Project Description 3

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3 PROJECT DESCRIPTION

3.1 INTRODUCTION

This section describes the Eastern Leases Project (the project) including the project setting and the proposed mining activities. It also describes the existing, approved mine and the integration of the project with existing operations. This section discusses key project alternatives and provides a justification for the project.

3.2 PROJECT OVERVIEW

Groote Eylandt Mining Company Pty Ltd (GEMCO) operates a manganese mine (the existing mine) on Groote Eylandt in the NT (Figure 3-1). Operations at the existing mine involve mining manganese ore by open cut mining methods, and then sizing and washing the ore in a concentrator. The washed ore is transported from the concentrator by road train to GEMCO's port facility at Milner Bay (Figure 3-2). GEMCO currently sells approximately 5 Million tonnes per annum (Mtpa) of manganese ore to domestic and export markets. The mine has been operating for more than 50 years, with operations having first commenced in 1964.

The project will provide access to additional mining areas, located east of the existing mine. The additional mining areas comprise two exploration tenements (Exploration Licences in Retention) termed the Eastern Leases. The Eastern Leases consist of the Northern Eastern Lease (Northern EL) and the Southern Eastern Lease (Southern EL) (Figure 3-2). The project will use the same open cut mining methods used at the existing mine. Project mining areas will be connected to the existing mine via a new haul road (Figure 3-2). Manganese ore will be transported via this haul road to the existing mine for processing.

Project mining operations will take place concurrently with mining operations at the existing mine. Ore mined as part of the project will be blended with ore from the existing mine, and sold as a single product. This will allow ore to be blended in a manner that produces an optimal quality product. The project will not change GEMCO's production rate.

The project is an additional mining area that will be operated as part of the existing mine, rather than an independent mine. Where possible, the project will make use of infrastructure (e.g. concentrator, stockpiles) at the existing mine. No upgrades of this infrastructure will be required, given that the project will not increase GEMCO's overall production rate.

The project will involve 13 years of mining. It will increase the life of the existing mine by four years. The EIS refers to Project Years, rather than calendar years, with Project Year 1 being the first year of construction. The construction phase will occur for 12-18 months. Based on current planning, construction would commence in 2017, which has been termed Project Year 1. Operations would commence in the second half of Project Year 2. Project scheduling is discussed further in Section 3.7.9.

3.3 PROJECT SETTING

3.3.1 Groote Eylandt

The project site is located on Groote Eylandt in the Gulf of Carpentaria, approximately 650 km south-east of Darwin and 50 km off the Arnhem Land coast (Figure 3-1 and Figure 3-2). Groote Eylandt is Australia's third largest island, with a land area of approximately 2,285 km^2. It is part of an archipelago of islands, with other nearby islands including Bickerton Island, Connexion Island and Winchelsea Island (Figure 3-1). The Traditional Owners of the Groote Eylandt Archipelago are an amalgamation of two cultures, the Warnindilyakwa, and the Nunggubuyu (ALC, 2014). The Traditional Owners are made up of 14 clan groups, divided into two moieties, united by a common culture of kinship, ceremony and language. Both cultures speak Anindilyakwa as their first language, and the land, people and culture are also referred to by this term.

Groote Eylandt is largely undeveloped, and much of the island is still used for traditional Aboriginal practices such as hunting and gathering. The existing mine is the main development on Groote Eylandt and has been operating for more than 50 years. Further detail on the existing mine is provided in Section 3.6.

The key townships on Groote Eylandt are shown on Figure 3-1, and are as follows:

- Alyangula, which is located on the north-west of Groote Eylandt and has a population of approximately 1,000 people. Alyangula was built by the proponent and predominantly houses the existing mine workforce and their families;
- Angurugu, which is located on the western side of the island, on the Angurugu River (Figure 3-2). It has a population of approximately 850 people, the majority of whom are Anindilyakwa People. Angurugu Township is surrounded by mining tenements associated with the existing mine; and
- Umbakumba, which is located on the north-east of the island and has a population of approximately 450 people, the majority of whom are Anindilyakwa People.

There are also a number of small, rural Aboriginal settlements (termed “outstations”) on Groote Eylandt (Figure 3-2). Outstations typically have varying levels of use, from occasional visitation to sporadic residency.

The Groote Eylandt Archipelago is located within the East Arnhem Local Government Area (LGA), administered by the East Arnhem Regional Council (EARC). Figure 3-1 shows the extent of the East Arnhem LGA.

Groote Eylandt is serviced by an airport near Angurugu (Figure 3-2), with regular charter and scheduled flights from Darwin and Cairns. There are also regular barge services between Darwin, the Milner Bay Port Facility at Alyangula, and Umbakumba.

There are two main public roads on Groote Eylandt, namely the Rowell Highway and the Angurugu–Umbakumba Road (Figure 3-2). Both roads are sealed, two lane roads. The Rowell Highway extends from Alyangula to the existing mine industrial area and is primarily used by vehicles travelling between Alyangula and the mine. It is also used for the transport of washed ore from the mine to the port facility. The Rowell Highway is owned and maintained by the proponent. The Angurugu–Umbakumba Road provides access to Umbakumba from Angurugu. It is owned by the EARC, and the portion of the road that lies within the proponent’s existing mineral tenements is maintained by the proponent.

There are also various unsealed public access roads and tracks on the island that typically lead to outstations or recreation areas.

Groote Eylandt, and the surrounding marine area, has significant ecological value. Groote Eylandt and various smaller surrounding islands are considered an International Site of Conservation Significance in the Northern Territory (Harrison et al, 2009). The islands have outstanding conservation values for nesting marine turtles and colonial seabirds. In addition, the threatened terrestrial fauna species present on the island are relatively protected from key threatening processes (such as Cane Toads) that exist on the mainland. Section 7 – Terrestrial Ecology provides further detail on the ecological value of Groote Eylandt.

The Groote Eylandt Archipelago (Figure 3-1) has been declared an Indigenous Protected Area (IPA). An IPA is an area of Indigenous-owned land or sea where Traditional Owners have entered into an agreement with the Federal Government to promote biodiversity and cultural resource conservation (Department of the Environment, 2013). IPAs form part of the National Reserve System, established by the Federal Government, to conserve unique landscapes, plant and animals. The Groote Eylandt Archipelago was declared the Anindilyakwa IPA in 2006, and is administered by the Anindilyakwa Land Council (ALC). The ALC Rangers are funded by the Federal Government through the IPA. A key focus of the ALC Rangers is to ensure that the unique culture and environment of the Groote Eylandt Archipelago is conserved for future generations.

There are no declared National Parks on Groote Eylandt.

3.3.2 Project Location

The project site is located in the south-western part of Groote Eylandt. The Eastern Leases are 2 km east of the existing mine at the closest point. The township of Angurugu is located approximately 6.5 km to the north-west of the Northern EL, and is the closest permanent residential community to the project site (Figure 3-2). The township of Alyangula is located approximately 20 km north-west of the Eastern Leases.

The project site (comprising the Eastern Leases and haul road corridor) is approximately 4,600 ha.

3.3.3 Natural Features

The project site is characterised by elevated rocky outcrops and gently sloping valleys. Elevations within the project site range from approximately 10 m Australian Height Datum (AHD) to 120 m AHD. The project site is located in the catchments of the Angurugu River, Emerald River and Amagula River. The Emerald River and its tributaries drain the majority of the Northern EL (Figure 3-2). The reach of the Emerald River within the project site is ephemeral, and the river becomes perennial downstream of the project site. A small section of the Amagula River traverses the Southern EL in the south-east corner of the tenement. The section of the Amagula River within the project site is perennial. Section 10 – Surface Water describes the surface water setting and provides catchment maps.

The land within and surrounding the project site comprises natural bushland that is mainly eucalypt dominated open forest, woodland and shrubland. The most common eucalypts are Darwin Woollybutt and Darwin Stringybarks, but a wide variety of other native plants occur. Other vegetation types include swamp forest and rainforest.

3.3.4 Land Ownership and Land Tenure

Aboriginal Land Rights Act (Northern Territory)

Groote Eylandt, including the project site, is Aboriginal land under the Commonwealth *Aboriginal Land Rights (Northern Territory) Act 1976* (ALRA). The ALC is responsible for managing this Aboriginal land. The proponent will need to secure a Mining Agreement and an agreement under Section 19 of ALRA from the ALC to allow the project to proceed. Section 2 – Regulatory Framework provides further detail on ALRA.

The majority of Groote Eylandt, as Aboriginal land under ALRA, is not open to the general public. However, the ALC has nominated a number of recreation areas that can be accessed by the general public, subject to a permitting system. Figure 3-2 shows the location of recreation areas in the vicinity of the project site.

3.3.5 Land Use

Groote Eylandt

Key land uses on Groote Eylandt include the townships described in Section 3.3.1, outstations, the existing mining and exploration operations, and traditional Aboriginal cultural practices. There are also small scale eco-tourism activities on Groote Eylandt, including a resort near Alyangula.

Project Surrounds

The area surrounding the project site is used predominantly for traditional Aboriginal practices and the nearest development to the project site is the existing mine, located 2 km to the west of the Eastern Leases at the closest point (Figure 3-2). The two closest outstations to the project site are shown in Figure 3-2 and include:

- Yedikba, also known as the Emerald River Outstation – located 2.2 km to the west of the Southern EL; and
- Wurrumenbumanja, colloquially referred to as the Leske Pools Outstation – located 3.5 km to the south of the Southern EL.

Aboriginal participants in EIS consultation noted that Wurrumenbumanja Outstation is occupied sporadically by a number of Aboriginal residents, and the Yedikba Outstation is occupied more frequently. Neither outstation was occupied at the time that the EIS consultation was undertaken (i.e. mid-2014).

The Ajubukwajumanja recreation area (also known as the Leske Pools recreation area) is located directly to the south of the Southern EL (Figure 3-2). This is one of a small number of areas on Groote Eylandt accessible to the general public, subject to visitors being in possession of a permit issued by the ALC. The area is well used by non-Aboriginal residents of Groote Eylandt, as well as Aboriginal residents. The Leske Pools recreation area comprises a section of the Amagula River which is characterised by a long, shallow sandy beach and several freshwater pools. The area offers good visibility for crocodiles and is thus highly regarded for swimming. There are no facilities, such as toilets or treated drinking water, at Leske Pools and visitors are required to be self-sufficient. Alyangula residents frequent Leske Pools for day trips or overnight camping, and the Alyangula Scouts run a camping trip to Leske Pools each year. Angurugu and Umbakumba residents camp at Leske Pools frequently, sometimes for extended periods. Although the Leske Pools recreation area is directly adjacent to the project site, the section of sandy beach and the waterhole where people camp and swim is located 2.4 km to the south of the Southern EL.

The section of the Emerald River north of Yedikba Outstation and near the Emerald River Road bridge is another area popular for swimming. The Emerald River Road bridge is located downstream of the project site, approximately 2.2 km to the west of the Southern EL (by direct line) (Figure 3-2).

Enungwadena (Kings Crossing) is located on the Amagula River, upstream of the project site, and approximately 1.5 km to the east of the Southern EL. Enungwadena is not open to the general public but is used by Aboriginal residents for swimming and recreation.

Project Site

The project site comprises natural bushland, and the land is used for traditional Aboriginal practices. Advice from the ALC indicates that the project site is located within land belonging to the following five clan groups:

- Maminyamanja;
- Wurrawilya;
- Amagula;
- Wurramara; and
- Mamarika.

In addition, the Lalara clan is the Jungai (spiritual leader) for the area in which the project site is located.

Consultation with residents of Angurugu and Umbakumba (Section 5 – Consultation) indicated that the project site is frequently visited for hunting and gathering of bush foods. Wallabies are the main animal hunted in the project site, and long-necked turtles, fish and crayfish are caught in the Emerald and Amagula Rivers. Yams and mussels are also collected along the rivers. Pandanus is harvested from the project site for basket weaving, and paperbark and stringybark trees are felled to make spears. It was reported during consultation that the area along the road to Dalumba Bay provided a valuable source of green plum. Sugar bag (i.e. honey from native bee species) is collected throughout the project site.

The other key land use within the project site is the proponent's ongoing exploration activities. The proponent has been undertaking exploration drilling within the project site since 2001.

There is no infrastructure within the project site, although there are a number of unsealed tracks. These include exploration tracks developed by the proponent as part of its exploration activities. These tracks are now used more widely by Aboriginal residents of Groote Eylandt to access various parts of the project site. In addition to exploration tracks developed by the proponent, there is an unsealed 4WD access road to Dalumba Bay that traverses part of the Southern EL (Figure 3-2). This road links the western side of Groote Eylandt to Dalumba Bay on the eastern side of the island and also provides access to Enungwadena and Amagula Pools (another area used by Aboriginal residents for traditional practices and recreation).

No farming or agricultural activities are undertaken in the vicinity of the project site, nor have such activities been undertaken in the past.

The majority of land within the project site is burnt annually or biennially, typically by Traditional Owners.

3.3.6 Sensitive Receptors

The nearest sensitive receptors to the project site are provided in Table 3-1 and shown in Figure 3-2.

Table 3-1 Sensitive Receptors

NAME	EASTING (GDA94)	NORTHING (GDA94)	NEAREST DISTANCE TO PROJECT SITE
Angurugu Township	658061	8453390	6.5 km to the north-west of the Northern EL
Yedikba Outstation (also known as Emerald River Outstation)	657336	8443030	2.2 km to the west of the Southern EL
Wurrumenbumanja Outstation (also known as Leske Pools Outstation)	663633	8436591	3.5 km to the south of the Southern EL
Swimming Hole at Leske Pools Recreation Area (Ajubukwajumanja Recreation Area)	665871	8437377	2.4 km to the south of the Southern EL

Coordinates in GDA94 MGA53

3.4 MINERAL AND PETROLEUM TENEMENTS

The tenements for the project comprise two ELRs, namely ELR28161 (the Northern EL) and ELR28162 (the Southern EL) (Figure 3-3). The proponent will apply to convert these ELRs to Mineral Leases (MLs). The project's haul road will not be covered by a mineral tenement. It will be necessary for the proponent to obtain access to this land via an agreement with the ALC under Section 19 of ALRA.

Tenements in the vicinity of the project site include the MLs associated with the existing mine. These are shown on Figure 3-3 and described in Table 3-2. The proponent also holds Exploration Licence (Applications) EL2457 and EL2455, which cover the northern and southern parts of Groote Eylandt respectively (Figure 3-3).

There is also an application for a petroleum tenement (EP245) held by Paltar Petroleum Ltd over the full extent of Groote Eylandt.

Table 3-2 Mineral and Petroleum Tenements on Groote Eylandt

TENEMENT NUMBER	STATUS	EFFECTIVE DATE	HOLDER
MINERAL TENEMENTS			
Exploration Licences (EL)			
EL2455	Application	01/02/1980	GEMCO
EL2457	Revised Application	23/10/2009	GEMCO
EL27937	Application	10/02/2010	Reflective Minerals Pty Ltd

TENEMENT NUMBER	STATUS	EFFECTIVE DATE	HOLDER
Exploration Licences in Retention (ELR)			
ELR28161[1]	Granted	17/11/2010	GEMCO
ELR28162[2]	Granted	25/11/2010	GEMCO
Mineral Lease (Northern) (MLN)			
MLN2	Renew Retained	30/09/1989	GEMCO
MLN3	Granted	20/12/1984	GEMCO
MLN951	Renew Retained	21/07/2006	GEMCO
MLN952	Renew Retained	21/07/2006	GEMCO
MLN953	Reduction Retained	24/12/2009	GEMCO
MLN956	Renew Retained	30/09/2010	GEMCO
MLN957	Renew Retained	30/09/2010	GEMCO
MLN958	Renew Retained	30/09/2010	GEMCO
MLN959	Renew Retained	30/09/2010	GEMCO
MLN960	Renew Retained	30/09/2010	GEMCO
MLN961	Renew Retained	30/09/2010	GEMCO
Extractive Mineral Leases (EML)			
EML28687	Granted	16/11/2011	Gebie Civil and Construction Pty Ltd
EML28417	Granted	04/09/2012	Gebie Civil and Construction Pty Ltd
PETROLEUM TENEMENTS			
Exploration Permit (EP)			
EP245	Application	22/08/2011	Paltar Petroleum Ltd

1 This was formerly EL10115, granted 13 October 2000, and converted to ELR28161 in 2010.

2 This was formerly EL10108, granted 13 October 2000, and converted to ELR28162 in 2010.

3.5 GEOLOGY AND RESOURCE UTILISATION

The proponent has undertaken detailed geological investigations related to the project. The key geological information relevant to the EIS TOR is described in this section.

