

BROWNS OXIDE PROJECT

New Tailing Storage Facility

CR 9001_1_v5

August 2007



Compass Resources NL

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1 INTRODUCTION

1.1 Background

Compass Resources NL (Compass) is currently constructing the Browns Oxide Project (BOP), located 7 km northwest of Batchelor and approximately 90 km south of Darwin (Figure 1.1). The BOP involves mining 3.9 Mt of oxide ore at a rate of 1.3 Mtpa to produce copper metal and nickel and cobalt carbonates over a mine life of 3 years.

In 2005, Compass prepared a Public Environment Report (PER) for the BOP (Compass, 2005), as required under a bilateral agreement between the Northern Territory Government and the Government of Australia under the *Environmental Assessment Act* and *Environment Protection and Biodiversity Conservation Act 1999*, respectively. The PER provided a comprehensive description of the existing environment in the area of the BOP, the potential environmental impacts as a result of the project, avoidance, management and mitigation measures proposed to minimise the potential for significant environmental impacts during construction, operation and decommissioning of the BOP, and residual impacts that are expected to occur after these various measures have been applied.

The BOP was approved by the Northern Territory Government in May 2006 and the Government of Australia in June 2006.

1.2 Purpose of this Notice of Intent

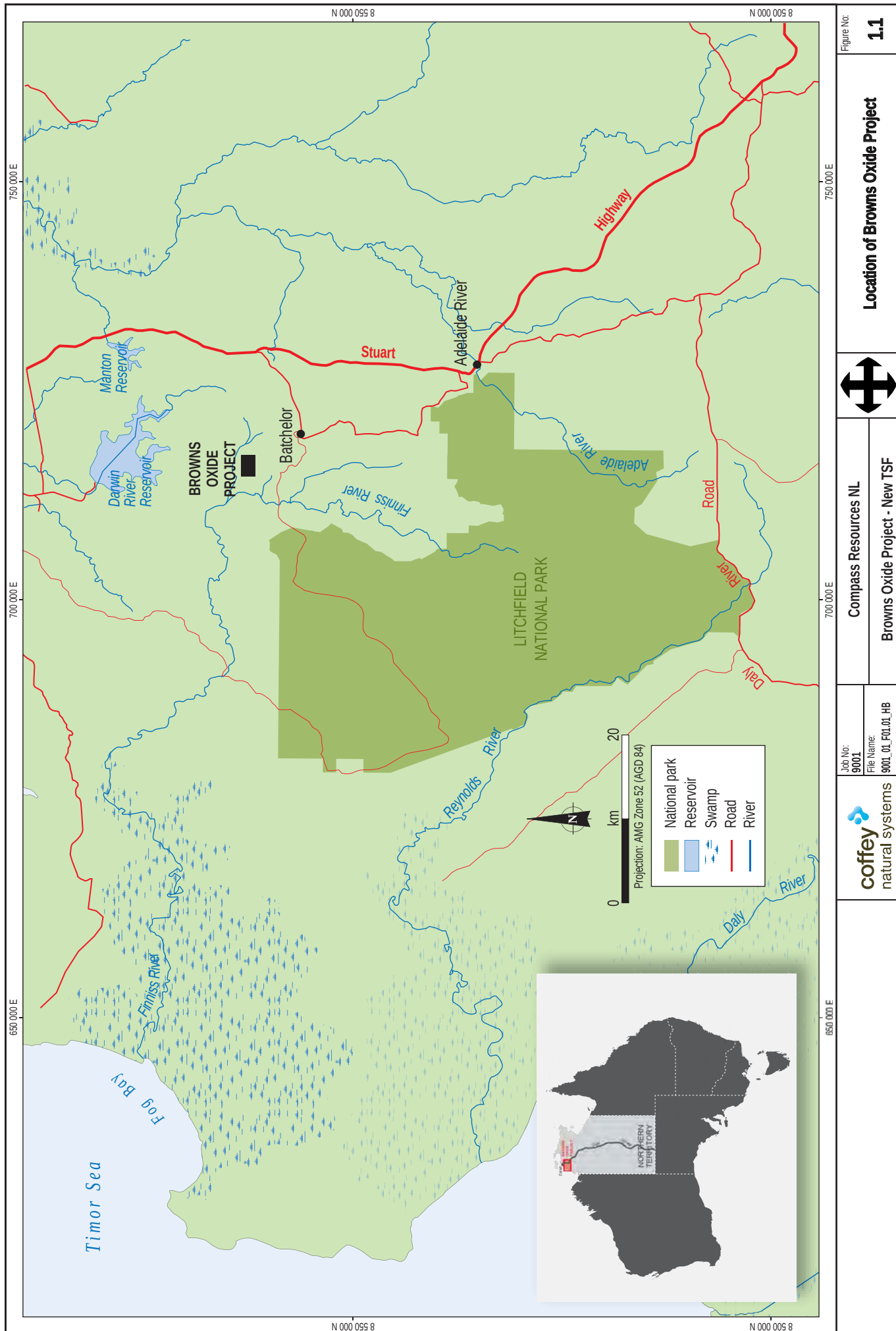
The tailing storage facility (TSF) associated with the approved BOP (i.e., the approved TSF) has been found to overlie a zone of potentially economic mineralisation. To avoid sterilisation of this zone, Compass intends to construct a new TSF to contain the tailing from ore processed from the Browns oxide deposit in a location adjacent to the approved TSF location.

This Notice of Intent (NOI) has been prepared in accordance with the Northern Territory Northern Territory Department of Natural Resources, Environment and the Arts (DNRETA) Information Guidelines for a Notice of Intent (DNRETA, 2007) and the Department of Primary Industries, Fisheries and Mines (DPIFM) Environmental Assessment of Mining Proposals Advisory Note (DPIFM, 2006).

The NOI presents an overview of the environmental aspects of the new TSF to assist DPIFM and the Environmental Protection Agency Program (EPA) in the determination of the level of environmental assessment. It relates solely to the establishment of a 35 ha TSF to store 3.55 Mt of tailing within mineral lease MLN 1157 from the Browns Oxide operation, and supersedes the NOI for a TSF submitted by Compass in December 2006 and subsequently withdrawn on 25 May 2007.

The objectives of this NOI are to:

- Outline the proposed TSF.
- Provide an initial environmental characterisation of the TSF area.
- Describe the environmental issues potentially associated with the TSF.
- Describe management and mitigation measures to minimise the potential for environmental impacts as a result of the project.



The NOI requirements are listed in Table 1.1, along with cross-references to the sections of this document in which each requirement is addressed.

Table 1.1 NOI requirements as addressed by this document

NOI Requirement	Report Section
Name of proponent and consultant	1.3.1
Address and contact details of proponent	1.3.1
Location of proposal	1.4
Description of proposal	Chapter 2
Outline of legislative and licensing requirements	Chapter 3
Description of site selection and related details of existing environment	2.2, Chapter 4
Description of marine and land uses in and adjacent to the proposal	4.3
Description of waste management and pollution control on and off site	2.4.4
Description of existing environment and related environmental issues	Chapter 4 and 5
Aboriginal and sacred sites clearance	4.7
Description of project timing, staging and decommissioning	2.4.5
Description of environmental commitments, safeguards and monitoring	Chapter 6
Description of rehabilitation and decommissioning	2.8

1.3 Proponent Details

1.3.1 Name and Address of Proponent

Compass Resources NL
Level 6, TCG Building, 80 Mitchell Street
Darwin NT 0800

The Compass contact is Mr Steven Ludwig, Manager Human Resources and Health Safety Environment.

