avoid the requirement for stockpiling.
- Detailed scheduling will be undertaken as part of operations to optimise the reuse of fresh topsoil and determine stockpile locations.
- If stockpiling is required, the topsoil will be stockpiled within the ultimate footprint of the open cut mining areas in order to limit the disturbance footprint of the project.
- Topsoil stockpiles will be placed in open areas, away from areas subject to inundation and airborne weed seed.
- Where possible, a typical topsoil stockpile height of 4 m will be maintained.
- Stockpiles will be direct seeded with local, native species at a high density to assist in weed and erosion control, and to maintain biological and chemical processes within the soil.
- Any necessary weed control will be undertaken on the stockpiles.
- All stockpiles will be clearly identified with signs.
- An inventory of available material, including soil types, will be maintained to ensure adequate materials are available for planned rehabilitation activities.

6.3.3 Overburden Geochemistry

Quarry development will involve the removal of overburden which lies above the manganese ore. Interburden is found between the horizons of the manganese ore and, depending on thickness of this material, may occasionally be handled as overburden. Overburden and interburden are discussed collectively as overburden in this section.

A detailed assessment of overburden geochemistry was undertaken in order to determine whether the geochemical properties of the overburden posed any constraints to rehabilitation or necessitated specific handling and management practices. The detailed results of this assessment are presented in the *Geochemistry Report* (Appendix A). In addition, leachate testing of overburden materials was undertaken to confirm the potential quality of runoff and seepage that could be generated by these materials. Testing indicated that overburden is likely to generate low acidity, low salinity runoff with negligible trace elements. The potential impacts associated with overburden runoff and seepage are assessed in Section 9 – Groundwater and Section 10 – Surface Water.

The following sections summarise the overburden geochemistry and any associated limitations to rehabilitation of the Eastern Leases.

Geochemical Assessment Methodology

The geochemical assessment commenced with a review of existing information related to the geochemical and physical characteristics of overburden materials likely to be generated from the project. This process was used to develop a sampling and testing program to obtain representative samples of overburden materials for the project.

The following technical guidelines for geochemical assessment of mining waste were used to ensure that the overburden sampling and testing program was appropriate:

- NT Environment Protection Authority (NT EPA) (2013) *Environmental Assessment Guidelines – Acid and Metalliferous Drainage*;
- Department of Industry, Tourism and Resources (DITR) *Leading Practice Sustainable Development Program for the Mining Industry Series 2006 to 2008*. Canberra ACT;
- Department of Minerals and Energy (1995). *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland*;
- Northern Territory Minerals Council (Inc.) and the Mines and Petroleum Management Division of the Northern Territory Government (2004) *Technologies for Environmental Advancement of Mining in the Northern Territory*; and
- International Network on Acid Prevention (INAP) (2009) *Global Acid Rock Drainage Guide* (GARD Guide). Document prepared by Golder Associates on behalf of INAP.

The sampling and testing program included the collection of samples from 25 drill holes that intersected the entire overburden profile. The sampling locations are shown on Figure 6-3. Note that there are multiple drill holes at a number of the locations shown in Figure 6-3. Drill holes were located to provide good lateral coverage of the proposed quarry areas and the immediate surrounds, with targeted cored drilling undertaken within the proposed quarries. The program focussed on acquiring representative samples of the main overburden materials and prioritised testing of high quality cored samples from drill holes located within the proposed quarries.

A representative subset comprising 86 overburden samples was selected for geochemical testing. The overburden samples were subjected to a series of static geochemical tests. The geochemical test program was designed to assess the degree of risk from the presence and potential oxidation of sulphides, acid generation and leaching of soluble metals and salts.

After the results of the static testing were received and reviewed, sub-samples were selected for multi-element testing based on material type, location, lithology and geochemical characteristics. Sixteen overburden samples underwent multi-element testing on their solid and soluble fractions. These samples were tested for alkalinity or acidity (pH dependent), total and soluble metals and metalloids, total cations, and major anions and cations.