3.5.1 Exploration History

The proponent commenced geological exploration of Groote Eylandt in 1962. This involved a program of test-pitting designed to prove up the economic significance of the deposit. Following confirmation of the economic viability of the manganese resource on Groote Eylandt, an exploration camp was established at the Emerald River a year later, with an announcement that manganese mining would proceed. With the exception of short periods where little to no exploration was undertaken, exploration has been ongoing since this time until the present day.

Several exploration campaigns were undertaken during the late 1960s and 1970s to inform the early stages of the existing mine development. Early drilling campaigns predominantly used open-hole and cored drilling methods to define the stratigraphy and ore extents within existing Mineral Leases.

In 1979, the first in a series of reverse circulation drilling campaigns was undertaken. With the exception of brief interludes, this series has continued uninterrupted to the present day.

The Eastern Leases was integrated into this series of reverse circulation exploration drilling campaigns in 2001. In recent years, exploration drilling on the Eastern Leases has intensified in order to provide accurate geological data and ore definition. A total of 1,757 drill holes were completed on the Eastern Leases between 2010 and 2014. This accounted for 1,600 m of core drilling, of which 7,275 geological samples have been collected.

Exploration of the Eastern Leases is currently ongoing with the 2015 program underway to further improve knowledge on ore quality and geological conditions in the proposed mining areas. This drilling will also improve resource status and structural confidence.

Further exploration will be required over the life of the mine to provide input into life of mine planning. In-fill drilling will be required to provide additional data on ore quality as mining progresses. Reverse circulation rotary drilling will continue to be undertaken to provide information needed to support the definition of the geological block model and the development of the mine plan.

3.5.2 Regional Geology

Groote Eylandt was formed on a stable basement of Proterozoic quartzite. This basement quartzite forms extensive elevated outcrops in the centre of the island.

The Proterozoic basement was eroded and redeposited during the early Cretaceous period, forming a sandstone unit comprising reworked quartzite.

A blanket of Cretaceous marine sediments was subsequently deposited over the paleosurface of basement and reworked basement materials in the west of the island. The distribution of the Cretaceous marine sediments is generally confined to the western plains and valleys of the island. The upper Cretaceous sediments contain the manganese deposit.

Manganese has been deposited as sedimentary layers occurring between clay and sand beds. The manganese deposit is essentially stratabound and strataform in character and it represents a continuous horizon up to 11 m thick. The manganese deposit gently undulates across the western plains of the island. The manganese deposit is described in detail in Section 3.5.4.

Much of the Cretaceous sediment profile (including some of the manganese deposit) has been extensively modified by a long period of tropical weathering (or laterisation) during the Tertiary period. This has resulted in the development of thick laterite profiles up to 25 m thick.

The surface geology typically comprises lateritic deposits between outcropping (i.e. exposed) quartzite. A thin veneer of Quaternary sediment overlies the lateritic materials in localised areas.

Figure 3-4 provides a cross-section illustrating the conceptual regional geology. The regional surface geology is shown on Figure 3-5.

3.5.3 Local Stratigraphy

The geology of the project site is broadly consistent with the regional geology.

The periphery of the project site is characterised by elevated basement outcrops that form hills and escarpments. Between these hills and escarpments, the basement paleosurface is deeply incised and has been in-filled by subsequent sediment deposition resulting in low-lying topography that is characterised by gently sloping valleys within the project site. Sediment deposits are generally observed to thin out in the vicinity of basement high points and outcrops.

The indicative stratigraphy within the project site and surrounding area is shown on Figure 3-6 and is described in the following sections.

Proterozoic Basement

The Proterozoic basement is a strongly jointed, massive, quartzite. Where the basement outcrops at the surface of the project site, the quartzite exhibits weathering and a joint-controlled topographic expression. Joint sets and weathering are considered to be uniform across the upper basements.

The Proterozoic basement is estimated to be 500 m to 1,000 m thick beneath the project site and dips gently to the south at 1 to 2 degrees.

Cretaceous Sandstone

The Cretaceous sandstone comprises marine sandstone overlying reworked basement materials.

Weathering and erosion of the basement quartzite has generated a poorly sorted, fine to coarse quartz sandstone overlying the quartzite. The thickness of the reworked basement is variable and can exceed 30 m at the project site.

The base of the marine sedimentary sequence consists of a fine to medium grained quartz sandstone. The marine sandstone was deposited during a single marine transgression during the early Cretaceous period. This unit overlaps the underlying reworked basement and the Proterozoic basement. The thickness of the marine sandstone is typically less than 11 m across the project site. This marine sandstone shows very similar lithological properties to the underlying reworked basement, with the units considered visually indistinguishable during fieldwork.

Cretaceous Marine Claystone and Manganese Deposit

The upper Cretaceous sedimentary sequence comprises a marine claystone with minor interbedded sandstone and siltstone. The marine claystone is low strength and highly variable in colour, ranging from mottled red and yellow to dark green and grey. The contact between this unit and the underlying marine sandstone is gradational and represents a change in the depositional environment from nearshore to shallow marine conditions. The marine claystone varies in thickness, up to a maximum of approximately 30 m in the project site

The marine claystone unit hosts the primary manganese orebody. The manganese deposit and orebody are described in detail in Section 3.5.4.

Tertiary Lateritic Clay and Laterite

During the Tertiary period, a recession in global sea levels exposed the Cretaceous sediments to deep tropical weathering. This weathering (or laterisation) resulted in the development of a weathered (or lateritic) profile within the Cretaceous sediments. This weathering profile is up to 25 m thick in the project site.

The weathering process leached soluble ions including calcium, magnesium, sodium, and potassium from the Cretaceous sediments. This resulted in the formation of a sequence of weathered clays and other sediments that were strongly oxidised, depleted of major ions and enriched in heavy elements (such as aluminium and iron).

These weathered lateritic clays and laterite materials form the overburden of the manganese orebody at the project site.

The lower weathering profile comprises a highly weathered and uniform lateritic clay that overlies the upper marine claystone (and associated manganese orebody). The lateritic clay comprises mottled yellow to red clay, sandy clay and silt. This unit varies in thickness up to approximately 12 m within the project site.

The upper weathering profile comprises a shallow, highly weathered and heterogeneous Tertiary laterite. At the project site this laterite horizon is predominantly characterised by ferricrete (i.e. sediments which have been cemented by iron oxide, forming a hard, erosion-resistant unit). Laterite is located at or near the present day surface across much of the project site beyond the Proterozoic basement outcrops. The Tertiary laterite varies in thickness and reaches 10 m in the project site.

Quaternary Sediments

Quaternary sediments within the project site typically comprise loose fine quartz sand grading to silt. This unit forms a thin cover that ranges from a few centimetres up to 3 m thick.

3.5.4 Manganese Ore

The manganese orebody is a stratabound and strataform sedimentary layer, comprising several manganese facies (i.e. units).

Ore Genesis

The manganese ore is a sedimentary manganese oxide deposit. These manganese oxides were originally chemically precipitated in wave-affected shallow sea-floor environments and formed loose, spherical grains, called oolites (grains ≤ 2 mm in diameter) and pisolites (> 2 mm in diameter).

Subsequent to deposition, a drop in global sea levels exposed the manganese deposit. The upper profile of the exposed deposit was extensively modified by a process of laterisation (i.e. tropical weathering) and supergene enrichment. As a result, manganese oxides within the deposit underwent partial to complete remobilisation and recrystallisation that resulted in the formation of cemented pisolite and massive manganese oxides.

Mineralogy and Stratigraphy

The manganese deposit (and orebody) are broadly defined by the major sedimentary facies as follows:

- Pisolite facies – This unit comprises massive, cemented or loose pisolite and/or oolite. The pisolite facies form the main high-grade ore.
- Siliceous facies – This unit comprises siliceous massive mangite and is present as thin bands and disseminations formed from the overlying pistolite. The siliceous facies form a high-silica ore.

The mineralogy of the loose pisolite is generally characterised by pyrolusite, romanechite, todorokite, vanadates and lithiophorite. Where these have been recrystallised into cemented mangan pisolite and massive mangite the mineralogy generally comprises dense cryptomelane and pyrolusite.

Exploration data indicates that mangite comprises approximately two-thirds of the manganese ore thickness present. The remainder of the manganese profile is represented by pisolites and minor oolites. The stratigraphy of the manganese deposit is shown on Figure 3-6.

Extensive exploration work undertaken at the existing mine has identified the major ores present within the manganese deposit, and allowed definition of the mineral resource. Subsequent exploration works within the project site have confirmed that the manganese ore body extends into the project site.

The mineral resource (or orebody) comprises manganese ore greater than 1 m in thickness that is capable of producing a washed manganese product grade of 43%. This includes the high-grade pisolitic ore and high-silica ore. Figure 3-7 shows the extents of the orebody at the project site. A total of approximately 39 Mt of manganese ore is proposed to be mined over the life of the project.

3.6 EXISTING OPERATIONS

This section provides an overview of the existing mine. This section has been included in the EIS for the purpose of explaining how the project has been designed to integrate with the existing mine. The existing mine is in possession of all necessary environmental approvals and no changes to these approvals are required as a result of the project.

3.6.1 Location

The existing mine is an open cut manganese mine located on the western side of Groote Eylandt. The mining operation comprises a number of MLs covering a total area of approximately 8,500 ha (Figure 3-3). The township of Angurugu is directly adjacent to the existing mine. The township of Alyangula and the Milner Bay Port Facility are located approximately 13.5 km to the north of the mine's concentrator and mine industrial area (Figure 3-8).

3.6.2 Mining and Rehabilitation Method

Open cut mining is undertaken in a number of operating quarries. The quarries are typically mined in strips approximately 40 m wide, and 400 m to 1,500 m long. Typical quarry depth varies between 10 and 25 m.

The mining operations involve the following sequence of activities, as shown in Figure 3-9:

- Clearing vegetation using bulldozers.
- Stripping and recovering topsoil. Topsoil is stripped and pushed into windrows, before being picked up by loaders or excavators and placed into trucks. The topsoil is then either placed directly on areas that are ready for rehabilitation, or stockpiled in designated areas for later use. Further detail on topsoil management is provided in Section 6 – Mine Rehabilitation and Closure.
- Pre-stripping overburden. Overburden is excavated, using a combination of excavators, trucks and dozers, in order to gain access to the ore. This material is either temporarily stockpiled or placed directly within previously mined quarries.
- Drilling and blasting the manganese ore. The ore is drilled and blasted in order to break up the material so it can be easily handled.
- Mining ore. The ore is mined using a truck and excavator fleet, and the ore is hauled to the existing mine using haul trucks.
- Backfilling quarries following ore removal. Dozers are used to backfill quarries with overburden, and a stable and free draining landform is created.
- Topsoil replacement. Topsoil is spread over backfilled areas at an average depth of 0.3 m. The topsoil is then ripped.
- Revegetation using seeds from native tree, shrub and endemic grass species.

Rehabilitation areas are monitored for performance and any required remediation is performed. Rehabilitation is designed to restore mined land to a self-sustaining open woodland, similar to the pre-mining environment and the surrounding undisturbed land. Section 6 – Mine Rehabilitation and Closure provides further detail on rehabilitation methods at the existing mine.

3.6.3 Ore Processing

A fleet of Caterpillar 777 haul trucks and excavators is used to extract the ore and transport it to the Run of Mine (ROM) stockpile, via a network of dedicated haul roads. The ROM ore is then fed into the concentrator where it is crushed, sized and washed. No smelting of ore occurs on Groote Eylandt. The process involves the following steps:

- In an entirely mechanical process, ROM ore is screened and crushed. Two size gradings of ore are produced from this process - lump ore (a larger size fraction) and fines ore.
- The crushed ore is washed (with water) in a drum scrubber to remove clay components.

- The lump ore is fed into a rotating drum separator containing a ferrosilicon media. The ore is separated from waste materials, such as quartz and silica, based on density. The manganese ore, being denser, adheres to the ferrosilicon and sinks to the bottom of the separator, enabling it to be removed.
- The fine ore is fed into a series of cyclones which contain a ferrosilicon media. Similar to processing of the lump ore, the heavier manganese is separated from waste materials based on density.

The main reagent used in processing is milled ferrosilicon, which is a composite of iron and silicon. Ferrosilicon is used as a slurry to assist with separating out the manganese ore. It is consumed at a rate of 0.4 kg per tonne of product. Ferrosilicon is defined as non-hazardous under the hazardous chemical ratings system.

The processing of ore gives rise to tailings and middlings, as discussed in Section 3.6.5.

The concentrator was originally commissioned in 1972, and since that time has undergone various upgrades and improvements. The most recent upgrade was in 2012. The proponent carries out routine shutdown periods every two months in order to service the concentrator to ensure production targets will continue to be met, and any identified maintenance issues are resolved. The concentrator has a capacity of 5 Mtpa (wet tonnes) of washed ore/concentrate.

3.6.4 Ore Transport

Washed ore is stored in the product storage bins at the concentrator or at the concentrate product stockpile (CPS) prior to being loaded onto road trains. The washed ore is transported by road train along the Rowell Highway to the Milner Bay Port Facility (Figure 3-8). In some instances, due to the nature and quality of the ore, it is not necessary to wash it and the ore is able to bypass the concentrator and be trucked directly to the Milner Bay Port Facility.

The ore is then unloaded at the Milner Bay Port Facility and stockpiled according to grade. Depending on customer requirements, ore may be blended prior to being reclaimed and conveyed to the ship loading facility. The ore is exported to international customers as well as the Australian domestic market. Figure 3-11 is a schematic showing the existing production process.

3.6.5 Tailings and Middlings

The processing of ore at the concentrator gives rise to two types of tailings, and a coarse waste fraction known as middlings (Figure 3-11). Tailings with a particle size less than 0.1 mm are thickened to produce slimes tailings, while tailings with a particle size greater than 0.1 mm are classed as sands tailings.

Geochemical testing has been undertaken on tailings and middlings. It has confirmed that tailings and middlings typically contain low concentrations of metals (except manganese) and have negligible capacity to generate acid. Leachate from these materials is typically pH neutral and low in salinity and trace metals. A detailed assessment of the geochemistry of the tailings and middlings is provided in the *Geochemistry Report* (Appendix A).

Sands and slimes tailings are pumped from the concentrator to dedicated tailings storage facilities (TSFs) located adjacent to the mine industrial area (Figure 3-10). The current active TSFs are conventional wet facilities located over historic quarries. These facilities are designed in accordance with the Australian National Committee on Large Dams (ANCOLD) guidelines. They are operated and monitored under the existing approved Mining Management Plan. The proponent maintains an extensive groundwater and surface water monitoring network to ensure that no adverse environmental impacts arise from the storage of tailings.

The proponent operates a life of asset planning process that includes ongoing evaluation of existing tailings management strategies and procedures. This includes TSF construction and design principles, water management and ongoing monitoring. This planning process ensures that sufficient capacity is available to meet tailings storage requirements associated with ongoing and future mine production, whilst ensuring that tailings are stored and managed with no significant adverse environmental impacts. As part of this process, the proponent is currently undertaking a tailings optimisation assessment, which will consider various future tailings management options over the life of the operations.

Middlings from the concentrator are hauled by truck to a designated storage area located opposite the ROM stockpiles (Figure 3-10). Middlings are then used as road base construction material or as stemming in blasting.

3.6.6 Infrastructure and Utilities

Key infrastructure associated with the existing mine includes administration buildings, warehousing, maintenance workshop facilities, fuel storage, and mine water storages (Figure 3-10).

Electricity is sourced from a diesel power station located on the Rowell Highway near the Milner Bay Port Facility (Figure 3-8). This power station also generates power for Alyangula, Angurugu and a number of outstations and off-lease businesses.

Water supplies for the existing mine include the re-use of mine-affected waters, as well as water extracted from the Angurugu River and bore fields. Mine-affected water includes water captured in quarries and decanted water from the TSFs. Water is abstracted from the Angurugu River from an abstraction point adjacent to Angurugu township. Potable water for the mine is supplied from a water treatment plant located adjacent to the Angurugu River abstraction point.