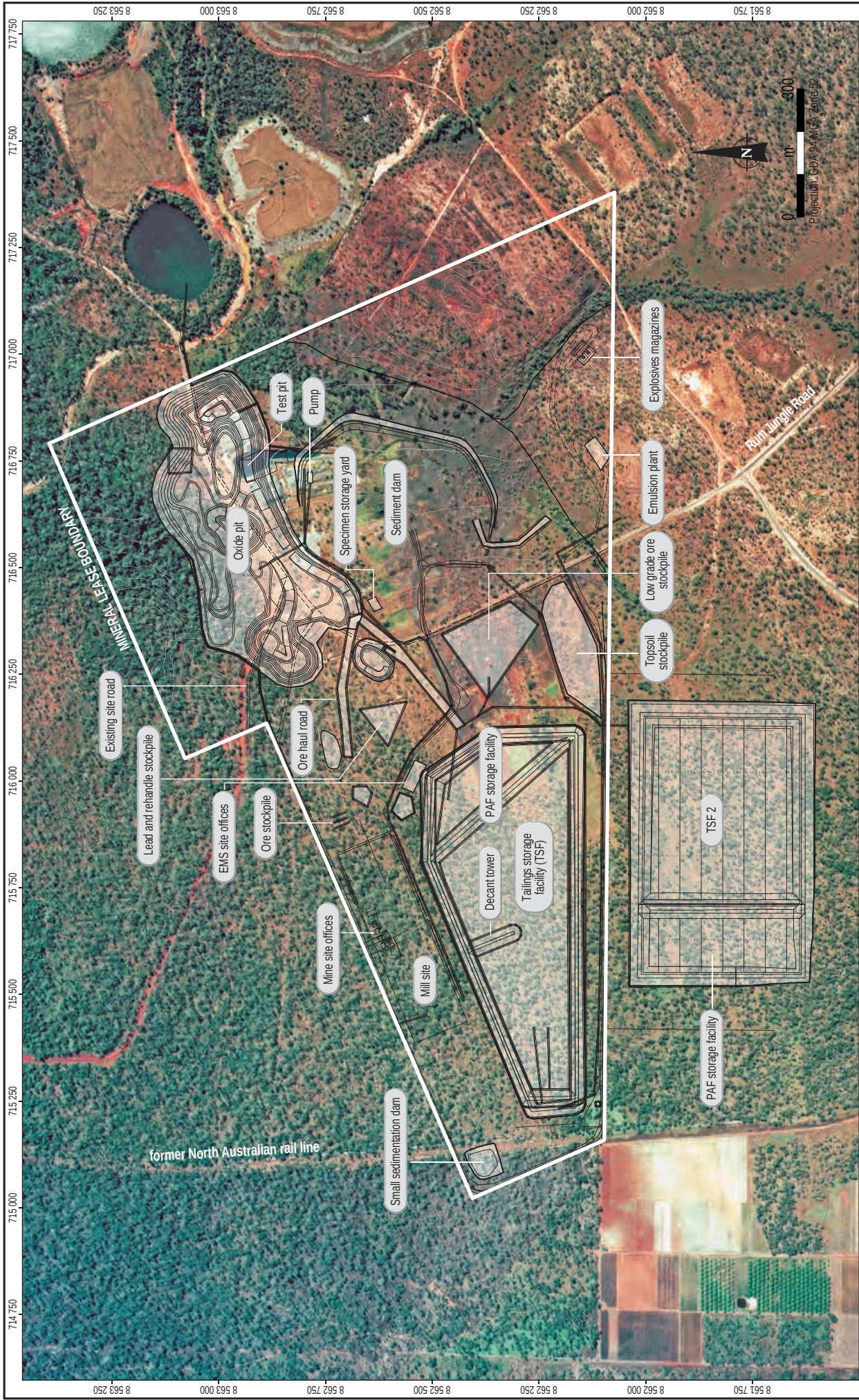
1.3.2 Name and Address of Lead Environmental Consultant

Coffey Natural Systems (formerly Enesar Consulting Pty Ltd)
Unit 8, 21 Parap Road
Parap NT 0820

The Coffey Natural Systems Project Director is Ms Tara Halliday, Associate and Darwin Manager.

1.4 Project Location and Land Tenure

The BOP is located 7 km northwest of the township of Batchelor, approximately 90 km south of Darwin in the Northern Territory (see Figure 1.1). The BOP lies entirely within a 175 ha area of granted mineral leases MLN 139 to 147 and MLN 150 to 152. The new TSF will be located to the immediate south of the currently approved TSF location (Figure 1.2). This is NT freehold land in the Hundred of Goyder, currently held by Compass under mineral lease MLN 1157.



coffey natural systems		Job No: 9001 File Name: 9001_01_F01.02_HB	Compass Resources NL Browns Oxide Project		Project area layout		Figure No: 1.2

2 TAILING STORAGE FACILITY DESCRIPTION

2.1 Rationale for the New Tailing Storage Facility

Subsequent to approval by the Northern Territory Government and the Government of Australia (see Section 1.1), the BOP is currently being constructed under Mine Management Plan M2006/0028 (Compass, 2006), approved by DPIFM under the *Mining Management Act* in July 2006. Amendments to the MMP to cover additional activities on MLN 1157, 1158 and 1161 were approved by DPIFM in October 2006.

Geotechnical and sterilisation drilling undertaken at the start of the 2006 dry season identified a zone of zinc mineralisation with economic potential underlying the location of the approved TSF. Development of the TSF as planned would therefore potentially sterilise this mineralisation, making its future recovery unfeasible. To avoid this, Compass proposes to construct a new TSF for the BOP in MLN 1157 which is currently used to store reclaimed topsoil and as a borrow area for rock that was used to armour the sedimentation dam wall.

To allow for the processing of ore mined from the Browns oxide deposit prior to the construction of the new TSF, it may be necessary to construct the first lift of the approved TSF to ensure that the project continues as scheduled and store a limited volume of tailing in this TSF.

Further definition of the zinc mineralisation will occur during this calendar year.

2.2 Siting

The existing mineral leases of the BOP contain insufficient area for the new TSF. The proposed location represents the optimal location for the new TSF, as it:

- Minimises the distance between the processing plant and the TSF;
- Minimises the additional area of land required to be disturbed for an access corridor from the BOP processing plant;
- Lies within the BOP Sedimentation Pond catchment.
- Is located in an area that:
 - Has already been disturbed by the gravel extraction and topsoil laydown activities;
 - Has obtained the necessary AAPA clearances;
 - Comprises predominantly disturbed *Eucalyptus tetrodonta*/*E. miniata* open woodland, which is common and widespread in the region;
 - Has no evidence of listed threatened or vulnerable species (as determined during flora and fauna studies carried out in 2002 and 2005);
 - Overlies the same aquifer as the BOP;
 - Has gentle (generally less than 1 degree) topography; and
 - Is not prospective for minerals.

2.3 Design

The preliminary design of the new TSF is based on the design principles of the currently approved TSF, updated to reflect site-specific design requirements.

The new TSF embankment has been designed by Australian Tailings Consultants (ATC, 2007) to incorporate all the waste rock and soil that will be mined from the Browns oxide deposit, other than that used to construct the first lift of the approved TSF. The 'paddock' style embankment (i.e., one comprising an embankment around all sides) will have a final maximum footprint of approximately 35 ha (Figure 2.1). The embankment will comprise a low permeability internal liner of clayey soils, with the majority of the embankment formed by rockfill. The use of waste material from the open pit will be maximised to provide the necessary rockfill for the embankment.