The assessment also included the testing of a further six samples for standard soil parameters relevant to rehabilitation success including exchangeable cations, effective cation exchange capacity, exchangeable sodium percentage, particle size distribution and Emerson aggregate testing. These parameters are indicators of salinity, sodicity, dispersivity, and fertility in rehabilitation media.

All testing was undertaken at a National Association of Testing Authorities certified laboratory in Brisbane (ALS Brisbane).

Overburden Geochemistry

The geochemical assessment has indicated that:

- 83 of the 86 overburden samples (i.e. 96.5%) are classified as Non-Acid Forming-Barren (NAF-Barren). In general, project overburden has significant excess buffering capacity and is considered to be a non-acid forming unit with significant excess acid neutralising capacity. This material has a high factor of safety with respect to potential for acid generation;
- Three samples classified as Potentially Acid Forming (PAF) were sourced at two drill holes (EL-S-MB05 and EL-S-MB06) located in a small area at the north-west end of the Southern EL. Given the highly weathered nature of the laterite, these three samples are considered to be an anomaly rather than representative of the broader geochemistry of the project site. The small proportion of PAF material would be buffered by the significant excess alkalinity of the large majority of the overburden materials found on the site, and therefore the bulk overburden material has a high factor of safety with respect to potential for acid generation;
- The concentrations of metals and metalloids in overburden are typically below applied guideline criteria for soils. The criteria used in the assessment were derived from the National Environmental Protection Council's health-based investigation levels for soils in public open spaces (NEPC, 2013). Only manganese was found to be elevated, reflecting the natural geological setting of the project;
- Overburden materials are non-sodic and despite the wet, tropical environment and therefore have a low risk of being susceptible to dispersion or erosion;
- Smectite and kaolinite clay minerals that may be sporadically present within the excavated overburden material are non-dispersive, and are not expected to present a significant materials handling issue for the project.

Limitations and Management Measures

The overburden materials were found to be stable and no specific management measures are required to manage dispersion or erosion.

There will be specific management measures for the handling and placing of overburden from the small area in the Southern EL which has been identified as containing PAF material. Management measures for this area include:

- Undertaking geochemical sampling ahead of mining in areas located within 500 m of EL-S-MB06 and EL-S-MB05 in order to identify the potential for any additional PAF material.
- Selectively handling and burying any PAF material within the centre of overburden emplacement areas away from final outer surfaces. PAF material will be placed directly within in-pit overburden emplacements, and will not be stored within temporary overburden emplacements.
- Registering any PAF material within the proponent's geological database.

In addition, samples will be collected at random from overburden emplacements and analysed on-site using net acid generation (NAG) tests as a rapid screening tool.

Dispersive clay minerals were not identified within the project site and are not expected to present significant materials handling issues. In the event that dispersive materials are encountered during earthworks, these materials will be managed by selectively handling and placing materials as backfill within the final void, thereby minimising the potential for erosion and water quality impacts. Any erosion and sediment controls would be undertaken in accordance with the measures described in Section 10 – Surface Water.

6.3.4 Rehabilitation Methods

The project site will be rehabilitated in accordance with the rehabilitation objectives and guiding principles described in Section 6.2.2. These objectives and principles are guided by legislation, the Mining Agreement for the existing mine, and internal company policies and procedures.

In general, the successful rehabilitation techniques described in Section 6.2.3 will be adopted for all rehabilitation undertaken on the project site. These include techniques in relation to landform design, placement and ripping of topsoil, and revegetation. Progressive rehabilitation will be undertaken, as shown in the indicative mine layouts provided in Section 3 – Project Description (Figure 3-12 to Figure 3-14). In addition to these general rehabilitation techniques, there are the following project-specific considerations:

- Project landform design will ensure that all quarries will be backfilled with overburden, creating a free draining landform that broadly replicates the pre-mining topography. Backfilling the quarries in this way will ensure that there will be no elevated overburden emplacements or final voids at the end of the mine life. It is much more common in the mining industry to have final landforms that include elevated overburden emplacements (i.e. free standing emplacements/stockpiles that may be tens of metres high) and final voids (i.e. deep quarries that are not backfilled and consequently accumulate water over time). The project has avoided the need for elevated overburden emplacements and final voids through careful mine planning and scheduling. The proposed post-mining landform is shown in Figure 3-15.
- In some instances there may be a small deficit or surplus of overburden. For example, in the Southern EL there is predicted to be a deficit in the amount of overburden available for backfilling quarries, leading to a slight depression in the backfilled quarries relative to pre-mining topography. In these areas the landform will be designed to be free draining, ensuring that water does not pond in the final landform. The grades in these areas will be sufficient to allow for free drainage, but gentle enough to prevent erosion and any destabilisation of the landform. Section 10 – Surface Water provides further detail.
- There will be times over the operating life of the mine where it is not feasible to place overburden directly in quarries, given a lack of available capacity at the time. In these instances, temporary overburden emplacements will be constructed and the overburden will be progressively relocated to quarries when they are available. No rehabilitation of these temporary emplacements will be undertaken, given their temporary nature. These temporary emplacements will all be located in future mining areas, meaning that there is also no need to rehabilitate the footprint of the emplacements.
- As part of the *Biodiversity Offsets Strategy* (Appendix E), the proponent will fund and coordinate a research program designed to identify ways that rehabilitation could be improved in order to provide habitat for threatened fauna species, particularly the Northern Hopping-mouse and the Brush-tailed Rabbit-rat. The rehabilitation techniques for the project may be adjusted in the future to reflect the findings of this research.

The rehabilitation monitoring program described in Section 6.2.4 will be extended to include rehabilitation within the project site. This will include monitoring of rehabilitation sites within the project site, as well as establishing any necessary additional analogue sites. The completion criteria will also be reviewed to confirm their adequacy for the project site, and amended as necessary.

6.3.5 Mine Closure and Decommissioning

According to the proponent's closure plan for the existing mine, the high level objectives for mine closure are:

- To leave the site in a safe condition;
- To create stable, non-polluting and functioning landforms that are, as far as practically achievable, consistent with the surrounding landscape and other environmental values; and
- To undertake rehabilitation that seeks to minimise environmental impacts resulting from permanent changes to ecosystems.

Detailed closure objectives for the project will be guided by these high level objectives, and will be developed through a consultative process with stakeholders, particularly the ALC.