3.7 EASTERN LEASES PROJECT

3.7.1 Proposed Mining Activities

Figure 3-12 to Figure 3-14 show the proposed quarries, overburden emplacement areas and haul roads at representative points during the project life, namely Project Year 3, Project Year 9 and Project Year 13. Figure 3-15 shows the final landform following the cessation of mining and the completion of rehabilitation. As shown in these figures, the Northern EL is proposed to be developed first, with development of the Southern EL commencing several years later. Both areas will then be mined concurrently from approximately Project Year 7. Further detail on project scheduling is provided in Section 3.7.9.

The project will make use of the same open cut mining methods that are currently used at the existing mine and are described in Section 3.6.2. The overburden depth within the project site is up to 25 m, with an ore thickness of up to 5 m. Similar to the existing mine, mining strips will be up to approximately 1,500 m long and 40 m wide.

Rehabilitation methods will also be similar to those used at the existing mine, with further detail provided in Section 6 – Mine Rehabilitation and Closure. Overburden will ultimately be placed in mined quarries ensuring that there will be no final voids and no elevated overburden emplacement areas at the end of the mine life. There are, however, instances over the operating life of the project where it is not feasible to directly place overburden in mined quarries, given a lack of available capacity at the time. In these instances temporary out-of-pit overburden emplacements will be constructed. Overburden will be progressively relocated to completed quarries when they are available. This approach, which involves rehandling of material, has been adopted to limit the disturbance footprint of the project. Figure 3-12 to Figure 3-14 show the location of temporary overburden emplacement areas during various stages of the project life. These temporary emplacements will be designed to have a maximum height of 15 m and an external batter slope of 10% (equivalent to 6°).

Table 3-3 shows annual ROM ore and overburden production from the project. The ore produced by the project will supplement production from the existing mine.

Table 3-3 Annual Ore and Overburden Production for the Project (Million Dry Tonnes)

PROJECT YEAR:	1	2	3	4	5	6	7	8
Overburden	0.0	1.7	8.3	10.4	7.5	4.7	6.8	7.5
ROM Ore	0.0	1.3	2.7	2.5	1.5	1.7	2.9	3.0

PROJECT YEAR:	9	10	11	12	13	14	15
Overburden	7.5	12.1	6.7	12.6	20.4	24.5	4.9
ROM Ore	4.2	5.1	2.2	3.6	4.8	3.9	0.0

The pre-stripping ratio (i.e. the ratio between overburden and ore) is 4:1 compared to 4.5:1 at the existing mine.

3.7.2 Equipment Fleet

The project will utilise the equipment fleet from the existing mine. Equipment likely to be used within the project site includes:

- Excavators;
- Loaders;
- Haul Trucks;
- Drill Rig/s;
- Dozers;
- Grader;
- Water Cart; and
- Mobile refuelling truck.

3.7.3 Ore Processing and Transport

Figure 3-11 is a conceptual process flow sheet showing the mining, transport and processing of ore from the project.

Ore from the project site will be transported to the existing mine, using trucks that will travel along project haul roads. The ore will be transported to the existing ROM stockpiles located at the mine industrial area (Figure 3-10). Stockpiled ore from the project will typically be blended with ore from the existing mine at the ROM stockpiles. Blended ROM ore will be crushed and conveyed into the concentrator for washing. No upgrades to the concentrator, stockpiles or any other infrastructure within the existing mine are required for the project. The design life of the concentrator is sufficient for the additional four years of production that will result from the project. No smelting of ore occurs on Groote Eylandt.

Washed ore in the form of a lump and fines product will be transported via road train to the existing Milner Bay Port Facility (Figure 3-8) for shipping to export and domestic markets. The washed ore may be temporarily stockpiled at the CPS located within the mine industrial area before being transported to Milner Bay. No changes to the road transport of ore or port facilities are required as a result of the project. These facilities are described further in Section 3.6.3.

3.7.4 Tailings and Middlings

Manganese ore generated by the project will be washed in the existing concentrator. As described in Section 3.6.4, this process generates tailings (sands and slimes) and middlings. Tailings and middlings handling and storage methods are described in the existing Mining Management Plan and summarised in Section 3.6.5. This system involves storing the tailings in dedicated TSFs, and stockpiling the middlings for reuse as construction material or for ongoing road maintenance. The current system for managing tailings and middlings will be extended to include tailings and middlings from the project.

Tailings generated over the life of the project will continue to be pumped via pipeline to the active TSFs at the existing mine. The total volume of tailings generated by the project is estimated to be 17 Mt (dry). The annual tailings generated will range from approximately 0.5 Mt in Project Year 2 to approximately 2.2 Mt in Project Year 13. Sands and slimes will each constitute approximately 50% of the tailings generated by the project. The life of project tailings will have a settled storage volume of approximately 12.7 Mm^3. The proponent's existing life of asset planning process (discussed in Section 3.6.5) will ensure that the available tailings storage capacity at the existing mine will be adequate for life of project tailings storage requirements.

Middlings generated by the concentrator over the life of the project will continue to be trucked to the existing middlings stockpile. The total volume of middlings generated by the project is estimated to be approximately 1.2 Mt (0.9 Mm^3), and ranges from 0.03 Mm^3 to 0.1 Mm^3 per annum over the life of the project. The designated stockpile area and storage capacity is more than adequate for the temporary storage of middlings over the life of the project. Similar to middlings generated by the existing mine, middlings from the project will be used as road base materials for the construction of the haul road or as stemming in blasting.

Geochemical characterisation of tailings and middlings was undertaken as part of the EIS and the results are presented in the *Geochemistry Report* (Appendix A). The tailings and middlings generated by the project have been assessed as being geochemically similar to those generated by the existing mine. These materials are expected to be non-acid forming, and generate runoff and seepage exhibiting neutral pH, low salinity and low concentrations of metals. The existing storage and handling strategies for these waste streams are therefore appropriate for the nature of these materials.

3.7.5 Infrastructure and Utilities

Project Infrastructure

The project is an additional mining area that will be operated as part of the existing mine, rather than an independent mine. Where possible, the project will make use of infrastructure (e.g. concentrator, stockpiles) at the existing mine. Consequently, there is very limited infrastructure required to be constructed within the project site. Infrastructure proposed for the project includes:

- Dams and associated water fill points. A single dam in the Northern EL and two dams in the Southern EL (Figure 3-14) will be constructed. Further detail on dams and the water management strategy is provided in Section 10 – Surface Water.
- A crib hut in each of the Northern EL and the Southern EL. The crib huts will be small demountable structures providing basic staff facilities (i.e. potable water, ablution facilities, dining area and kitchenette).
- Separate light and heavy vehicle parking areas, adjacent to the crib huts. These also include areas for basic servicing of vehicles and equipment.
- Temporary laydown storage areas.

A network of haul roads will be constructed within the project site to provide access to the mining areas. Haul roads will be unsealed and designed to be used by mine vehicles only. Haul roads will have a compacted base of laterite and middlings. There are a number of locations where culverts will be constructed to allow haul roads to cross watercourses. Section 10 – Surface Water provides details on the indicative location of the culverts and the conceptual design of the watercourse crossings. The vegetation that will be cleared for the construction of the haul roads will be stockpiled on the project site and burnt.

Erosion and sediment controls will be constructed over the life of the project. These controls will include collection drains and sediment dams to capture runoff from disturbed areas, and diversion drains to divert overland flow away from disturbed areas. Erosion and sediment controls will also be installed as part of haul road construction. Erosion and sediment controls are described in Section 10 – Surface Water.

The total project disturbance footprint, which includes areas disturbed by mining and the construction of haul roads and infrastructure is approximately 1,525 ha. This equates to approximately one third of the total area of the project site. As shown in Figure 3-15, the full extent of the project disturbance footprint will ultimately be rehabilitated.

Once all necessary approvals have been obtained for the project, the proponent will commence the detailed design phase of the project. Detailed specifications will be developed for all project-related infrastructure during this stage.

Project Utilities

Electricity and Diesel

There is no fixed or permanent electricity supply to the project site and all power will be produced using diesel generators.

Diesel generators will be located at the crib huts, pump dewatering locations and also at areas where floodlighting is required for night work. Diesel for the project will be stored at the fuel storage facilities located at the existing mine (Figure 3-10). No upgrades to the diesel storage facilities at the existing mine are required as a result of the project, as the project will not increase annual diesel demand of the existing mine. Diesel for the project will be transported to the project site using mobile refuelling trucks. No permanent bulk storages for diesel are proposed to be constructed in the project site, and any on-site storage of diesel will be limited to small scale portable containers.

Water

As detailed in Section 10 – Surface Water, the project will maximise the reuse of quarry water to meet the project dust suppression demands. Any additional water supply requirements will be sourced from the mine-affected water stored at the existing mine. Potable water for the project will be supplied from the existing water treatment plant in Angurugu. The existing water treatment plant has sufficient capacity to supply the project’s potable water requirements. Potable water will be transported to the project site by tanker, as required, and stored in accordance with relevant standards and regulatory requirements.

Communications

Communication on the project site will be via UHF radio and satellite phone. Radio communications between the project site and the existing mine will be provided via a receiver aerial tower located on the project site.

Sewage Facilities

Portable ablution facilities will be used on the project site, and no sewage treatment facilities are proposed to be constructed. Sewage waste will be collected and transported to the sewage treatment facilities at the existing mine for treatment and disposal.

Project Consumables

Consumables and materials required to be used within the project site are detailed in Table 3-4. They include the total consumables to be used during construction (i.e. for the two construction phases), as well as annual quantities of consumables to be used during operations. It should be noted that the annual consumables required for the operations phase are not additional to annual consumables used at the existing mine, given that the project will not change GEMCO’s production rate or the amount of ore being mined annually.

Table 3-4 Estimated Quantities of Consumables Required over the Life of the Project

CONSUMABLE / MATERIAL	AVERAGE ANNUAL VOLUME / QUANTITY	
	Construction (Total)	Operations Phase (Annual)
Diesel fuel	6,755 KL	9,220 KL
Hydraulic Oils	100 KL	250 KL
Grease / Lubricants	5,000 kg	15,000 kg
Vehicle Batteries	50 units	100 units
Oil filters	2,000 kg	10,000 kg
Air filters	150 units	250 units
Steel	60 t	-
Concrete	1,500 m^3	-
Polyethylene Pipe (HDPE)	20,000 m	-
Corrugated metal pipe	2,300 m	-
Road base – Middlings	250,000 m^3	Quantities based on maintenance requirements
Road base – Laterite	520,000 m^3	
Explosives – ANFO	-	450 t
Explosives – Detonators	-	250 boxes
Tyres	150 units	250 units

Transportation of consumables and materials to the project site is discussed in Section 3.9.

3.7.6 Mine Planning

The project site is considered to be environmentally and culturally sensitive. Limiting the potential impacts of the project, both during mining and post-mining, was therefore an important principle of project design.

Mine closure planning was a key consideration in the project planning process. The project design ensures that there will be no residual disturbance associated with the project. 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.

Project planning has also been cognisant of the environmental and cultural values of the watercourses on the project site. As noted in Section 3.3.3, the Emerald and Amagula Rivers traverse the project site. The project has been designed to ensure that mining will not encroach on these watercourses or their tributaries. Buffers have been defined around these watercourses and there will be no mining within the defined buffers. The buffers were delineated by the 1% Annual Exceedence Probability (1 in 100 year) flood extents. Section 10 – Surface Water provides detail on the flood modelling that was undertaken to delineate the buffers. The buffers have been designed to allow mining to take place in a manner that avoids disturbance of the main channels of the watercourses and limits any interference with surface water flows. As a result of this approach to mine planning, no river diversions or levees are required for the project. Figure 3-7 shows the proposed quarries in relation to the ore body and watercourses, indicating the extent of the ore body that has been excluded from mining due to environmental and cultural considerations.

The location of the manganese ore deposit, and presence of cultural heritage sites, also means that no mining of the rocky outcrops on the project site is proposed. Rocky outcrops, in addition to providing habitat to a number of fauna species, contain significant archaeological sites including rock shelters with art (Section 16 – Archaeology). The proposed mine plan ensures that there will be no disturbance of these areas.

3.7.7 Operating Hours

Construction and mining activities will take place 24 hours per day, 7 days per week. Mining will be undertaken on a campaign basis and consequently may not take place all year round. A decision on the duration of mining at the project site will be made on a year by year basis, influenced by mining conditions within the project site and the existing mine, as well as ore quality and market considerations. Weather conditions can also affect mine scheduling. Studies such as the air quality assessment and noise assessment (*Air Quality Report* – Appendix I, and *Noise Report* – Appendix J) have assessed the project at peak operating conditions, which may only be experienced for a few weeks of each year. These studies and the resulting impact predictions are therefore highly conservative.

3.7.8 Construction Activities

As noted in Section 3.7.5, there is very limited infrastructure to be constructed within the project site. Construction activities are therefore limited to earthmoving activities associated with the construction of:

- Haul roads, including 8 km of haul roads linking the Eastern Leases and the boundary of the existing mine;
- An overpass at the haul road intersection with the Emerald River Road (Section 3.9.6);
- Culverts where haul roads cross watercourses;
- Truck parking areas, laydown yards and crib huts; and
- Dams.

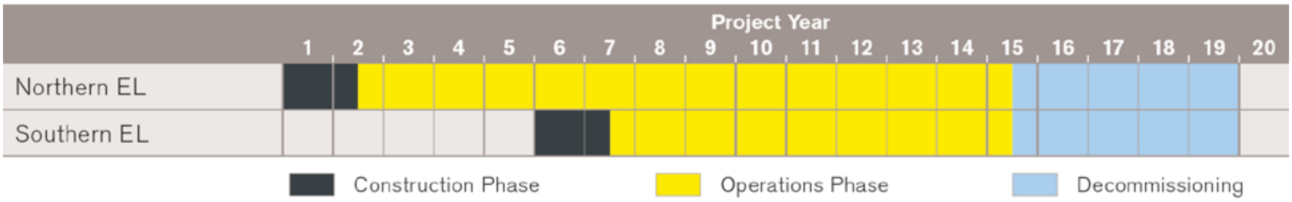
Construction will be undertaken using standard engineering techniques and involve the use of mobile equipment, including but not limited to dozers, scrapers, loaders, haul trucks, graders, compactors and water carts. Erosion and sediment controls will be constructed as an integral part of construction activities, as described in Section 10 – Surface Water.

Material for the construction of haul roads will be sourced from within the haul road corridors. Middlings will also be used for the construction of haul roads and will be sourced from the existing mine. Materials for the construction of the mine water dams will be sourced from the dam footprints and/or active mining areas. All borrow pits required for the project will be located within the disturbance footprint of the project.

3.7.9 Project Development Schedule

Diagram 3-1 provides the key milestones in the proposed project development schedule. These timelines have the potential to change as project development may be influenced by factors such as global commodity prices and activities within the existing mine. The timing of the commencement of construction is also subject to the receipt of environmental approvals, Mineral Leases, and a Mining Agreement under ALRA.

Diagram 3-1 Project Mining Schedule



Two construction phases are proposed for the project. Construction in the Northern EL is anticipated to occur over a maximum period of 12-18 months in Project Years 1 and 2. This takes account of potential external influences such as the wet season and associated mobilisation / demobilisation of people and equipment. Construction in the Northern EL would include construction of the main haul road linking the Northern EL with the existing mine, as well as construction of dams, crib huts etc. Construction in the Southern EL is scheduled to occur in Project Years 6 and 7.

Mining operations in the Northern EL are scheduled to commence in the second half of Project Year 2. Mining operations are scheduled to commence in the Southern EL in Project Year 7. Mining operations will continue until Project Year 15. This equates to a total of 13 years of operational mine life (i.e. mining of ore).

The project will extend the life of the existing mine by four years. Without the project, the existing mine would cease operations in approximately 2027 (Project Year 11).

A decommissioning phase will be undertaken in Project Years 16-19, after mining operations have concluded.

3.8 WORKFORCE AND ACCOMMODATION

The following sections provide an overview of workforce and accommodation arrangements. Further detail is provided in Section 15 – Socio-economics and the *Socio-economics Report* (Appendix K).

3.8.1 Existing Mine

The existing mine is forecast to have a workforce of approximately 835 people in 2018 when the project is scheduled to commence operations. The majority of the existing mine workforce (approximately 66%) is a non-resident workforce, employed on a fly-in fly-out (FIFO) basis. Accommodation for the non-resident workforce is provided in a number of accommodation villages owned by the proponent. There is currently a surplus of approximately 100 accommodation rooms available in the employee villages. The majority of the resident workforce lives in Alyangula in accommodation supplied by the proponent. A small proportion of the resident workforce lives in Angurugu and Umbakumba.