The new TSF has been designed on the basis that it will store both tailing and potentially acid forming (PAF) waste rock from the Browns oxide deposit (Figure 2.2). This selective placement of PAF material in the TSF will ensure any drainage from this material can be managed with TF drainage (e.g., toe-drains, interception bores). The PAF material will be covered by NAF material on closure to:

- Limit the exposure of PAF material to atmospheric oxygen, thereby minimising the rate at which future oxidation can occur within the PAF material.
- Reduce water infiltration into the embankment, thereby minimising the volume of acid rock drainage (ARD) produced should the PAF rock oxidise and acidify.

A drilling and uranium analysis program was conducted in 2005, with data from 23 drill holes analysed. Conclusions from this data indicate (a) generally low levels of uranium with depth (median 13.7 ppm, mean 24.5 ppm), and (b) short intersections of higher levels of uranium (up to 240 ppm). These pockets of higher uranium ore can be readily blended to reduce the level to below the 80 ppm uranium (or radioactive equivalent of 1 Becquerel per gram) cut-off value which defines ore as radioactive, as defined by The National Directory for Radiation Protection (APRANSA, 2007). As such, these low levels of uranium are considered not to require specific management measures (or impose specific constraints) concerning the use of waste rock in the construction of the TSF embankment and/or disposal of tailing in the TSF.

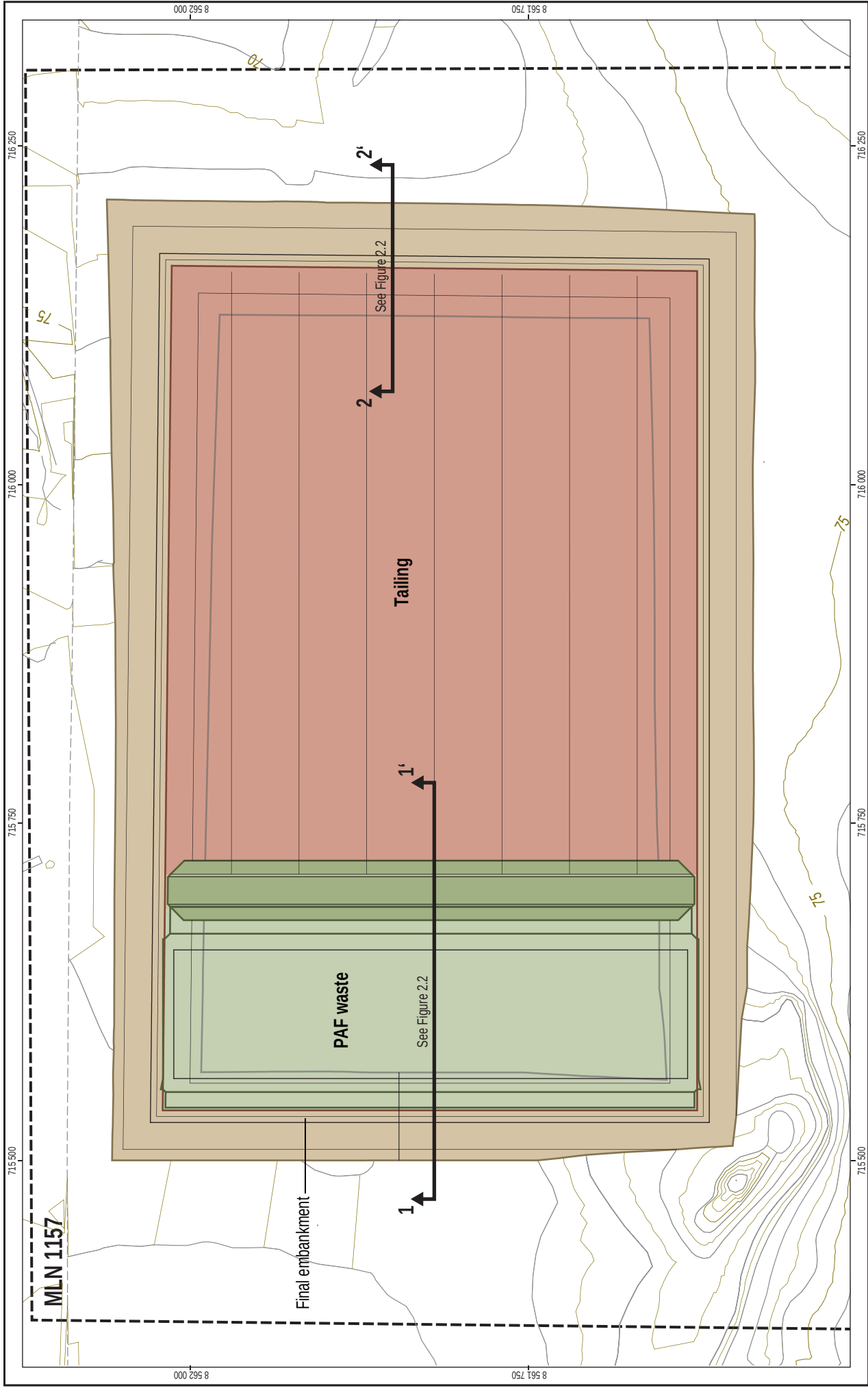
The new TSF will be fenced after construction to prevent access by people, stock and large ground-dwelling mammals.

2.4 Construction

Construction of the new TSF will follow the same process as described in the PER for the approved TSF, and is summarised below.

2.4.1 Construction Methods

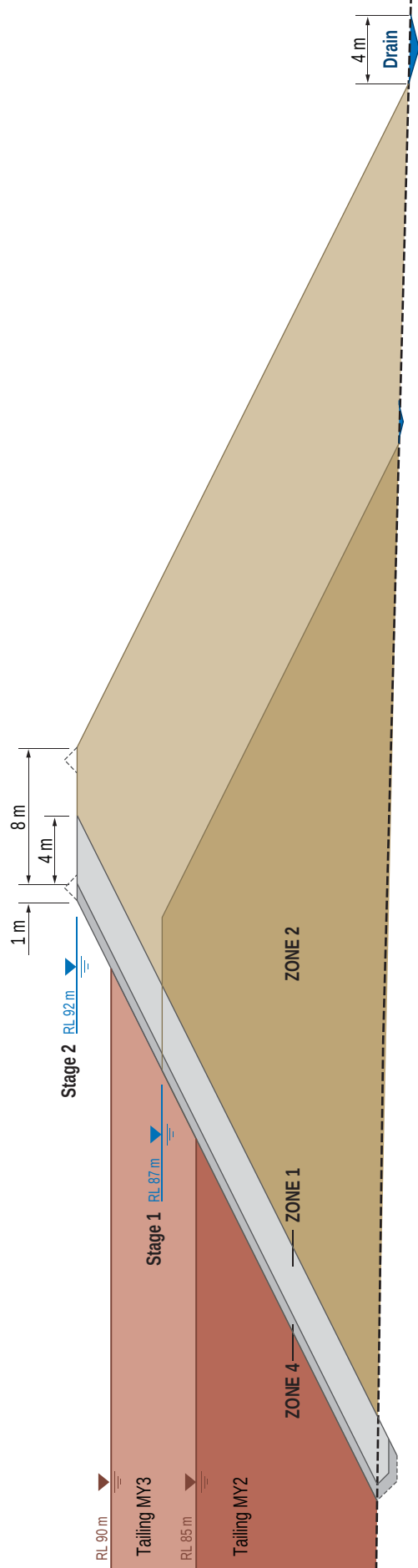
Construction of the new TSF can be separated into preparatory and TSF construction phases. The extent of site disturbance will be minimised wherever possible, with the construction footprint being similar to the ultimate footprint (about 35 ha) for the new TSF.