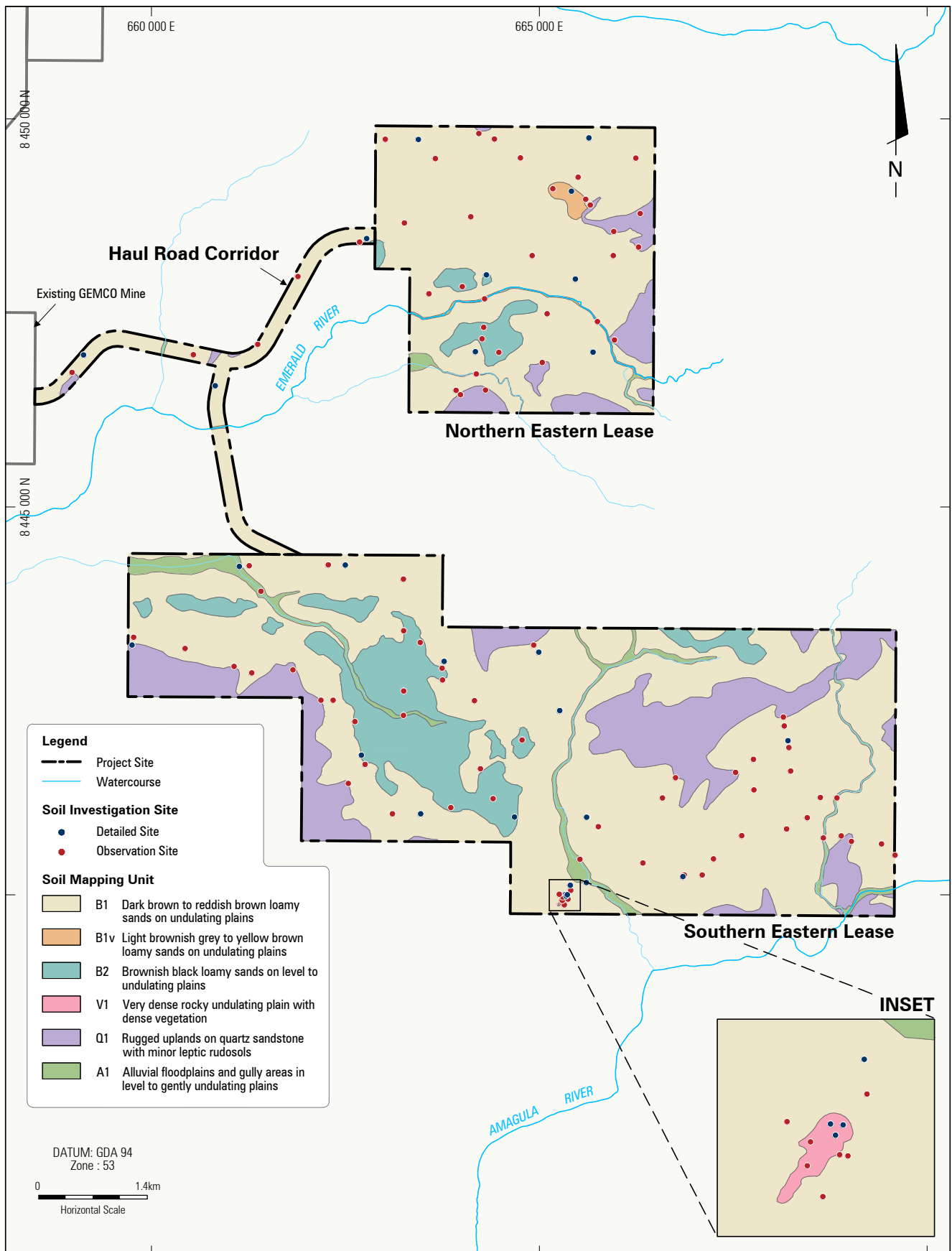
Closure objectives will be achieved by undertaking progressive rehabilitation of mining areas, as described in previous sections, as well as by decommissioning infrastructure on the project site. Infrastructure on the project site includes haul roads, crib huts and laydown yards. At mine closure, all physical infrastructure will be removed from the project site, and hardstand areas will be ripped, before being spread with topsoil and seeded (as per Section 6.3.4). Exploration drill holes will be capped and progressively rehabilitated over the mine life.

The entire project site will be rehabilitated to a sustainable ecosystem that will support traditional Aboriginal land practices, such as hunting, gathering, and recreation.