3.8.2 Project Construction Phase

As discussed in Section 3.7.9, it is anticipated there will be two construction phases for the project which correspond with the timing to access and develop the Northern EL and Southern EL, respectively. Both of these phases will require a construction workforce of around 90 people over a period of 12-18 months.

The project construction workforce will be employed primarily as non-resident workers on a FIFO roster arrangement because of the short-term nature of the construction phases. As discussed above, there is sufficient capacity within the proponent's existing accommodation arrangements for the 90 person construction workforce required for the project.

A small percentage of the construction workforce will also include resident employees, responsible for the overall management and supervision of the project and its contractors. Rosters for the project construction workforce will be consistent with rosters for the existing operations.

3.8.3 Project Operations Phase

The project operations workforce will be drawn from the workforce at the existing mine, and there will be no net increase in the size of GEMCO's workforce. The project will not change the existing FIFO split, rostering or accommodation arrangements for this workforce. No additional accommodation will be required to be constructed or obtained. Although the project will not increase the size of the existing workforce, it will extend the life of the existing mine by four years, providing employment for 835 people for an additional four years.

3.8.4 Project Decommissioning Phase

A four-year decommissioning phase will be undertaken in Project Years 16-19, after mining operations have ceased. The peak decommissioning workforce will be approximately 50 people in Project Years 16, 17 and 18. This workforce will be sourced from the existing mine workforce or specialist contractors experienced in decommissioning or mine closure.

3.9 TRAFFIC AND TRANSPORTATION

3.9.1 Road Network

Roads within proximity to the project site include:

- The Rowell Highway, a sealed, two lane road extending from Alyangula to the existing mine industrial area. It is used is primarily used by vehicles travelling between Alyangula and the mine (Figure 3-2). It is also used for hauling washed ore from the existing mine to the port facility. This road is owned and maintained by the proponent.
- The Emerald River Road, an unsealed road that provides access to the southern part of Groote Eylandt, including a number of outstations and recreation areas (Figure 3-16). The EARC own this road, but the proponent is responsible for maintaining the section of this road that lies within the proponent's existing mineral tenements.
- An unsealed track that comes off the Emerald River Road and provides access to Dalumba Bay. This track traverses the Southern EL (Figure 3-16). This road is owned by the EARC. When the Mineral Leases for the project are granted, the proponent will become responsible for maintaining the section of this road that lies within the project site.

3.9.2 Site Access

The project site will be accessed from the existing mine via the project haul road corridor (Figure 3-16). No additional light vehicle access will be provided as the site will only be accessed by mine employees working within the project site.

3.9.3 Transportation on Public Access Roads

This section provides a description of project related traffic on public access roads. The only public access road that will be used is the Rowell Highway, a road owned and maintained by the proponent.

Employee Transportation

Construction Phase

The project will require an additional 90 employees over a 12-18 month period for the two construction phases. The majority of the workforce will reside in accommodation villages. These workers will use the existing bus services that the proponent provides for its workforce to travel between the accommodation villages and the existing mine. The bus services travel along the Rowell Highway. The additional employees may necessitate a small number of additional bus movements per day (approximately four), as well as a small number of light vehicle movements (approximately 40). Given the small number of vehicle movements and the limited duration of the construction period, no significant impacts on the road pavement or level or service of the Rowell Highway are predicted. In addition, it should be noted that the proponent owns and maintains the Rowell Highway.

The current scheduling of chartered flights to and from the mainland is sufficient to cater for the additional FIFO employees required for the construction phase of the project. Additional flights can be chartered by the proponent, in the event this is necessary. There are currently charter flights between Darwin and Groote Eylandt, and Cairns and Groote Eylandt. Commercial flights operate between Groote Eylandt and Darwin, and Groote Eylandt and Gove/Cairns.

Operations Phase

As there will be no additional workforce required for the operations phase of the project, there will be no change to or increase in workforce transportation requirements.

Materials Transportation

Construction Materials and Consumables

Table 3-4 provides estimated quantities of materials to be used during construction. These include general consumables, as well as construction materials such as concrete, steel, piping etc. Materials are currently kept within designated stores on the existing mine, and would be transported to the project site when required, via the mine haul roads (as described in Section 3.9.4).

Materials, if not already available from the existing stores, will be delivered from the mainland. Materials for the existing mine typically arrive on the island at the Milner Bay Port Facility via the weekly scheduled barge service from Darwin, which is run by a private freighting agency. The materials will then be transported by road to the mine via the Rowell Highway. Logistical arrangements will be made by the proponent to ensure that any materials required for the project can be transported to site using the existing barge service.

The project will make use of the light and heavy vehicles that currently collect materials and equipment from the barge and transport them to the designated stores on the existing mine. Over the course of the construction phases of the project, it is estimated that an additional 16 heavy vehicle movements per day on the Rowell Highway may be required for the delivery and movement of construction materials. No significant impacts on the road pavement or level or service of the road are predicted, given the small number of additional vehicle movements and the limited duration of the construction period.

Operations Phase

The project will not change GEMCO's production rate, and the amount of ore being mined annually. The total volume of freight being transported to the existing mine will therefore not change. Similarly, the project will not increase vehicle or ship movements associated with the transportation of manganese ore.

3.9.4 Transportation on Mine Haul Roads

This section describes transportation of personnel and materials between the existing mine and the project site. Transportation will be via the project haul road, which will connect the project site to the existing mine. There will be no public access to the haul road.

Employee Transportation

During the construction phases, employees will travel from the existing mine to the project site in a mine compliant bus that will travel along the project haul road. During the operations phase, employees will travel to the project site in 4WD vehicles.

Materials Transportation

The following materials will be transported from the existing mine to the project site:

- Construction materials such as concrete, steel piping (as described in Section 3.9.3). These materials will be transported from the existing mine along the project haul road. Table 3-4 provides an estimate of the quantities of construction materials that will be required.
- Middlings for use as road base material. Table 3-4 provides an estimate of quantities to be transported during construction.
- Diesel for the project will be stored at the fuel storage facilities located at the existing mine (Figure 3-10) and transported to the project site using a mobile refuelling truck. Quantities of diesel to be transported are provided in Table 3-4. The refuelling truck will utilise haul roads, and will not travel on public access roads or tracks.
- Explosives will be stored at designated, secured facilities at the existing mine and transported to the project site as required. The frequency will be determined based on mining conditions. Quantities of explosives to be transported are provided in Table 3-4. The explosives will be transported in a vehicle licensed to carry dangerous goods.
- Larger mining equipment such as tracked dozers or excavators will be transported to the project site from the existing mine using a float. The equipment to be used on the project site is listed in Section 3.7.2. As noted in this section, the equipment will be sourced from the equipment fleet at the existing mine.

3.9.5 Relocation of Unsealed Road to Dalumba Bay

A section of the public access road leading to Dalumba Bay traverses part of the Southern EL (Figure 3-16). This road comprises an unsealed track, suitable only for 4WD vehicles. It is owned by the EARC. It is used sporadically by Traditional Owners to access Kings Crossing, or areas near Dalumba Bay on the east coast of the island.

Part of this track is located in areas proposed to be mined by the project. The track will therefore need to be relocated to avoid the mine and ensure the safety of those who utilise the track. Figure 3-16 shows the proposed realignment of the track. The relocation works will include the grading of the alternative alignment, and installation of appropriate signage. The proponent will consult with the EARC and the ALC in relation to the proposed relocation.

3.9.6 Emerald River Road Overpass

The Emerald River Road is an unsealed public access track, used by locals and Traditional Owners to travel to recreation areas (such as Leske Pools) or outstations. The Emerald River Road is owned by the EARC. The project haul road will run from the Eastern Leases, cross the Emerald River Road, and then enter the existing mine site adjacent to D-Quarry (Figure 3-16). At the intersection of the haul road and the Emerald River Road, the haul road will be constructed as an overpass, ensuring that the project will not affect the users of Emerald River Road. The proponent will consult with the EARC and the ALC in relation to the design of the overpass, and will obtain any necessary approvals from these agencies prior to its construction. Figure 3-16 shows the location of the proposed overpass.

3.10 PROJECT ALTERNATIVES AND JUSTIFICATION

3.10.1 Project Alternatives

Introduction

The aspects of the project where alternatives were considered during project planning include:

- Alternative manganese resources;
- Alternative mine plans;
- Alternatives with respect to final voids and locations for overburden emplacement;
- Alternative haul road corridors;
- Alternative mine scheduling;
- Alternative processing options;
- Alternatives with respect to mine water management; and
- Alternatives relevant to Matters of National Environmental Significance (MNES).

There are no feasible alternatives with respect to the mining method (i.e. use of underground mining rather than open cut mining) given the general stratigraphy and shallow nature of the ore deposit.

A summary of the alternatives that were selected is provided in Table 3-5, with further detail provided in the remainder of this section.

Table 3-5 Summary of Project Alternatives

PROJECT ASPECT	PREFERENCE	ALTERNATIVE
Resource	Eastern Leases	Tenements that are not as well progressed (EL2457 and EL2455)
Mine Plans	Forgoing the resource beneath the Emerald and Amagula Rivers, and delineating environmental buffers around the rivers to protect them	Mining the full resource beneath the Emerald and Amagula Rivers by diverting the rivers and mining the river channels
		Mining a portion of the resource beneath the Emerald and Amagula Rivers by constructing levees adjacent to the main channels
Final Voids and Elevated Overburden Emplacements	Planning and scheduling mining in a manner that avoids the need for final voids or elevated overburden emplacement areas at the end of the mine life	Standard mining techniques designed to limit overburden haulage distances and rehandling of material, resulting in final voids and elevated overburden emplacement areas at the end of the mine life
Haul Road Alignments	Preferred haul road alignment minimising environmental disturbance	Alternative haul road alignments
Processing Arrangements	Stockpiling and processing ore at the existing mine	Stockpiling and processing ore at the project site
Water Management	Storage of excess mine-affected water, and reuse during times of water deficit	Routine discharge of excess mine-affected water to watercourses

Alternative Resources

The proponent has been operating the existing mine for more than 50 years and is seeking an alternative resource to extend the life of this mine. The Eastern Leases are the only resource, beyond the existing mine, that the proponent could feasibly access within the short to medium term. The Eastern Leases are current exploration tenements and are covered by an existing Exploration Agreement with the ALC. Significant exploration work has been undertaken in the Eastern Leases to date, and the proponent is well advanced in its discussions with the ALC in relation to obtaining a Mining Agreement for the project.

As detailed in Section 3.4, the proponent has applications for two additional exploration tenements (EL2457 and EL2455) on Groote Eylandt. These exploration tenements are only at application stage and the process for granting them may be extended, given their location on Aboriginal land and the requirement to obtain an Exploration Agreement with the ALC for the tenements. No exploration work has therefore been undertaken in these areas and the Eastern Leases comprise the proponent's key resource for future development.

Alternative Mine Plans

The project is located in the headwaters of the Emerald River and Amagula River, both of which are sensitive from an environmental and cultural perspective. The project mine plan has been designed to avoid potential impacts on the rivers, by incorporating buffers around the watercourses into the project mine plan. Although the manganese ore body extends beneath these rivers, the proponent is not proposing to mine the resource beneath the river. Alternative mining options, which would have increased resource utilisation but increased the project's environmental impacts, include:

- Mining the full resource beneath the Emerald River and Amagula River by mining the river channels. This option would be technically feasible by diverting the rivers through backfilled overburden areas and constructing flood protection levees to protect mining operations. The option, although allowing for maximum resource recovery, was not pursued due to environmental and cultural considerations.
- Mining a portion of the resource beneath the Emerald River and Amagula River by constructing levees directly adjacent to the main channels of the rivers, rather than leaving a buffer around rivers. This would have effectively created an engineered river channel. It would have allowed extraction of a portion of the resource beneath the rivers, but had the potential to result in environmental impacts during major flood events.

Figure 3-7 shows the extent of the manganese ore body on the project site in relation to the proposed quarries and the watercourses. It illustrates the extent to which mine planning has been constrained by the location of watercourses. Section 19 – Environmental Management Plan describes management measures that are proposed to ensure that the mining within the project site will be undertaken in a manner that minimises environmental impacts.

Final Voids and Elevated Overburden Emplacements

As detailed in Sections 3.7.1 and 3.7.6, the mine plan and mine schedule have been designed to ensure that all overburden will ultimately be placed in mined quarries, creating a final landform that is similar to the pre-mining landform. It is much more common in the mining industry to have final landforms that include elevated overburden emplacements and final voids. The project has avoided the need for elevated overburden emplacements and final voids through:

- Careful mine planning and scheduling;
- A suitable material balance (i.e. the quarries generally have sufficient capacity for the overburden that will be generated by the project); and
- Rehandling of overburden. As noted in Section 3.7.1, temporary out-of-pit overburden emplacements will be created to store overburden at times during the mine life when there are no available completed quarries. The overburden will then be progressively relocated to quarries when they are available. There are significant economic costs associated with rehandling overburden in this way, but as detailed below there are also significant environmental advantages. It is noted that, in order to further reduce the disturbance footprint of the project, all temporary out-of-pit overburden emplacements are proposed to be located in areas that will

subsequently be mined. Alternative locations beyond the mining footprint were considered, and had economic and technical advantages in some cases. However, these alternative locations were not selected as they would have increased the project's disturbance footprint.

There are many environmental advantages associated with this approach, compared to the elevated overburden emplacements and final voids that are more common in the mining industry. These advantages include:

- Improving conditions for mine rehabilitation. Elevated overburden emplacements, particularly ones that are steep sided, may have issues with erosion, topsoil retention and vegetation establishment. These issues are significantly reduced for the proposed project landform.
- Benefits for flora and fauna due to the high standard of the rehabilitation and revegetation that is achievable for the proposed project landform.
- Reduced erosion due to the gentle grades and the ability to achieve a high standard of rehabilitation. Reduced erosion also leads to reduced potential for sedimentation of watercourses.
- Reduced disturbance footprint by placing overburden in mined quarries, rather than creating permanent out-of-pit emplacements. Limiting the disturbance footprint in this way reduces the area of vegetation to be cleared, which has benefits for flora and fauna.
- Limiting any impacts on visual amenity due to the ability to create and rehabilitate a landform that is similar to the pre-mining landform;
- Environmental benefits specifically associated with the lack of final voids, including:
  - Avoiding potential impacts on groundwater in the post-mining phase due to final voids. Avoiding the potential loss of groundwater due to evaporation from final voids will improve the probability of a full recovery of groundwater levels post-mining, similar to pre-mining groundwater levels. Section 9 – Groundwater provides further detail on post-mining recovery of groundwater levels.
  - A full recovery of groundwater levels post-mining, as described above, will limit any loss of groundwater baseflow to the watercourses on the project site. It will also limit impacts on ecosystems that are associated with groundwater. These issues are discussed in Section 10 – Surface Water and Section 7 – Terrestrial Ecology.
  - Creating a free-draining post-mining landform, which will ensure that there is no loss of downstream catchment yield.

Alternative Haul Road Alignments

Various alignments for the haul road corridor were proposed and assessed based on the following key design factors and considerations:

- Grade;
- Horizontal alignment;
- Minimum footprint of disturbance;
- Minimum number of watercourse crossings;
- Physical and hydraulic nature of watercourse crossings;
- Requirement for cut and fill earthworks;
- Proximity to areas of cultural or environmental sensitivity;
- Minimum interaction with public access roads;
- Source and availability of suitable geotechnically competent road base materials;
- Capital investment for developing the roads;

- Operational costs for maintaining and using the roads (e.g. grading of roads, fuel for haul trucks); and
- Overall haul distance.

The proponent undertook a multi-criteria analysis workshop and assessed potential haul road corridor options against the above criteria to select the preferred haul road alignment. The selected alignment was influenced by economics, productivity, water management, health, safety, environment and community issues.

Alternative Mine Scheduling

A number of alternatives were considered with respect to the scheduling of the project. The current schedule assumes that the project would operate concurrently with the existing mine and ore from the project would supplement ore mined at the existing mine. An alternative would be for the project to only be developed once mining at the existing mine has ceased. Ore from the project would then replace ore from the existing mine, rather than supplement it. This alternative scenario would mean that ore from the project site would be mined at a higher rate and over a shorter timeframe than what is proposed in the EIS. This scheduling arrangement would not alter the overall disturbance footprint of the project, and would not significantly change the majority of the environmental impacts associated with the project (e.g. impacts on flora and fauna or surface water). However, it may increase the severity of impacts such as noise and dust, which are influenced by the rate of mining. One of the reasons that this alternative is not being pursued is because current planning, influenced by market specifications, indicates that it is desirable to blend ore from the Eastern Leases with ore from the existing mine in order to produce a product of the required quality.