Source: Australian Tailings Consultants				Job No: 9001	Compass Resources NL		New TSF - final embankment layout	Figure No: 2.1
				File Name: 9001_01_F02.01_HB				



CROSS-SECTION 1-1'



CROSS-SECTION 2-2'

Source: Australian Tailings Consultants



Job No:
9001

File Name:
9001_01_F02.02_HB

Compass Resources NIL

Browns Oxide Project - New TSF



TSF cross-sections

Figure No:

2.2

2.4.1.1 Preparatory Activities

Preparatory activities associated with the construction of the new TSF are:

- Vegetation clearing and grubbing.
- Topsoil stripping and stockpiling.
- Levelling of the site.
- Compaction of existing clayey soils.

2.4.1.2 TSF Construction

Following the preparation of the foundations the following construction activities will be undertaken:

- Construction of the embankment around all sides of the new TSF, where this will consist of the following zones:
 - An internal lining of compacted clayey soil (Zone 1), comprising a number of layers of low permeability material, tests of compacted materials for embankment lining returned values in the range 3.0E-08 to 6.0E-09 m/sec (ATC, 2007). Material for this zone will be preferentially sourced from a borrow pit located within the storage area.
 - A rockfill zone for the external embankment (Zone 2), constructed using NAF pit waste material.
 - An internal ramp to access the decant system, and PAF bund (Zone 3). The PAF bund will provide a physical barrier between tailings and the PAF waste, and is required because the tailing level will be higher than the PAF waste level in the early stages of construction.
 - A protective rockfill layer (Zone 4) placed (loose) over the face of the Zone 1 layer to provide protection from erosion and evaporative drying.
- Construction of the embankment lift using 'downstream' methods, i.e., the new wall will be built on the downstream (outer) slope of the previous wall (see Figure 2.2) at a later stage.

2.4.2 Infrastructure

Consumables and infrastructure associated with the construction of the BOP will be utilised for the construction of the new TSF. TSF-specific infrastructure (e.g., pipelines, pumps, spigots) will be the same as for the approved TSF.

2.4.3 Workforce

The existing workforce employed for construction of the BOP will construct the new TSF. Most of this workforce has been employed as contractors and sourced primarily from the local area and Darwin. The TSF will be constructed by Exact Mining Services under the supervision of Australian Tailings Consultants.

2.4.4 Waste Management

Waste (e.g., putrescibles, cardboard and plastic) generated during construction and operation of the new TSF will be managed and disposed in accordance with the Hazardous Materials and Waste Management Plan in the Browns Oxide Project MMP.

2.4.5 Timing

Construction of the new TSF is scheduled to commence immediately following the receipt of all necessary regulatory approvals, taking into account limitations for construction activities associated with the Northern Territory wet season. Construction is anticipated to take approximately 3 months. Deposition of tailing into the new TSF will commence immediately following completion of construction.

2.5 Tailing Deposition and Management

Operation of the new TSF will follow the same process as described in the PER for the approved TSF, and is summarised below.

2.5.1 Tailing Deposition

Tailing will be deposited in the approved TSF until the new TSF is constructed.

Tailing in the new TSF will be deposited sub-aerially. A main ring will run around the embankment crest, and tailing will be discharged through a series of spigots (typical spacing 20 m) onto a sloping beach. Decant water and rainfall run-off will collect at a low-point on the centre of the storage, and will be recovered through a decant system.

2.5.2 Tailing Management

As per the approved TSF, the physico-chemical properties of the tailing and the planned burial of the PAF black shale tailing by NAF supergene tailing are such that specific management measures in relation to the potential formation of acid drainage from the deposited material are not required during operations. However, the tailing properties and the TSF will be regularly monitored to confirm these predictions.

During operations, 'shallow' seepage through the embankment will be collected in a toe drain and recycled. 'Deep' seepage, i.e., through the TSF base, will be either detected by monitoring bores, in which case it will be extracted and returned to the TSF and/or process plant, or captured by the groundwater drawdown cone resulting from the mine pit.

The tailing management strategy will follow that detailed in the BOP MMP, and will include:

- Regular inspection of the pipeline and automatic monitoring of the pump pressure to detect line failure.
- Placement of a clayey lining on the internal face of the embankment and controlled tailing deposition.
- Maximum water re-use via collection in a decant pond and return to the process plant.
- Monitoring of:
 - Tailing and stored water levels/volumes, and decant water quality.

- Installed instrumentation.
- Seepage from the TSF during and after operations.
- Monitoring for the occurrence of significant dusting from the tailing beaches (and alteration of the tailing deposition regime if this is required).
- Annual surveillance audits.

2.6 Access Corridors

Access to the new TSF will be via a short (~100 m) access road to be constructed from the existing BOP access road. The access road will be located within a fenced corridor that will also contain the tailing pipeline and other necessary infrastructure from the BOP processing plant. Should approval be granted for the new TSF, an alternate site entry route will need to be established on the western boundary of MLN 1157 (see Figure 1.2).

2.7 Water Management

The climate of the Top End of the Northern Territory shows both strong seasonality and extremes of precipitation ranging from extreme cyclonic rainfall to drought. The project's water management system, of which the new TSF will be an integral component, has been designed to accommodate both the normally variable rainfall and the occasionally more severe shortages and surpluses of water that may occur over the life of its operation. The following principles apply to the design and operation of the system:

- Minimise water consumption.
- Maximise water recycling.
- Establish a preferential hierarchy of uses based on water quality.
- Control discharges from operational areas of the lease.
- Control potential contaminants used on site.
- Minimise the disturbance of land.

The implications of this strategy for the new TSF are as for the approved TSF, i.e., process water will be recycled from the TSF as a first priority, runoff from the TSF perimeter will be diverted to toe drains and recycled, and the footprint of the facility will be as small as possible.

The new TSF is located within the same catchment as the approved TSF, and will be designed such that surface seepage collection drains can be directed to the existing sedimentation dam on the Browns mineral lease.

Water will be managed in accordance with the Water Management Plan in the Browns Oxide Project MMP.

2.8 TSF Decommissioning and Rehabilitation

2.8.1 Decommissioning

Decommissioning of the new TSF will be consistent with the approach for the approved TSF, as outlined in the strategic rehabilitation and mine closure plan described in the BOP MMP.

The objectives of decommissioning the new TSF will be to:

- Leave the site in a physically and geochemically stable condition with no or low maintenance requirements.
- Leave the site in a safe condition, so as to minimise risks to public safety.
- Prevent excessive erosion and ensure that the site does not become a significant source of water- or wind-borne material.
- Revegetate the TSF to the point where a self-sustaining community comprised largely of native species characteristic of the surrounding country is established (i.e., a modified natural habitat).
- Minimise the visual impact of the facility.

2.8.2 Rehabilitation

Rehabilitation of the new TSF will be undertaken in accordance with the strategic rehabilitation and mine closure plan described in the BOP MMP. General rehabilitation procedures will include:

- Progressive revegetation of disturbed areas of the new TSF throughout the operation, where practicable.
- Topsoil stockpiled during the construction process will be replaced as the final landform of the new TSF is achieved. Ideally, the topsoil stockpiles will retain their seed resources allowing revegetation to occur naturally. If this does not occur to a sufficient degree, the new TSF area will be seeded and fertilised, with the application of seeds and fertilisers being timed to take best advantage of moisture and seasonal conditions.

Following mine closure, disturbed areas of the new TSF will be contoured, respread with topsoil and revegetated where necessary.

3 LEGISLATIVE FRAMEWORK

3.1 Commonwealth Legislation

3.1.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), actions that are likely to have a significant impact on a matter of national significance are assessed. The Commonwealth Department of Environment and Water Resources (DEWR) is responsible for administering the act.

Matters considered to be of national environmental significance are:

- World Heritage properties.
- National Heritage places.
- Ramsar wetlands of international significance.
- Threatened species and ecological communities.
- Migratory species.
- Nuclear actions.
- Commonwealth marine areas.
- Additional matters of national environmental significance (prescribed actions).