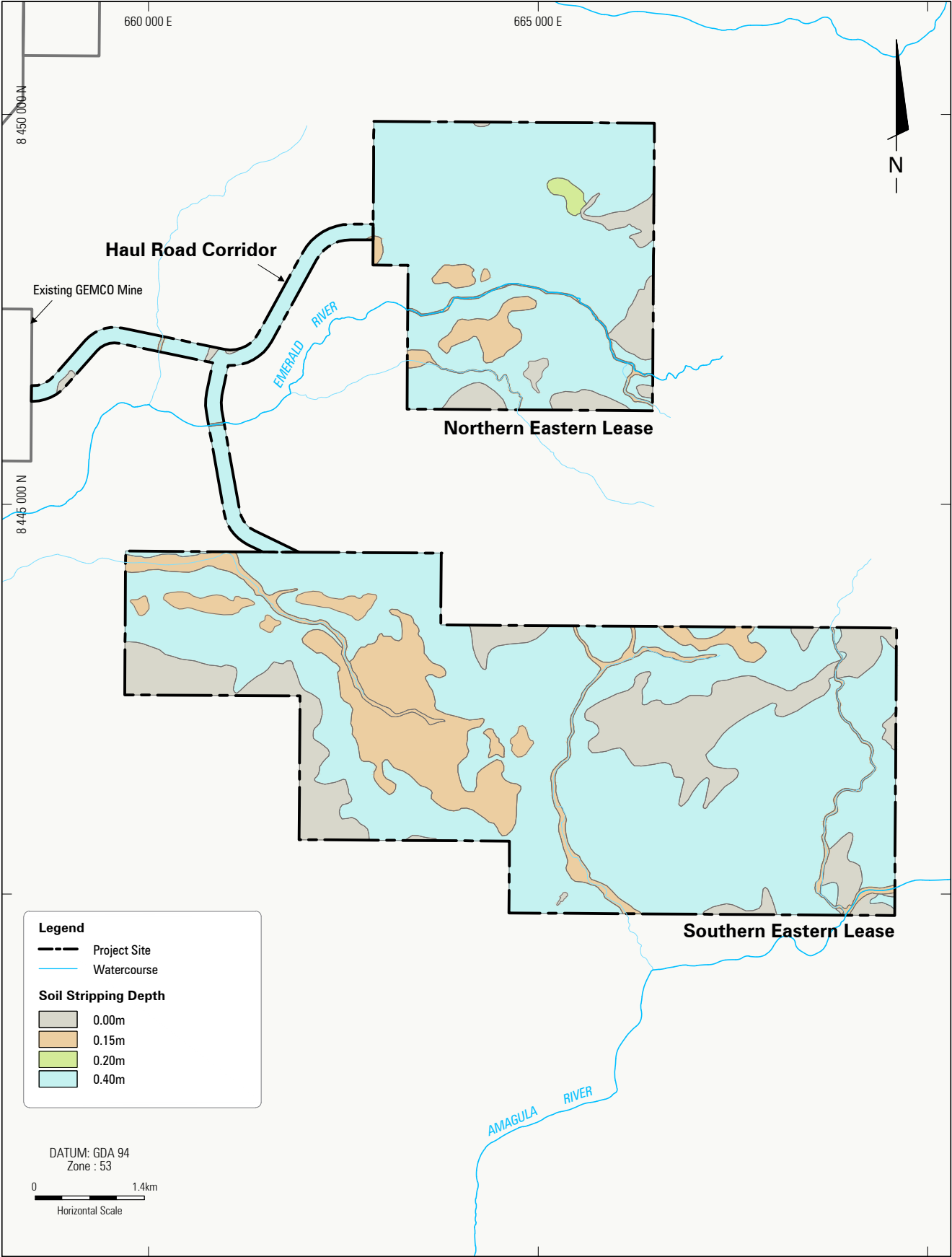
Mine closure planning includes consideration of social and economic legacy planning. The proponent is currently engaging with the ALC in relation to these issues. Further detail is provided in the *Socio-economics Report* (Appendix K).

Unplanned closure (or sudden closure) may occur when mining suddenly ceases due to financial constraints or if the operation is forced to close by regulatory agencies due to non-compliance with regulatory requirements. Given that rehabilitation will be undertaken progressively, and the project does not involve the use of levees or river diversions, there are no significant additional requirements for unplanned closure over and above those specified for planned closure. In the event of unplanned closure, mine rehabilitation would be completed and any overburden in temporary overburden emplacement areas would be used to backfill quarries.