Alternative Processing Arrangements

The alternative of stockpiling and processing ore within the project site, rather than transporting it to the existing mine, was investigated. This included sizing and washing ore at a new facility on the project site. This alternative was not, however, economically viable because of the costs of constructing new infrastructure on the project site, particularly given the relatively small volume of ore to be mined as part of the project. Constructing new infrastructure in the project site (rather than using existing mine infrastructure) would also significantly increase the disturbance footprint and associated environmental impacts of the project.

Alternatives for Mine Water Management

Water balance modelling has indicated that there are likely to be times during the project life when there will be a surplus of mine-affected water (i.e. runoff captured in the quarries). This will particularly occur during the wet season, when significant rainfall occurs and there is limited use of water within the project site for dust suppression. The following two alternatives for this surplus water were considered:

- Storage of excess mine-affected water, and reuse during times of water deficit; or
- Routine discharge of excess mine-affected water to watercourses on the project site.

The proponent has selected the former option in order to avoid any potential for actual or perceived impacts on watercourses, given that the watercourses on the project site have both environmental and cultural values. There are significant costs associated with this option as it will be necessary to ensure that there are water storages (e.g. dams or quarry voids) with capacity to contain all surplus water predicted to be generated. The volume of mine-affected water predicted to be generated was determined by long term water balance modelling over a 124 year period, as detailed in Section 10 – Surface Water.

Although no routine discharges of mine affected water are proposed, the proponent will request that discharge conditions are included in the Authorisation under the *Mining Management Act*. These discharge conditions are intended as a contingency measure only and the potential discharge water quality limits will be designed to ensure that discharges will not impact downstream water quality or aquatic environments. The proposed discharge water quality limits are discussed in Section 10 – Surface Water.

Alternatives Relevant to Matters of National Environmental Significance

As noted in Section 2 – Regulatory Framework, the project requires assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1991* (EPBC Act) due to the potential for significant impacts on threatened species and communities, and migratory species. A number of the alternatives described in the preceding sections can limit the extent, severity and duration of potential impacts on MNES, as follows:

- The selected mine plan limits the project disturbance footprint as far as possible, limiting clearing of habitat for threatened species, including species listed under the EPBC Act.
- The selected mine plan allows for the post-mining landform to broadly recreate the pre-mining topography and landform. This will enhance the potential for high quality rehabilitation to be achieved, including creating habitat for threatened species in rehabilitated areas.
- The selected mine plan includes buffers around watercourses and limits potential impacts on watercourses. Watercourses provide resources and habitat for a number of threatened species.
- The selected mine water management strategy does not involve any routine discharge of mine-affected water. This ensures that there will be no downstream impacts on watercourses or the downstream estuary areas (and associated threatened species).

3.10.2 Project Justification

The proponent's justification for the project is:

- It involves a responsible mine plan that considers environmental constraints, and incorporates appropriate control measures to limit any adverse environmental and social impacts to an acceptable level;
- It maximises the responsible utilisation of the manganese resource; and
- It will result in significant economic benefits for the local area and the NT.

The key economic benefits of the project include:

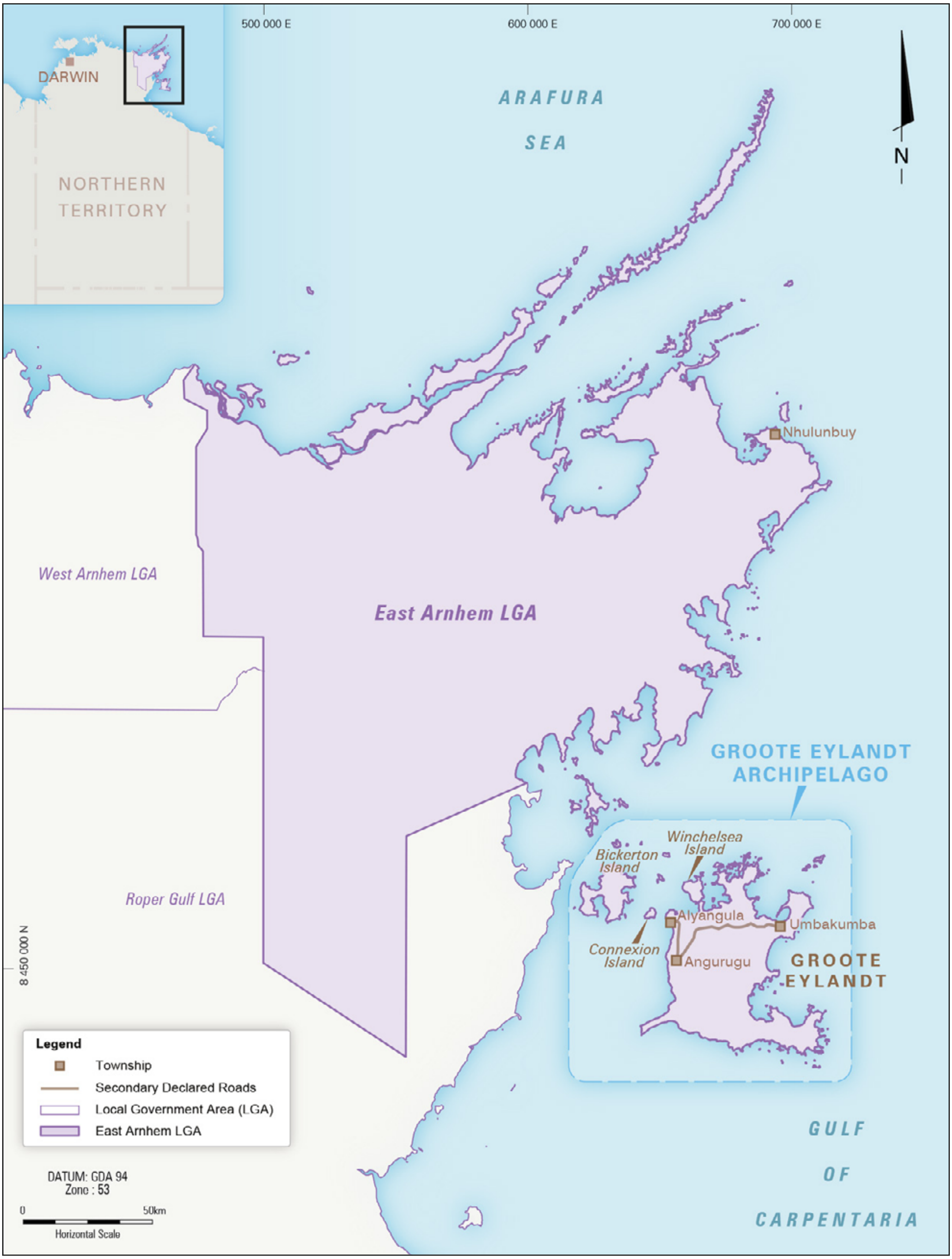
- Capital expenditure in the NT of approximately $160 million during the project construction phase;
- Four additional years of operations, which will result in an additional four years of:
  - Operational expenditure on Groote Eylandt of approximately $1.9 million per year;
  - Royalty payments to the ALC, Traditional Owners and NT Government; and
  - Tax payments to the Federal Government of approximately $100 million per year for each additional year.

3.10.3 Consequences of Not Proceeding with the Project

The consequences of the project not proceeding are:

- The opportunity to mine approximately 39 million tonnes of high quality manganese ore (over the life of the project) would be lost;
- The opportunities provided by the project to maintain and develop Australia's market share in high quality manganese would be lost;
- The additional royalty charges and government levies associated with the project would be lost;
- The contribution of the project to the NT's economy would not eventuate;
- Extending the operation of the existing mine life by a further four years would be lost, thereby losing a further four years of employment for the existing workforce;
- The project's environmental impacts specified in this EIS would not eventuate; and
- The significant socio-economic benefits associated with the development of the project would be forgone, including significant economic benefits to the Traditional Owners through statutory and indirect royalty payments.

FIGURES



EASTERN LEASES PROJECT

Local Government Areas and Groote Eylandt Archipelago

FIGURE 3-1

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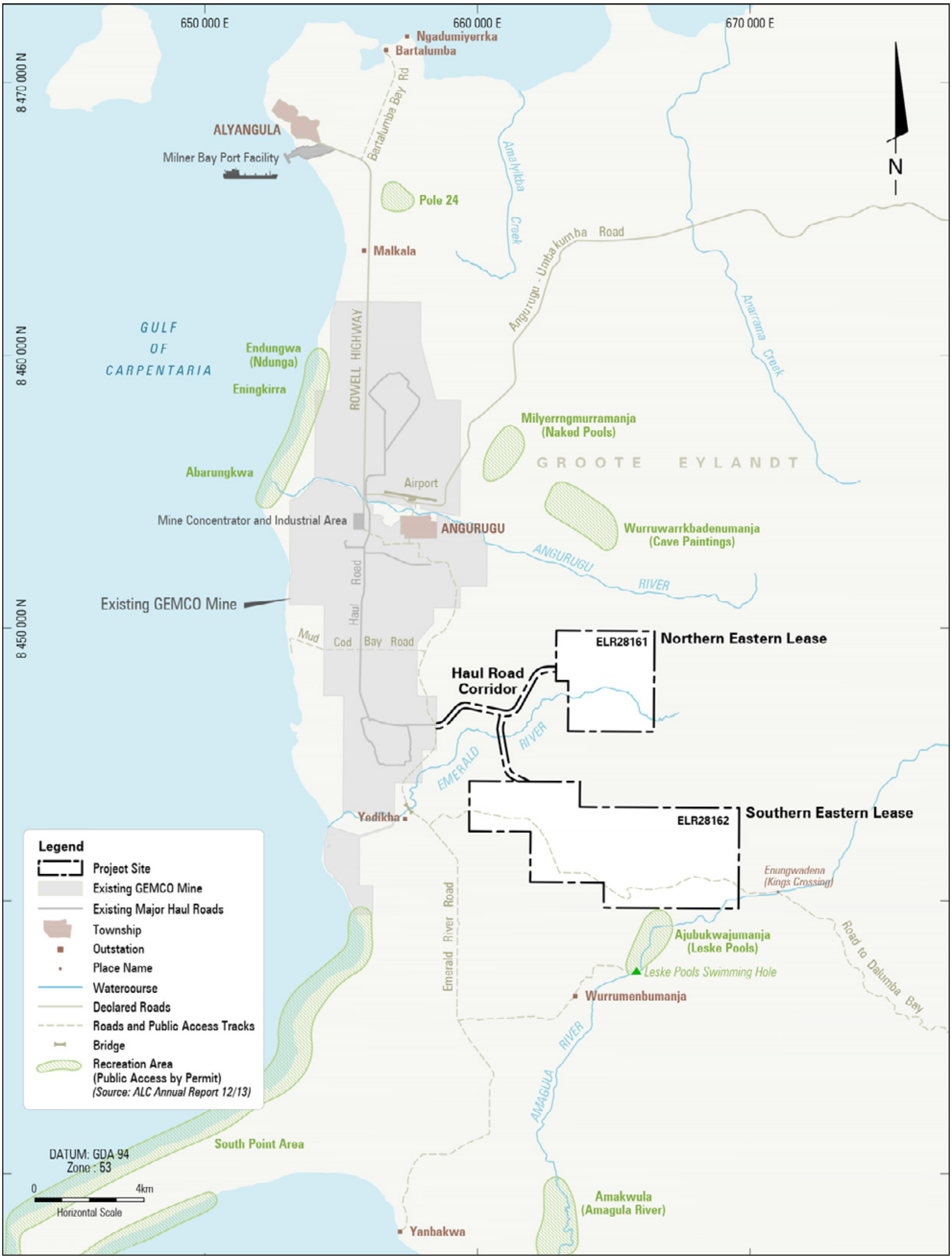

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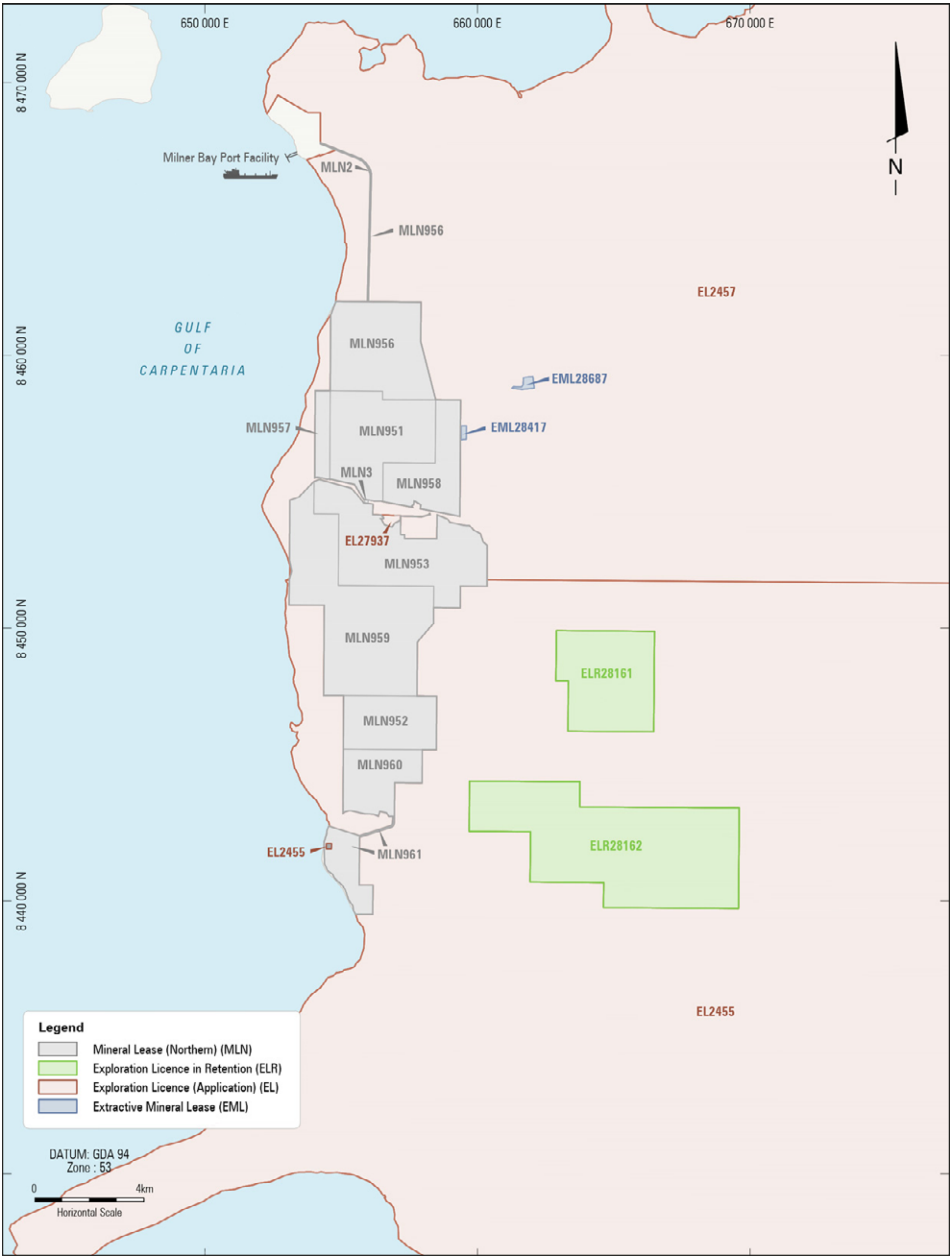
Local Setting