The Commonwealth EPBC Act requires a referral to be made for any project that has the potential to impact a matter of national environmental significance.

An EPBC Act referral addressing the construction of the new TSF as described in this document was submitted to the DEWR on 16 July 2007. This referral supersedes the previous TSF referral submitted by Compass on 19 January 2007. Additional information was sought by DEWR on 15 August 2007, with this information provided on 24 August 2007.

3.1.2 Other Relevant Legislation

Other Commonwealth legislation relevant to the project includes:

- *Aboriginal Land Rights (Northern Territory) Act 1976.*
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984.*
- *Heritage Act 1975.*
- *Native Title Act 1993.*

3.2 Northern Territory Legislation

3.2.1 Environmental Assessment Act

The *Environmental Assessment Act* (EA Act) provides for 'the assessment of the environmental effects of development proposals and for the protection of the environment'. The Minister for Natural Resources, Environment and Heritage is responsible for administering the act and determines the appropriate level of assessment, which depends upon the sensitivity of the local environment, the scale of the proposal and its potential impact upon the environment. The EPA assists the Minister in undertaking the assessment.

The assessment process is initiated by submission of a NOI by the proponent to the Northern Territory Government through the Minerals and Energy Referral Assessment branch of the Department of Primary Industry, Fisheries and Mines (DPIFM). The NOI is evaluated by DPIFM to determine whether assessment under the EA Act or *Mining Management Act* is required. If assessment under the EA Act is required, the NOI is referred to the Minister for Natural Resources, Environment and Heritage (Department of Natural Resources, Environment and the Arts (DNRETA)) and the proponent will be required to prepare a Public Environmental Report (PER) or Environmental Impact Statement (EIS).

3.2.2 Mining Act and Mining Management Act

The principal legislation for the regulation of mining in the Northern Territory comprises the *Mining Act* and the *Mining Management Act*, both of which are administered by DPIFM. The BOP is currently being constructed under Mine Management Plan M2006/0028, approved by DPIFM under the Mining Management Act in July 2006. The 2007-2008 MMP is currently being assessed by DPIFM.

3.2.3 Other Relevant Legislation

Additional Northern Territory legislation relevant to the project includes the following acts:

- *Aboriginal Land Act.*
- *Bushfires Act.*
- *Environmental Offences and Penalties Act.*
- *Heritage Conservation Act.*
- *Local Government Act.*
- *National Environment Protection Council (Northern Territory) Act.*
- *Northern Territory Aboriginal Sacred Sites Act.*
- *Planning Act.*
- *Soil Conservation and Land Utilisation Act.*
- *Territory Parks and Wildlife Conservation Act.*
- *Waste Management and Pollution Control Act.*
- *Water Act.*
- *Weeds Management Act.*

4 DESCRIPTION OF EXISTING ENVIRONMENT

4.1 Climate

Batchelor has a monsoonal climate with distinct wet and dry seasons. The Australian Bureau of Meteorology maintains several weather stations in the vicinity of Batchelor, but the longest data record (60 years) has been collected from Darwin Airport. Average annual rainfall is approximately 1,710 mm, with an average monthly rainfall ranging from 426 mm in January during the wet season to 1.0 mm in July during the dry season (BOM, 2007). The mean monthly maximum temperature ranges from 30.5 °C in July to 33.2 °C in November (BOM, 2007).

4.2 Landform, Topography and Drainage

The new TSF area is characterised by gently undulating hills, with most of the site sloping gently to the east at an overall slope of less than 1%. The site is located approximately 1 km to the southwest of the south branch of the East Finniss River and lies within the catchment of this river. There is no surface water linkage with the former Rum Jungle operations area to the northeast of the project area.

4.3 Land Use

The new TSF is located about 7 km northwest of the township of Batchelor and falls within the jurisdiction of the Coomalie Community Government Council and Coomalie land use plan (Figure 4.1). Two groups of Aboriginal people, the Kungarakana and Warai, have traditional ownership interests to the east of the site.

The site is located more than a kilometre southwest of the historic Rum Jungle Mine (see Figure 1.2), and is entirely located within the northern section of MLN 1157, which covers an NT freehold property whose owner cannot be traced. Compass has purchased the Crown Lease over this 'deadman' block. A rural subdivision is located to the southwest about 2.5 km from the site. Other nearby land uses include cattle grazing on a property to the south and a mango orchard approximately 3 km southeast, and both of these properties have surface catchment areas and groundwater aquifers that are separate from those that apply to MLN 1157. Litchfield National Park is approximately 14 km southwest of the location of the new TSF (see Figure 1.1).

4.4 Flora

4.4.1 Field Surveys

Two flora surveys have been undertaken of the BOP region over the past six years. Judy Egan, Botanical Consultant (Egan, 2005), undertook a flora impact assessment for the BOP PER, which focussed on the 1.75 km² (175 ha) BOP area and selected surrounding vegetation types. This area is located immediately to the north of the location of the new TSF. Egan's assessment built on the previous flora assessment of the broader region in and around the BOP mineral leases undertaken by Metcalfe in 2002 (Metcalfe, 2002), which covered a much larger area of 37.5 km² (3,750 ha), including the new TSF site.

4.4.2 Flora of Conservation Significance

No vegetation communities of declared conservation significance, at either the Commonwealth or Territory level, have been recorded within the new TSF site. Similarly, no plant species of conservation significance listed under the EPBC Act have been recorded within the site, nor do records exist of any rare or endangered plant species. The only protected species present is the cycad *Cycas armstrongii*, which is listed as threatened under the *Territory Parks and Wildlife Conservation Act* and has been widely recorded elsewhere on the BOP site and in the region. Permits are required for the removal of this species.

4.4.3 Vegetation Distribution and Composition

Native vegetation distribution within the new TSF site closely reflects the interplay of topography and soils, and the influence of seasonal fluctuations in fresh water supply and drainage. Consequently, the pattern of vegetation broadly corresponds to major topographic contours.

Vegetation of the site is dominated by *Eucalyptus tetradonta*/*E. miniata* Open Woodland (Plate 4.1), which largely comprises eucalypt-dominated open woodlands with minor areas of denser woodland habitat. Characteristic species in this vegetation association include:

- *Eucalyptus miniata*, *E. tetradonta* and *E. confertiflora*.
- *Erythrophleum chlorostachys*.
- *Brachychiton megaphyllus*.
- *Cycas armstrongii*.

An area of *Eucalyptus papuana*/*Corymbia foelscheana*/*Melaleuca* spp. Open Woodland to Grassland occurs in the northeast portion of the site. Characteristic species in this vegetation association include:

- *Eucalyptus papuana*.
- *Corymbia foelscheana*.
- *Lophostemon grandiflorus*.
- *Melaleuca dealbata*.
- *Acacia auriculiformis*.

Large areas of vegetation have been cleared across the site of the new TSF for the excavation of borrow pits (Plate 4.2) and storage of topsoil (Plate 4.3). These activities were carried out under an amendment to the BOP MMP approved by DPIFM.

4.4.4 Introduced Flora

Much of the new TSF site is subject to moderate to very dense weed infestation (see Plate 4.1), with the most common weed species being gamba grass (*Andropogon gayanus*), calopo (*Calopogonium mucunoides*) and mission grasses (*Pennisetum* spp.).



Plate 4.1

Eucalyptus tetradonta/Eucalyptus miniata open woodland characteristic of the site of the new TSF, showing dense infestation of Gamba grass (*Andropogon gayanus*).



Plate 4.2

Borrow pit excavation at the south of the new TSF site.



Plate 4.3

Topsoil storage area on the new TSF site.