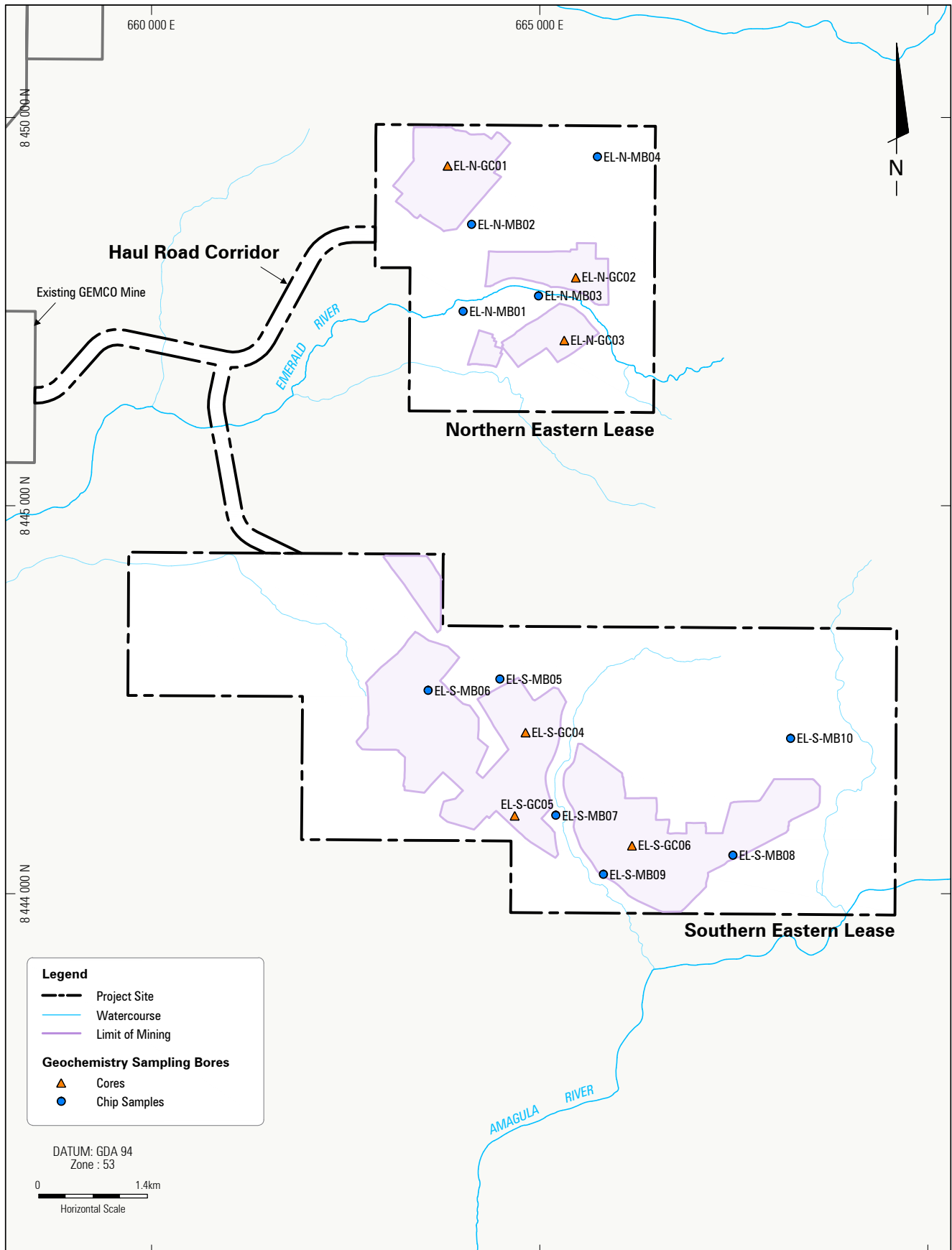
FIGURES



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PLATES



Plate 6-1 **View of 26 year-old Rehabilitation at the Existing Mine**
(Darwin Woollybutt in foreground)



Plate 6-2 Photo-point Monitoring at Rehabilitation Site VMS3

<i>Location (Figure 3-8 for location of D Quarry):</i>	<i>D Quarry</i>
<i>2011 GIS Classification:</i>	<i>5</i>
<i>Year Planted:</i>	<i>1992</i>

(Sourced from: URS 2008, 2011)



Plate 6-3

Photo-point Monitoring at Rehabilitation Site VMS22

Location (Refer Figure 3-8 for location of G Quarry):

2011 GIS Classification:

Year Planted:

G Quarry

5

2005

(Sourced from: URS 2008, 2011)