FIGURE 3-2



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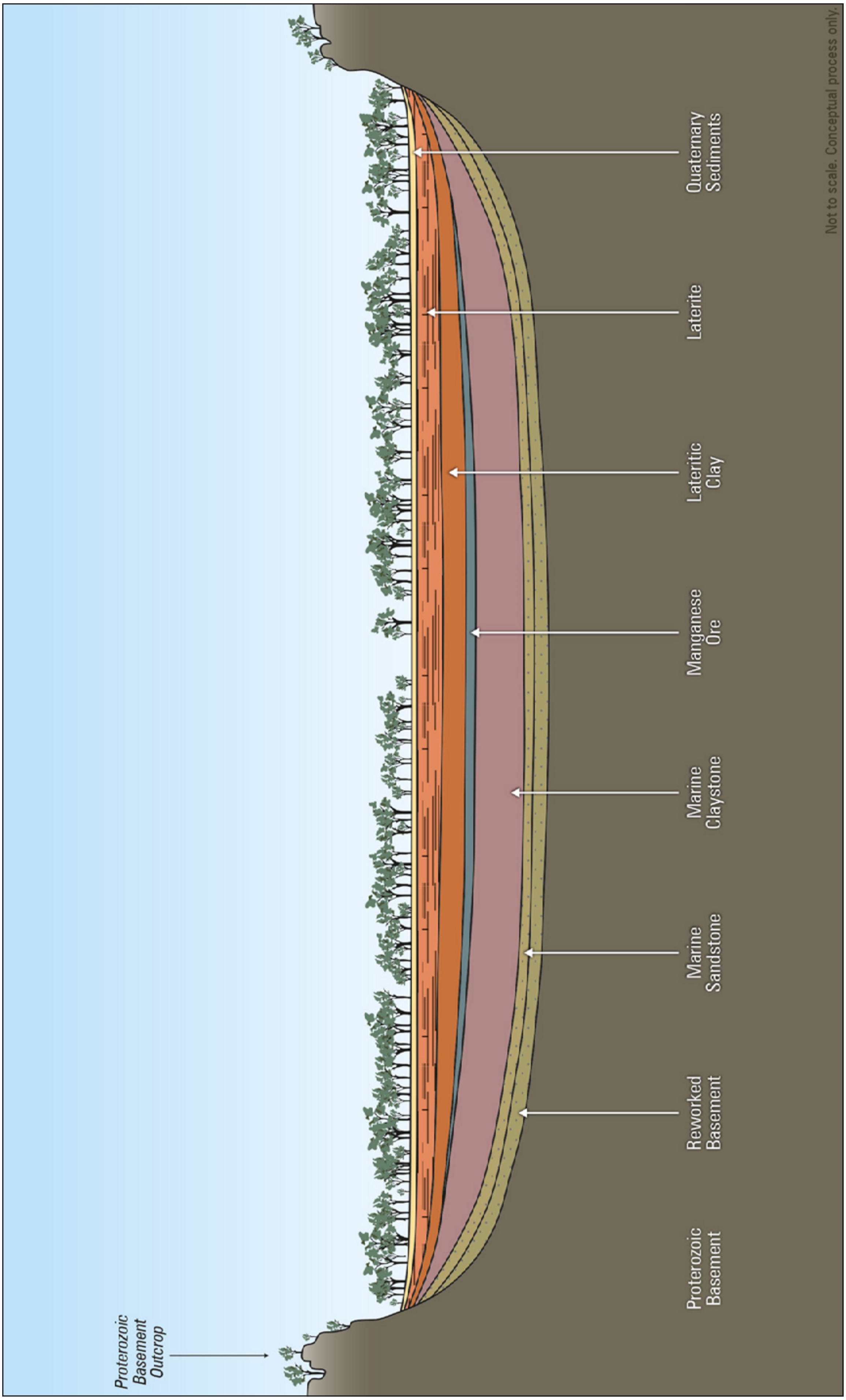
Mineral Tenements

FIGURE 3-3



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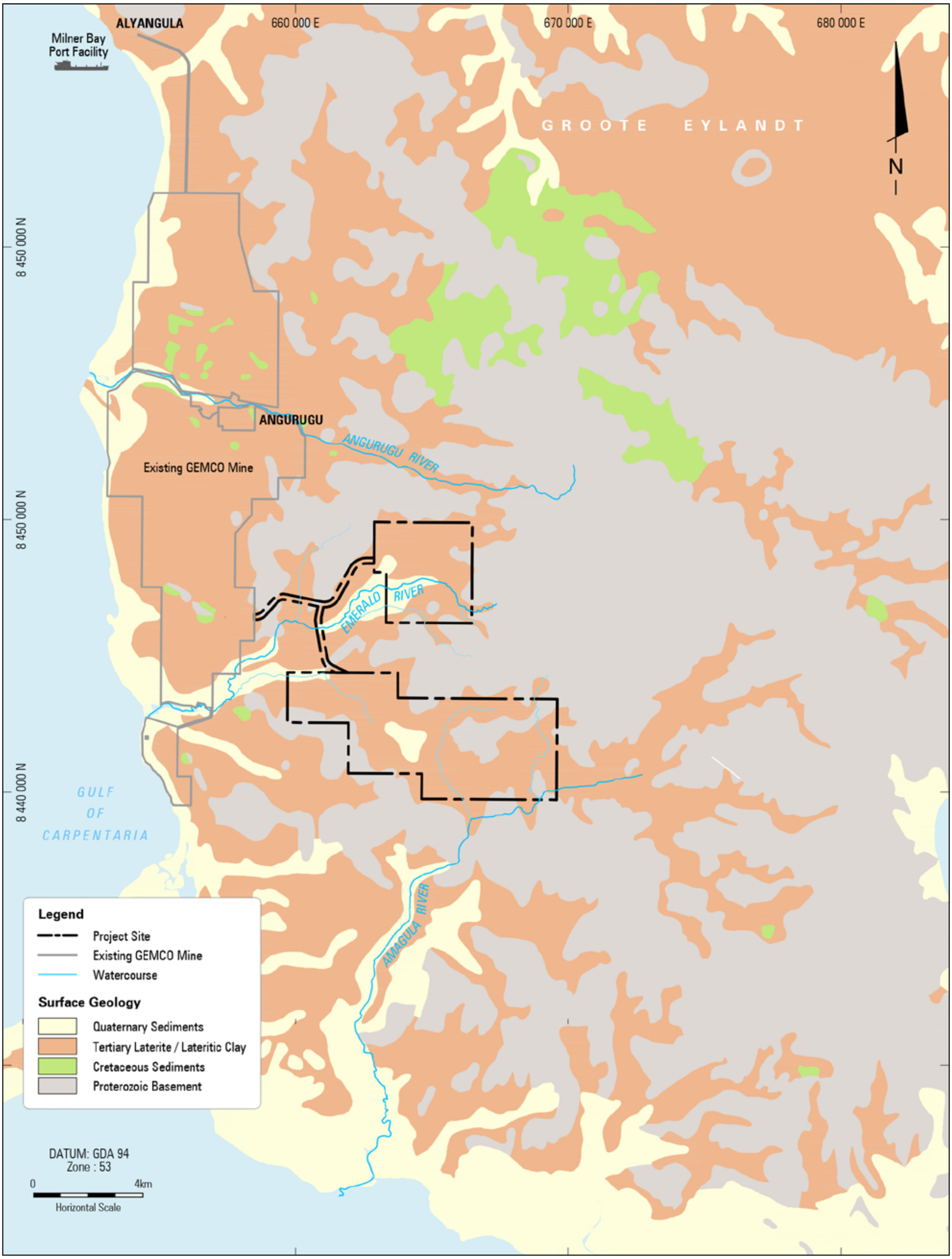
Conceptual Regional Geology Cross-Section

FIGURE 3-4



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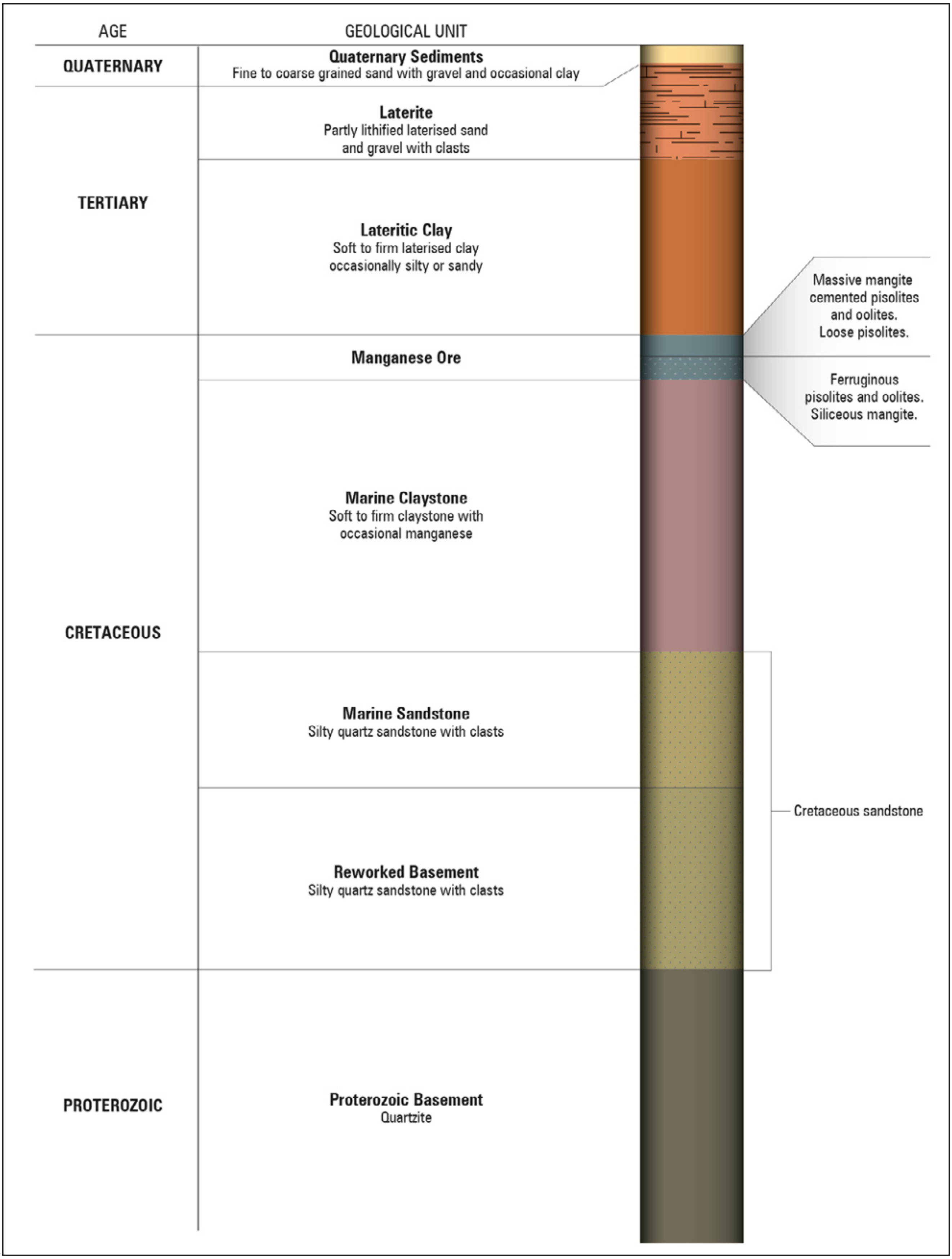
Surface Geology

FIGURE 3-5



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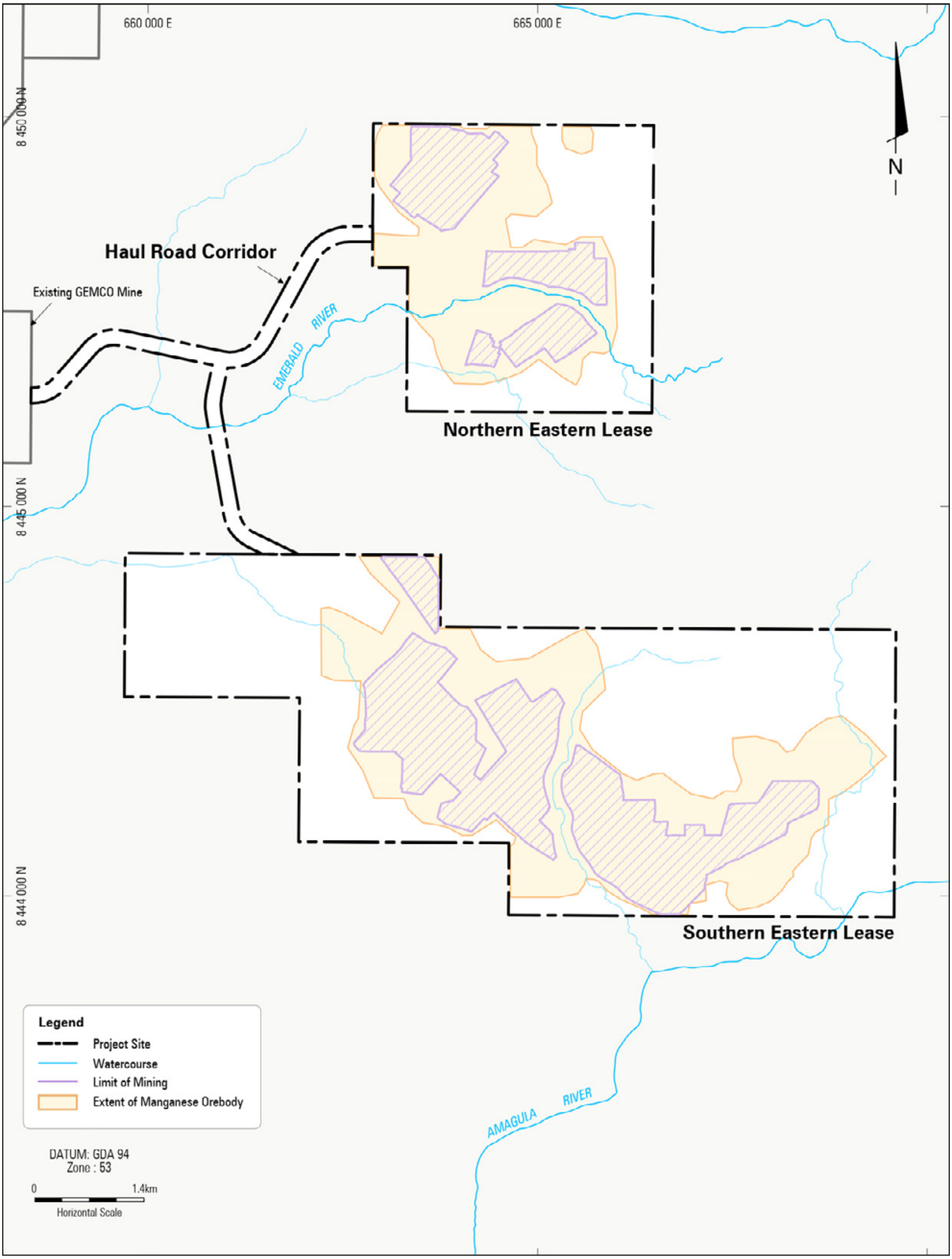
Indicative Stratigraphy of the Project Site