4.5 Fauna

4.5.1 Field Surveys

Two fauna surveys have been undertaken of the BOP region since 2002. Ecological Management Services (EMS, 2005) undertook desktop assessment and field surveys during the wet season of 2005 which focussed on the 1.75 km² (175 ha) BOP mineral leases. This was immediately to the north of the location of the new TSF. This survey built upon the 2002 dry season survey of the 37.5 km² (3,750 ha) of the broader region, including the new TSF site.

4.5.2 Fauna of Conservation Significance

Three species listed as vulnerable or endangered under the EPBC Act are present, or potentially present, within the site:

- Northern quoll (*Dasyurus hallucatus*).
- Partridge pigeon (*Geophaps smithii*).
- Red goshawk (*Erythrotriorchis radiatus*).

Additional species listed as vulnerable or near threatened under the TPWC Act that are present, or potentially present, within the site are:

- Northern death adder (*Acanthophis praelongus*).
- Yellow-spotted monitor (*Varanus panoptes*).
- Brush-tailed phascogale (*Phascogale tapoatafa*).
- Bush stone-curlew (*Burhinus grallarius*).
- Black-footed tree rat (*Mesembryomys gouldi*).
- Arnhem Land pebblemound mouse (*Pseudomys calabyi*).
- Pale field-rat (*Rattus tunneyi*).
- Arnhem sheath-tail bat (*Taphozous kapalgensis*).

4.5.3 Fauna Distribution and Composition

The new TSF site and immediate surrounds support a range of fauna species including 18 amphibians (including the cane toad [*Bufo marinus*] which arrived in the area during the 2004–2005 wet season), 38 reptiles, 120 birds and 33 mammal species (29 native and four introduced). A brief summary of these is provided below.

4.5.3.1 Amphibians

The number and abundance of amphibian species in the region is consistent with that of the wider 'Top End' of the Northern Territory, with diversity comparable to that of the nearby Litchfield National Park. Seventeen native amphibian species were observed during the combined dry and wet season surveys.

4.5.3.2 Reptiles

A high diversity of reptile species occurs in and around the site. The open forest and woodland habitat that dominates the site supports a high diversity of skinks and lizards, while the acacia regrowth/monsoon vine-forest habitat in the north and the open drainage areas to the north and east of the BOP mineral leases (but not in the new TSF site), respectively, support a reduced reptile diversity and abundance.

4.5.3.3 Mammals

Twenty-eight native mammal species have been identified in and around the site, including microchiropteran bats, rodents and macropods. The highest diversity of mammals is in the upland eucalypt forest habitat to the north of the site, while the open drainage and floodplain habitats in the region have low species diversity. Similar species are present throughout the dry and wet seasons.

4.5.3.4 Birds

There are approximately 120 bird species in and around the site, and this is about half the number of species in surrounding areas, including Litchfield National Park. The majority of species are widely distributed in the open forest/woodland habitats that are common in and around the area, with the remaining species usually associated with wetlands or freshwater habitats; a limited number occur primarily in riparian forests or vine thickets to the north of (but outside) the new TSF site.

4.5.4 Introduced Fauna

Four introduced vertebrate fauna species have been identified around the site and are common in the region: the domestic dog, feral pig, cane toad and feral cat.

The cane toad (*Bufo marinus*) has colonised the area over the past few years and large numbers of toads are likely to invade local habitats in the immediate future. It is known that in recently colonised populations such as in the BOP minerals lease area, cane toad numbers rapidly increase to levels far in excess of those in older established populations (DEH, 2005). The impact of cane toads on the northern quoll and reptiles is of particular concern (DEH, 2005).

The feral cat (*Felis catus*) was observed in the region during the wet season 2005 survey and is relatively common. Predation of native wildlife by feral cats is of particular concern given their impact on reptile, bird and small mammal populations in the region.

4.6 Groundwater

4.6.1 General

The groundwater system for the Coomalie Community Government Council region is shown on Figure 4.2. Groundwater levels are influenced by the monsoonal climate, with levels generally starting to rise around December in the early wet season, peaking in February, and then receding until the annual rise starts again in the following wet season.

The hydrogeology of the general area was assessed by Coffey Geosciences (Coffey, 2005) for the BOP. During this investigation three bores were drilled along the southern edge of the BOP minerals lease (immediately north of the new TSF site). A pre-existing bore, RN24130, is located approximately 900 m to the west of the new TSF site.

A regional groundwater monitoring program is currently being undertaken by Compass, as required under the MMP, and the data will be gathered throughout the life of the mine.

The information from this monitoring will be used to develop a hydrogeological groundwater model for the Browns Oxide project and the extended regional area, which will further inform the description of local groundwater conditions.

4.6.2 New TSF Site

During the recent site investigation for the new TSF, conducted by Australian Tailings Consultants in June 2007, eight new monitoring bores were established (Figure 4.3 and Table 4.1). The shallow subsurface geology at the new TSF site, as determined by the construction of these bores as well as soil test pits, comprises shale, clay, lateritic clayey gravel and amphibolite. At depth, the site is underlain by shale and amphibolite of the Whites Formation and Coolmalie Dolostone in the southeast portion of the site. From the test work to date, no faults have been identified within the vicinity of the site.

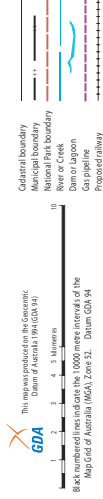
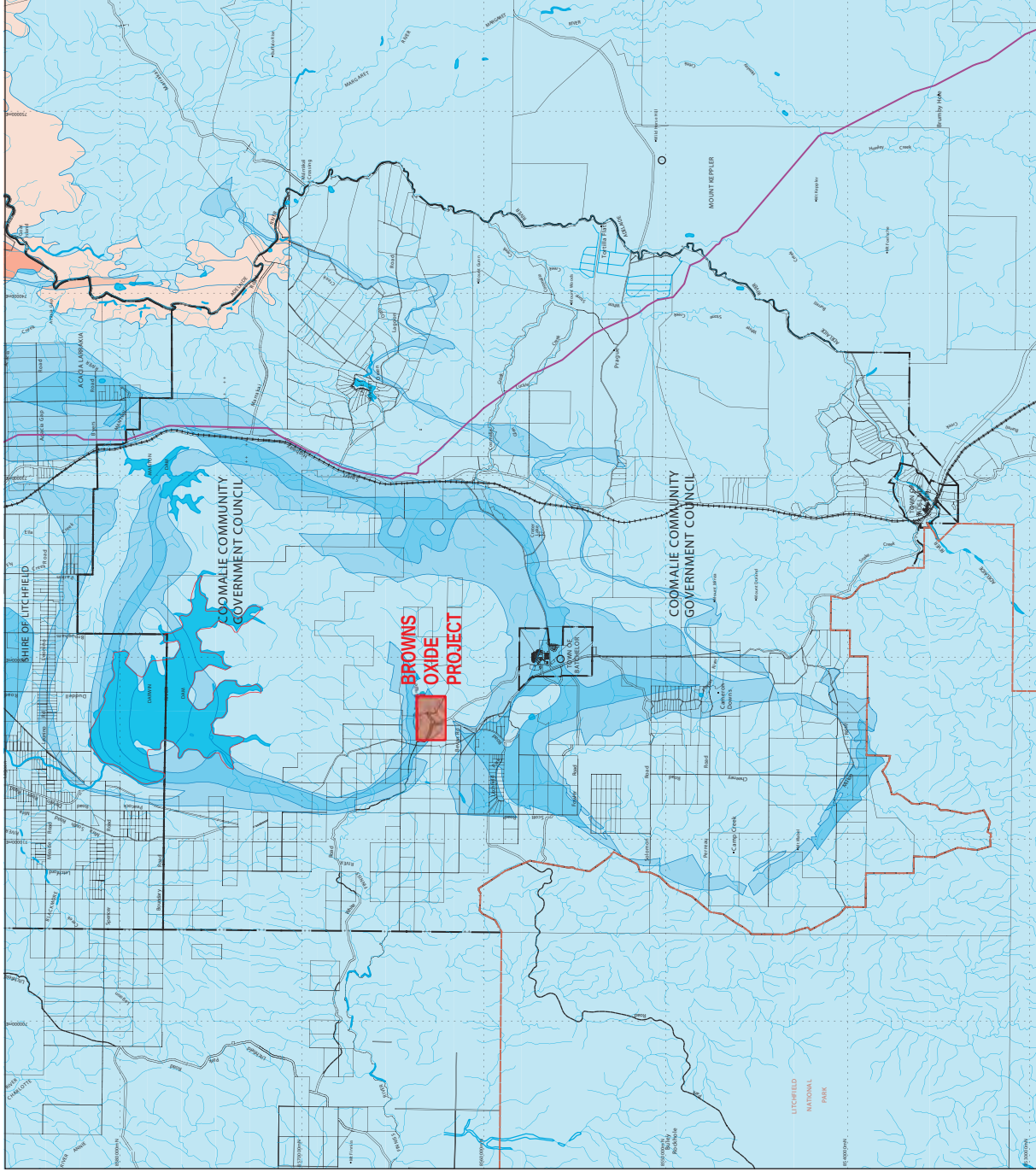
Aquifers are likely to occur within:

- Lateritic clayey gravel.
- Weathered, vuggy or fractured magnesite of the Coolmalie Dolostone.
- Weathered or fractured shale or amphibolite of the Whites Formation.
- Faults that intersect weathered or partially weathered zones of the bedrock.

Groundwater occurs at depths ranging from 3.0 to 8.4 m below surface around the new TSF site, with the direction of flow generally following topography. Groundwater under the new TSF location is likely to flow towards the Browns Oxide deposit open pit, whereas in the southern portion of the lease, the groundwater is likely to flow south and southeast (URS, 2007). In general, shallow groundwater monitoring bores have higher groundwater levels than deeper bores, indicating a downward groundwater flow gradient.

Table 4.1 Groundwater monitoring bores for the new TSF

Bore	Water level (RL) 19-7-07	Water level (m below ground level)	Bore depth (m)	Cased interval (m below ground level)		Permeability (m/sec)	Permeability (m/day)
7a	72.70	6.16	10	4	10	3.0E-07	2.6E-02
7b	72.70	6.53	30	24	30	3.0E-07	2.6E-02
8a	66.50	8.20	10	4	10	3.0E-07	2.6E-02
8b	66.40	8.40	30	24	30	2.0E-07	1.7E-02
9a	68.90	3.00	10	4	10	6.0E-07	5.2E-02
9b	68.50	3.40	30	24	30	2.0E-08	1.7E-03
10	70.50	7.20	23.8	18	24	2.0E-07	1.7E-02
11	63.80	5.90	14.5	9	15	3.0E-07	2.6E-02



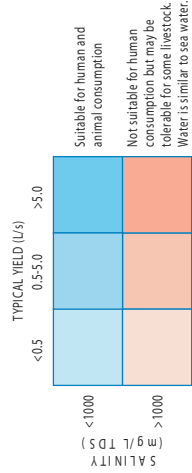
This map is prepared for the Coomalie Community Government Council.
Browns Oxide Project
Map of Australia (MGA), Zone 52, Datum GDA 94
Design File: Coomalie, GWS, 52m
Plot File: Coomalie, GWS, 52m
Prepared and produced by the
Conservation and Natural Resources Group,
Department of Infrastructure, Planning and Environment,
Northern Territory of Australia.
EDITION 2 - APRIL 2004

Coomalie Community Government Council
The Northern Territory of Australia declares that the reproduction or use of this map in any form, or the reproduction or use of any part of it, without the written permission of the Northern Territory of Australia, is prohibited.

- Notes:**
- 1 - This map should only be used for regional groundwater assessment and not for specific sites, individual blocks, investment or other purposes without further advice from the Conservation and Natural Resources Division of the Department of Infrastructure, Planning and Environment.
 - 2 - Local variations in supply will occur.
 - 3 - The information shown on this map is subject to amendment on further investigations.

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GROUNDWATER SALINITY AND YIELD



Note: Mangroves are underlain by salt water

Northern Territory Government
Department of Infrastructure, Planning and Environment
GROUNDWATER SUPPLY
PROSPECTS of the
COOMALIE COMMUNITY
GOVERNMENT COUNCIL

coffey
natural systems

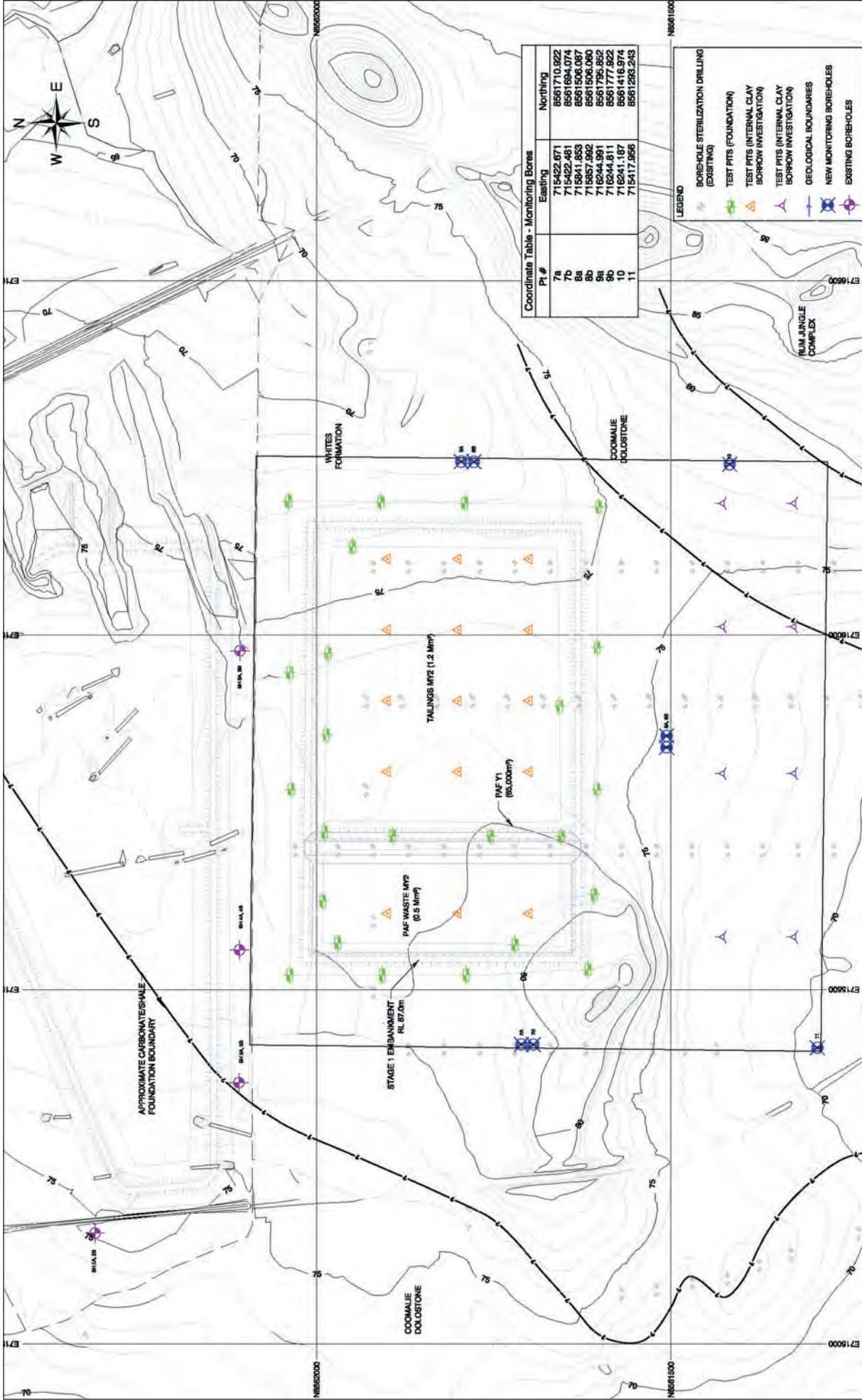
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Browns Oxide Project - New TSF