FIGURE 3-6



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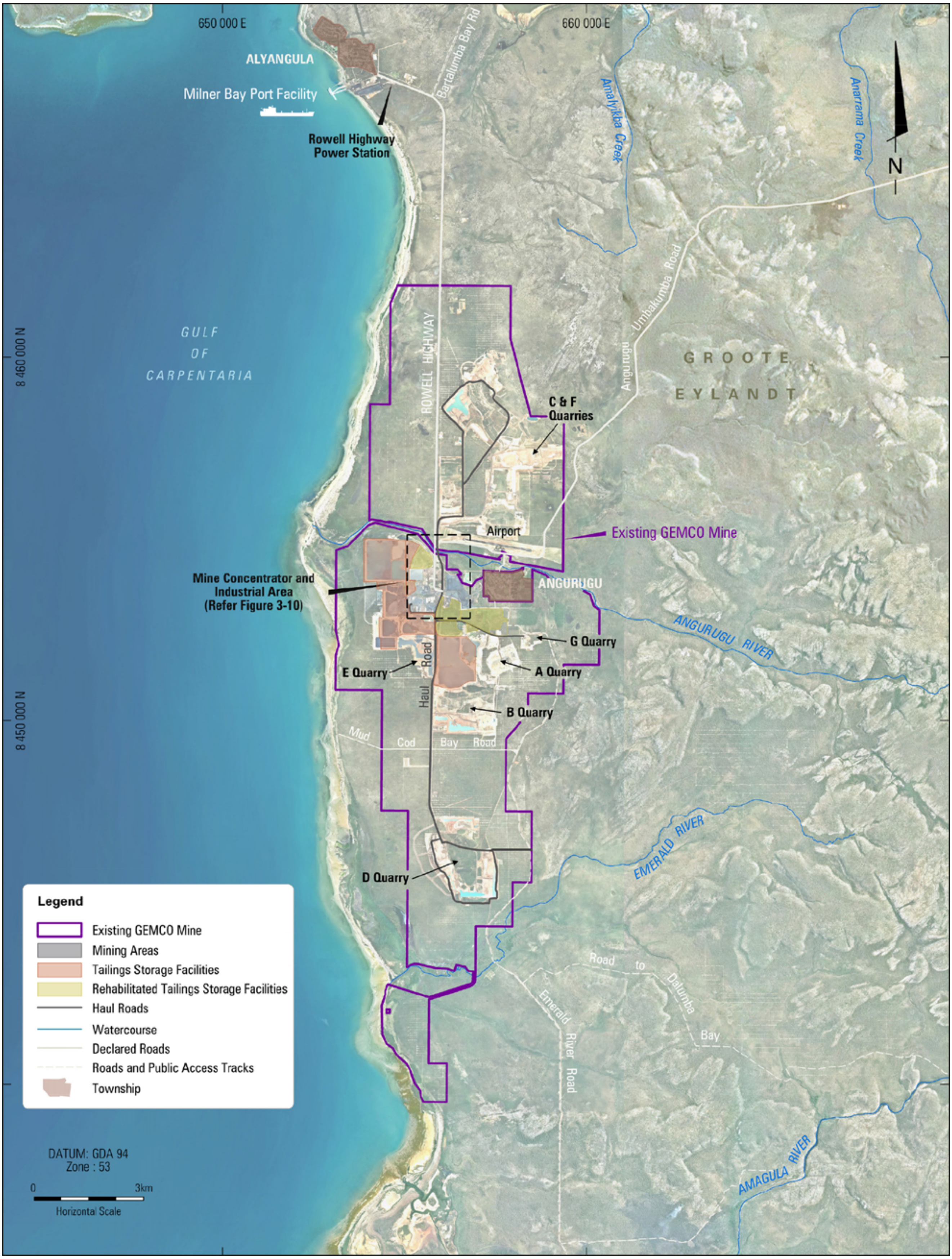
Manganese Orebody Extent within the Project Site

FIGURE 3-7



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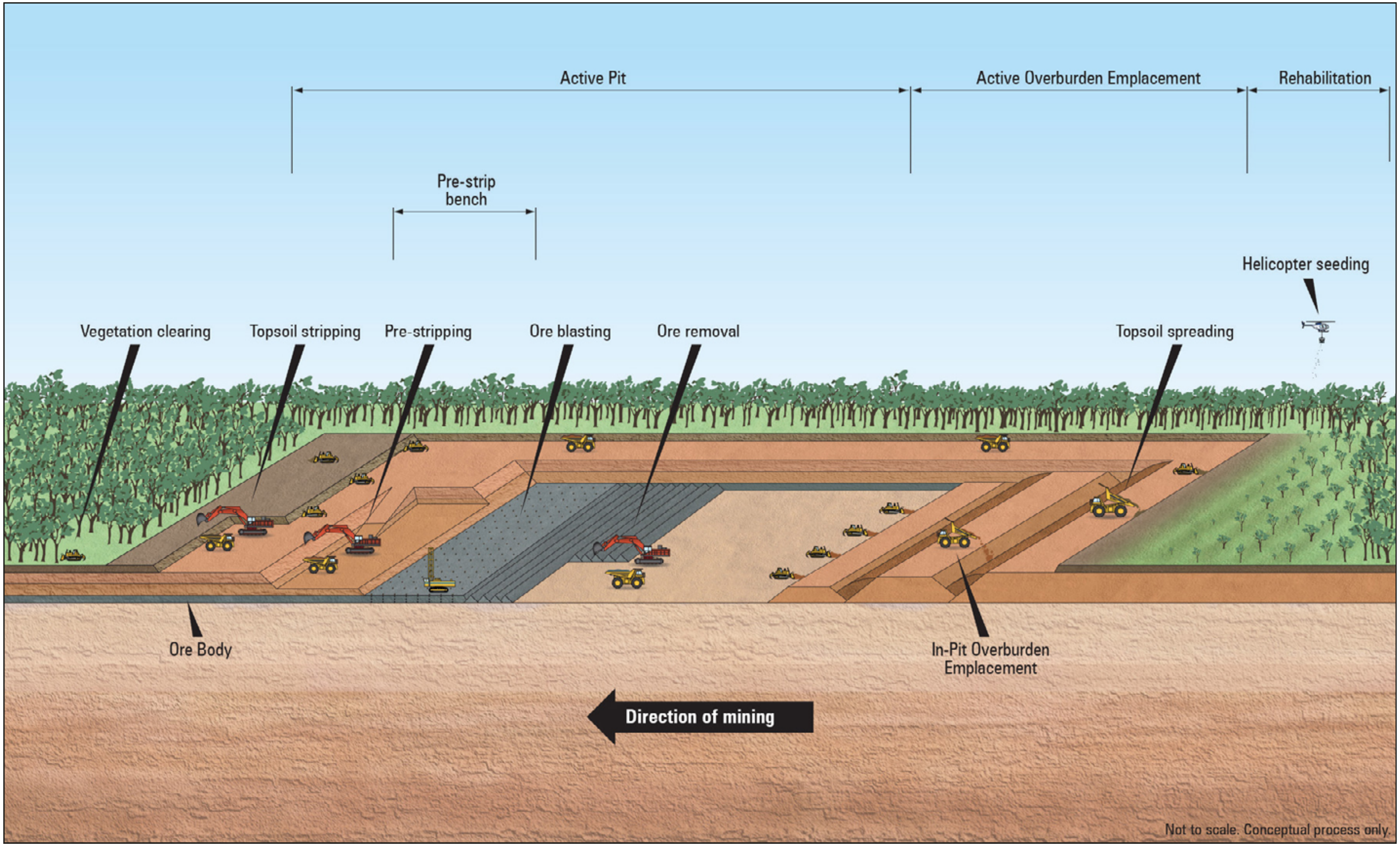
Existing GEMCO Mine

FIGURE 3-8



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Open Cut Mining Operations Schematic

FIGURE 3-9

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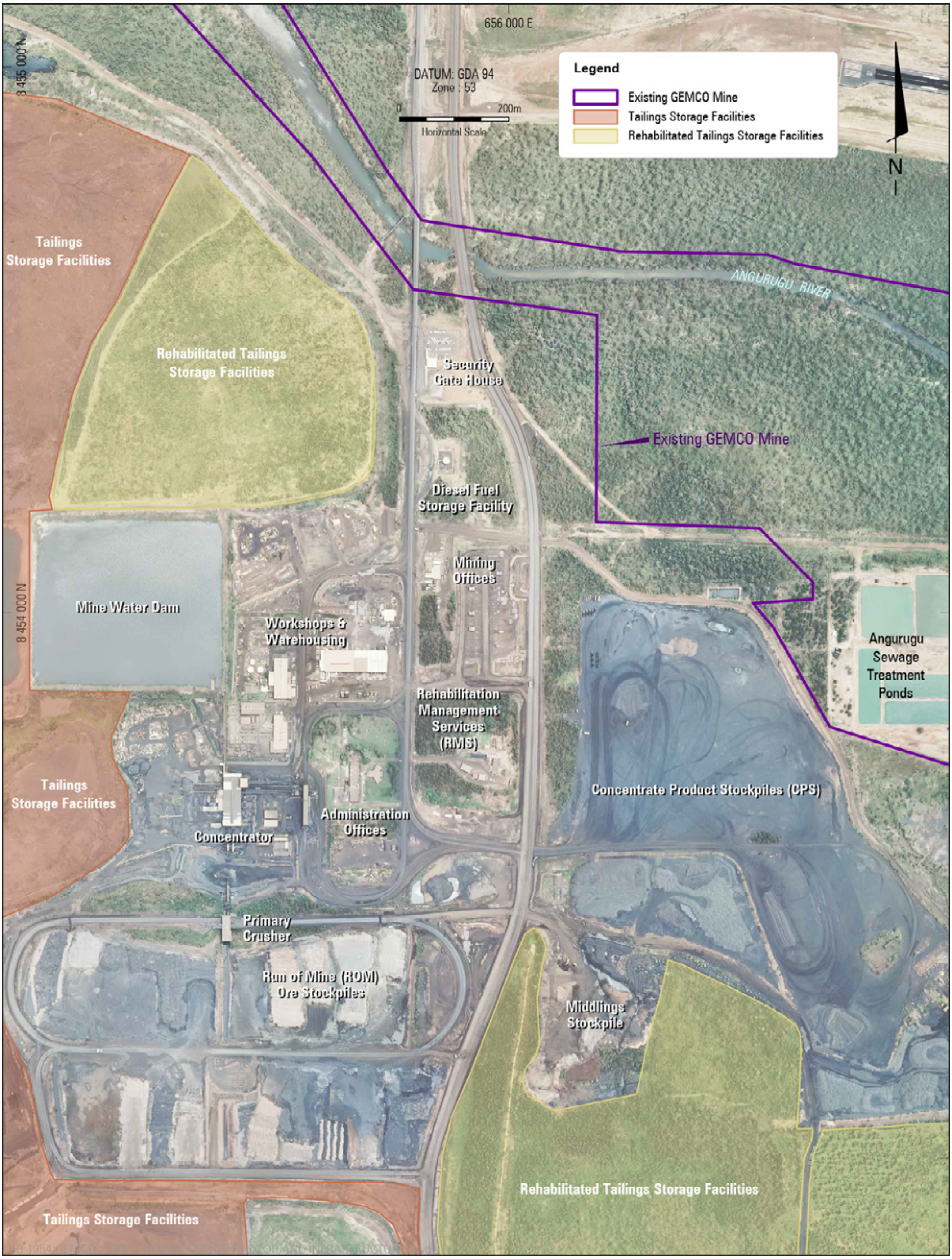

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Existing GEMCO Mine
Mine Concentrator and Industrial Area

FIGURE 3-10

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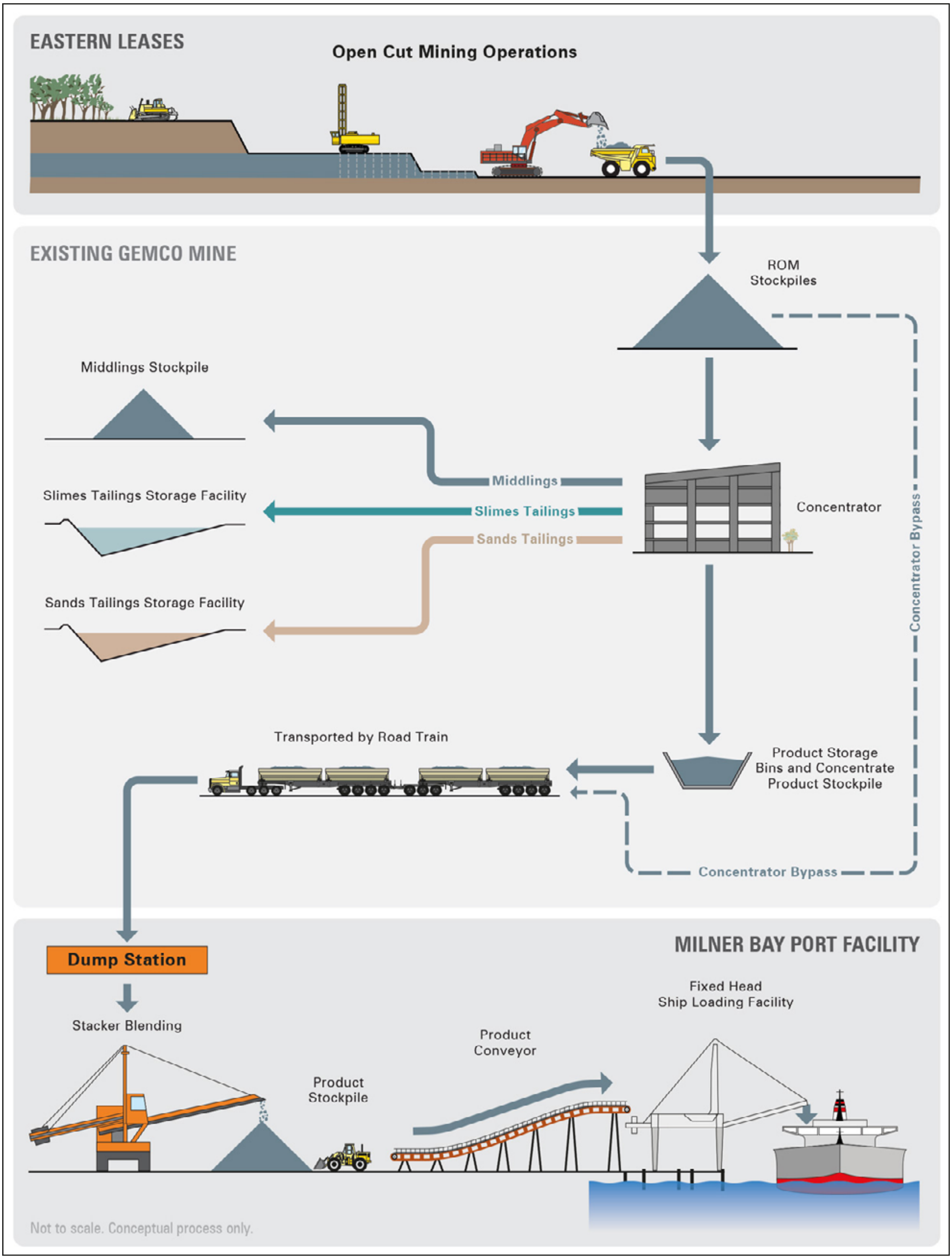

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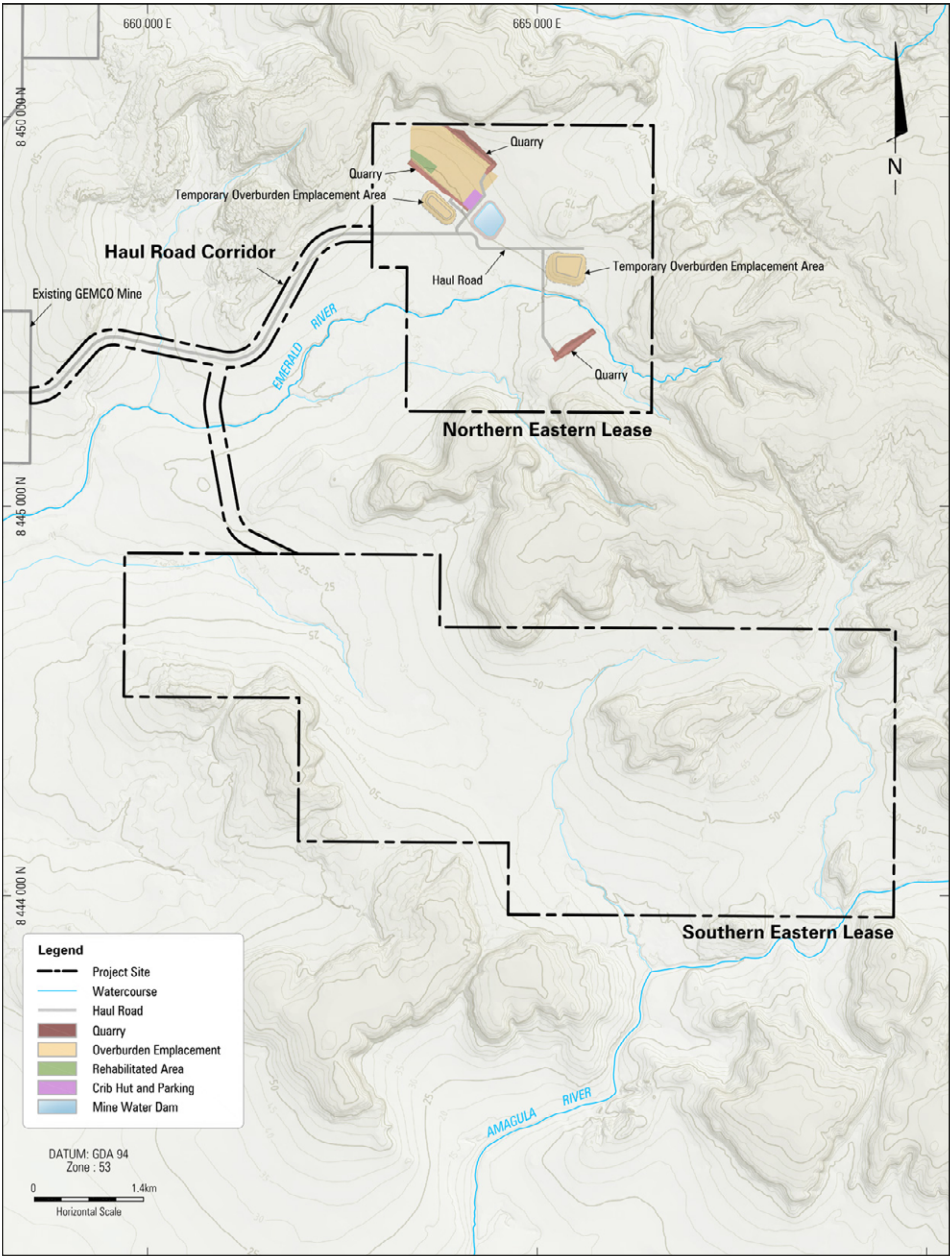
Production Process

FIGURE 3-11



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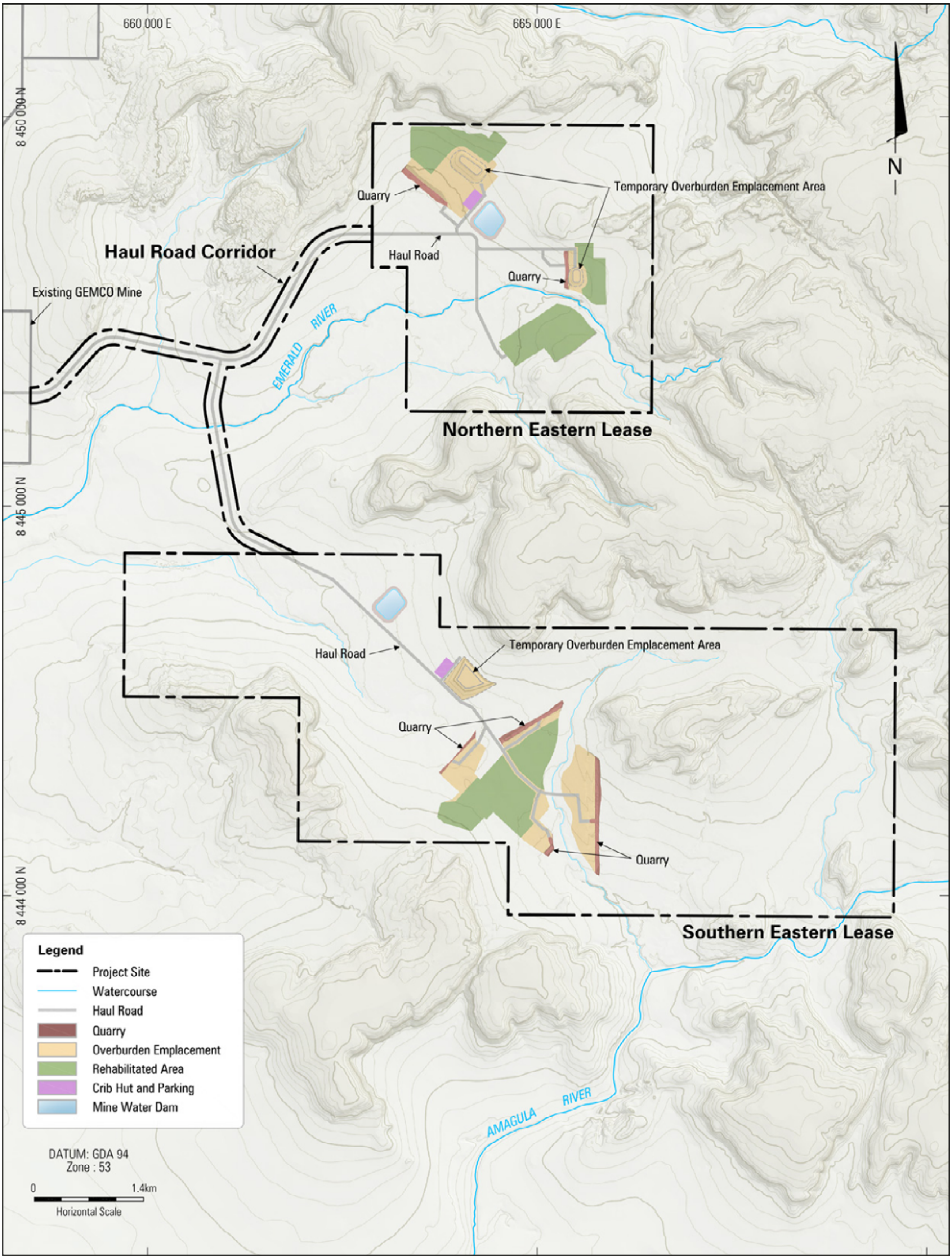
Indicative Mine Layout
Project Year 3

FIGURE 3-12



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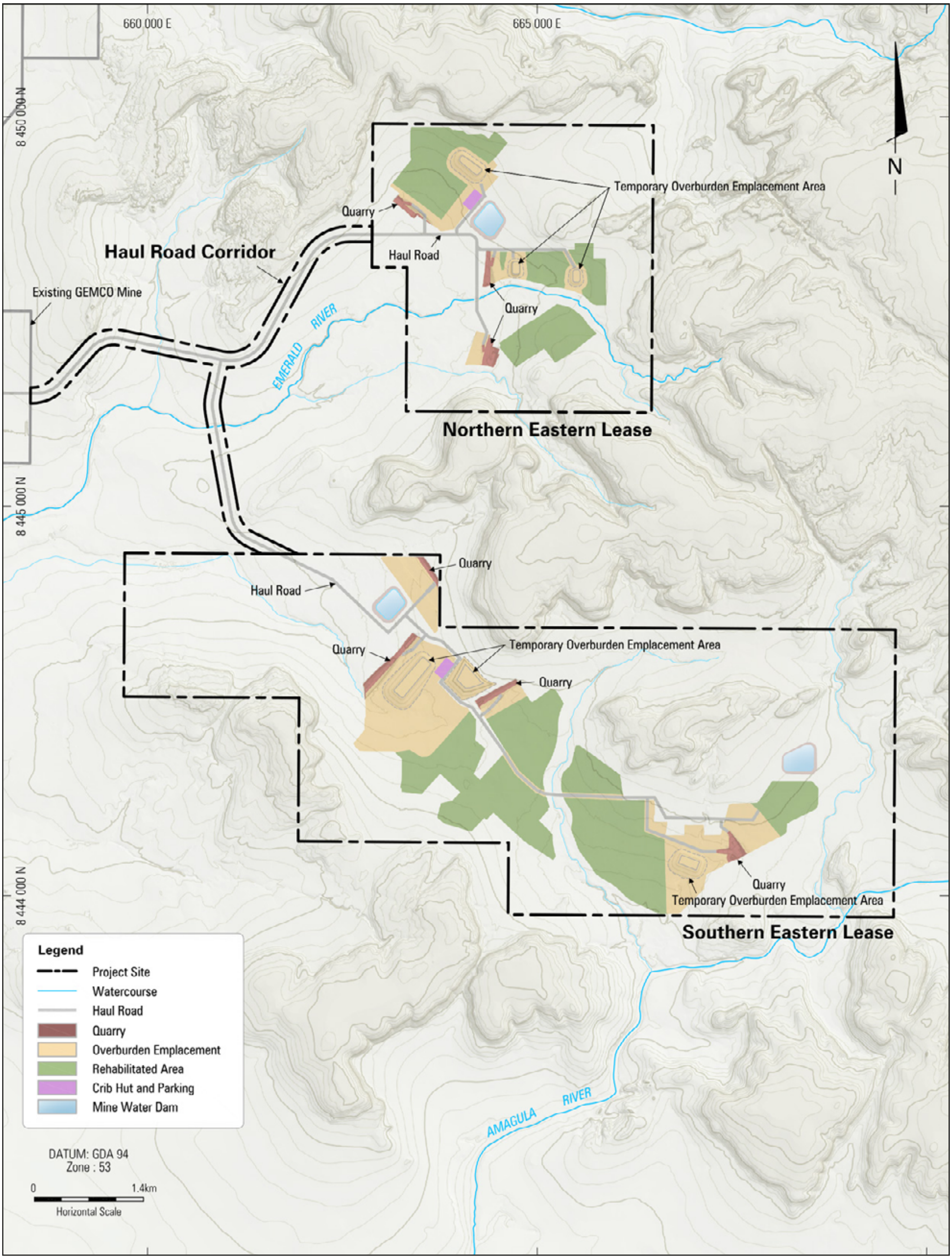
Indicative Mine Layout
Project Year 9

FIGURE 3-13



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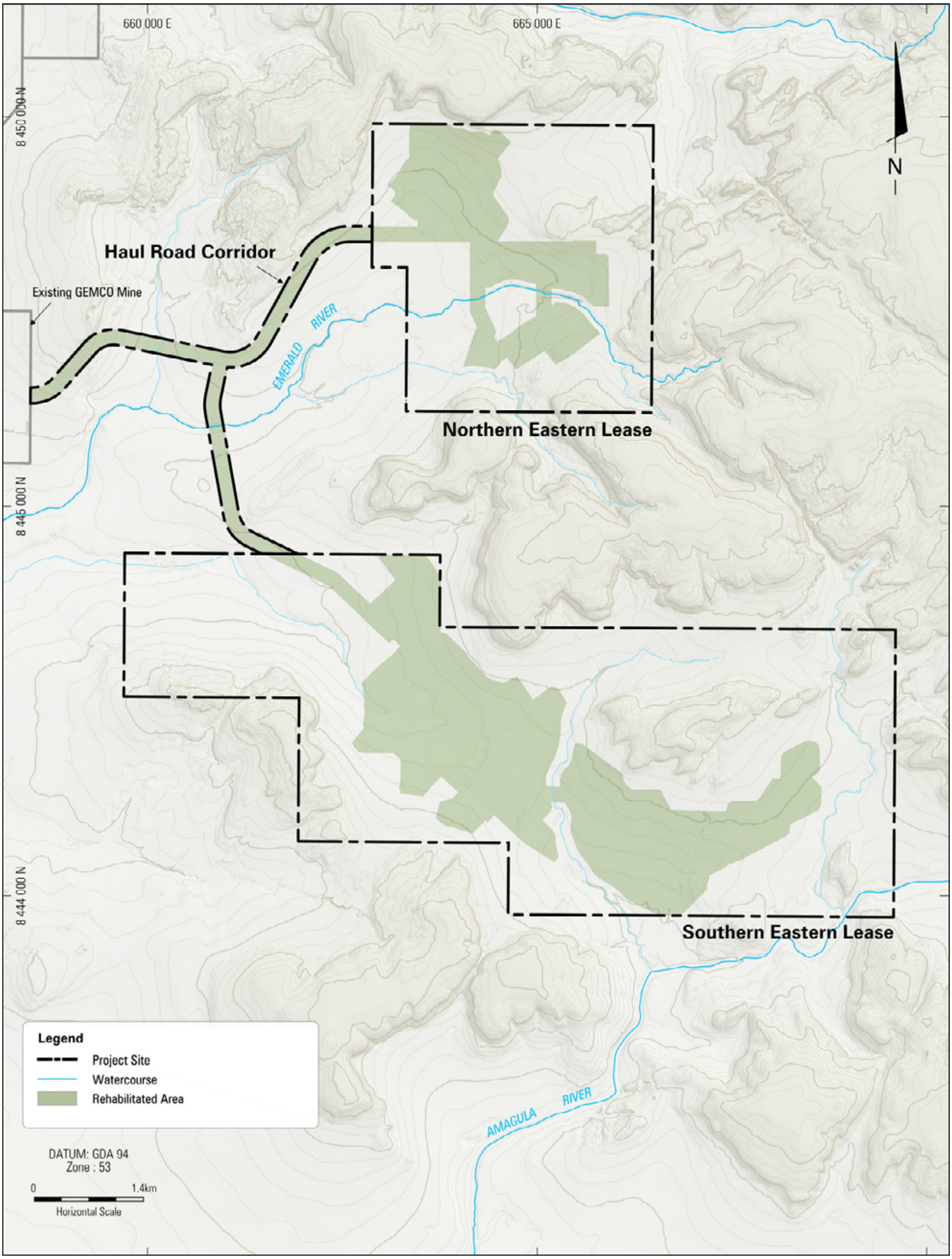
Indicative Mine Layout
Project Year 13

FIGURE 3-14



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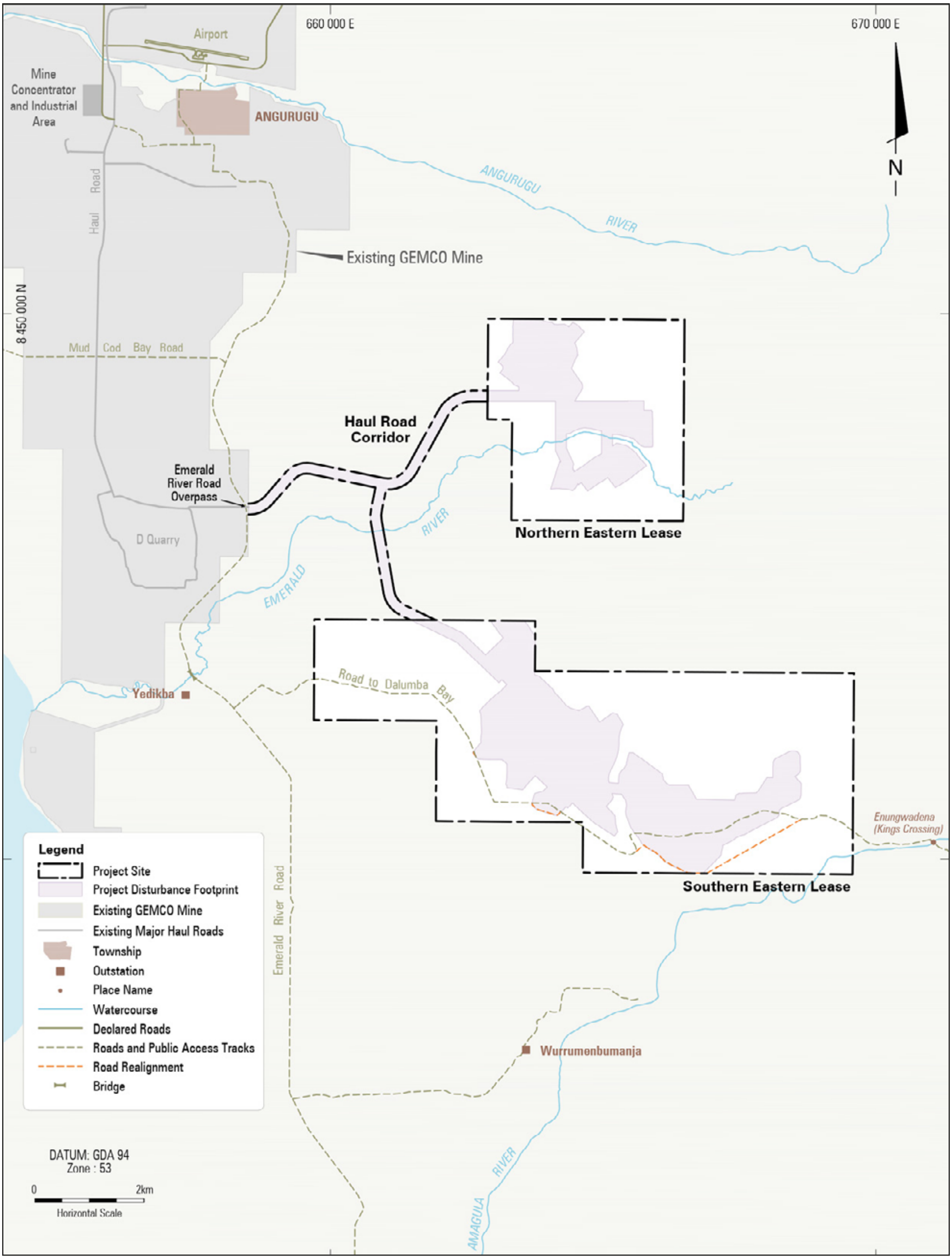
Indicative Mine Layout
Final Landform

FIGURE 3-15



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Road Network

FIGURE 3-16