**Groundwater supply prospects of the
Coomalie Community Government Council**

Figure No:
4.2



Source: Australian Tailing Consultants



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Compass Resources NL
Browns Oxide Project - New TSF



Groundwater monitoring bores
for the new TSF

Figure No:

4.3

Permeability testing on groundwater monitoring bores indicated values ranging between 1.7E-02 and 5.2E-02 m/day. The results indicate relatively low permeability strata was intersected for the test intervals within Coolmalie Dolostone and Whites Formation.

4.7 Cultural Heritage and Archaeological Sites

No known sites of European historical or archaeological significance are present in the new TSF site.

Several Aboriginal archaeological sites, areas of isolated artefacts, artefact scatters and historic sites have been located on the site during previous surveys. Compass will obtain existing site data from the Aboriginal Areas Protection Authority to inform further surveys of the site to be carried out as part of the assessment process for the new TSF.

Compass carries out its exploration and mining activities in accordance with authority certificates issued by the Aboriginal Areas Protection Authority pursuant to the *Northern Territory Aboriginal Sacred Sites Act*. The authority certificate currently held by Compass and relevant to the project area is C98/124. The Northern Land Council (NLC) and traditional owners will be consulted regarding management of any sites potentially affected by the project.

4.8 Air Quality

The siting of the new TSF is remote from significant pollution sources, although local air quality may be influenced by the construction of the BOP immediately to the north of the TSF site.

4.9 Noise

Existing noise levels near the TSF site are considered to be relatively low based on anecdotal evidence, although noise associated with the construction of the BOP is likely to have temporarily increased existing noise levels in the area.

5 IDENTIFICATION OF ISSUES

5.1 Potential Environmental Impacts

The environment of the new TSF site is essentially the same as that of the approved TSF location. As such, potential environmental impacts due to the new TSF are anticipated to be similar to those associated with the TSF that were presented and discussed in the BOP PER (Compass, 2005) and MMP (Compass, 2006). The assessment and approval process of the BOP through 2005–2006 addressed these impacts, and management and mitigation measures were developed in consultation between the Commonwealth DEWR¹, Northern Territory DNRETA, Compass and other stakeholders.

A summary of the potential environmental impacts as a result of the development and operation of the new TSF is provided below. As might be expected given that the original TSF was an integral component of the BOP as described in the PER (Compass, 2005), no new issues compared to those described in that document have been identified.

Management and mitigation measures developed for the BOP that will be implemented for the new TSF are outlined in Chapter 7.

5.1.1 Land Use

The use of approximately 35 ha of land for the new TSF site has the potential to alter the current landform and possibly impact future land and resource use.

5.1.2 Flora

5.1.2.1 Vegetation Clearing

Approximately 35 ha of vegetation will be cleared for the construction and operation of the TSF. Although no vegetation communities of declared conservation significance occur in the TSF site, either at the Commonwealth or territory level, one protected species found or likely to occur in the TSF site is the cycad *Cycas armstrongii*.

The clearing of vegetation will remove individual plants from the broader regional population. This has the potential to impact on the distribution, dispersal and genetic diversity of populations of species in the region. The removal of vegetation also has the potential to further fragment and reduce the area of habitat available for fauna species dependent on it for resources. The possible consequences of habitat fragmentation for fauna species are discussed in Section 5.1.3.

5.1.2.2 Weeds

A total of 33 introduced plant species have been recorded in and around the new TSF site, with several of these such as gamba grass and mission grass being of particular concern. Project-related vehicles

¹ Formerly the Department of the Environment and Heritage.

and equipment (especially earth-moving equipment) have the potential to introduce and/or spread weed species within and around the TSF site.

Increases in weed density and distribution have the potential to further reduce the available local habitat for fauna species that are dependent on specific vegetation communities. Several weed species also have the potential to alter the extent and intensity of fire surrounding the TSF site.

5.1.3 Fauna

5.1.3.1 Habitat Loss and Fragmentation

Vegetation clearing will potentially increase fragmentation of habitats in the local area, with possible consequences including increased inter- and intra-specific competition for resources due to reduced foraging areas, increased hunting pressure from prey species due to a reduction in habitat providing cover, and the isolation of breeding populations.

Habitat fragmentation can also lead to a change in the environmental conditions along vegetation corridors (such as increased light, wind and temperature). This can often favour the establishment and spread of 'edge' species, which are usually exotic, leading to a shift in vegetation community composition.

5.1.3.2 Sedimentation of Waterways

Disturbance to soils from construction activities may result in increased soil erosion and transport of soils to local waterways, such as the East Finniss River. This can affect water quality parameters such as total suspended solids, pH and dissolved oxygen, which can alter the quality of habitat for aquatic species, as well as directly adversely impacting on aquatic biota.

5.1.4 Groundwater

There is potential for seepage to occur through the TSF base, with possible effects on local groundwater quality.

5.1.5 Cultural Heritage and Archaeological Sites

Issues relating to the conservation of Aboriginal and non-Aboriginal heritage in the TSF site focus on the need to:

- Avoid, where possible, current known locations of significance.
- Minimise the potential disturbance to locations of archaeological significance discovered during project activities.
- Manage adverse impacts where they are unavoidable.

As such, any sites of Aboriginal cultural significance identified will be taken into account during planning and design of the new TSF.

5.1.6 Air Quality

The potential air quality issue associated with the construction of the new TSF is the liberation of particulate matter adversely affecting local air quality. Earthmoving equipment will also emit carbon dioxide and monoxide.

5.1.7 Noise

Potential sources of noise may include:

- Mobile construction equipment, including the excavator and bulldozer.
- Transport vehicles and reversing alarms.

Noise increment above background levels at nearby sensitive receptors is a potential issue.

5.2 Other Issues

5.2.1 Closure and Rehabilitation of the TSF

Potential issues associated with the closure and rehabilitation of the TSF are discussed in Section 2.8 of this report.

5.2.2 Biting Insects

Twenty different pest mosquitoes occur in the Northern Territory, some of which are capable of spreading harmful diseases such as Murray Valley encephalitis, Ross River and Barmah Forest virus disease (CDC, undated).

The potential for large and uncontrollable mosquito and biting midge breeding presents a potential nuisance and health risk (DLPE, 2000). This potential risk applies to Batchelor and surrounding areas given the ephemeral nature of, and riparian vegetation associated with, creeks draining the project area.

Inappropriate management of TSF decant water, formation of standing water during construction and ponding of water on the TSF surface could exacerbate existing, or create new, mosquito-breeding habitats.

6 ENVIRONMENTAL MANAGEMENT OF IMPACTS

The BOP MMP contains the following issue-specific management plans that outline the measures that will minimise and mitigate potential environmental impacts as a result of that project:

- Air Quality Management Plan.
- Biological and Land Management Plan.
- Cultural Heritage Management Plan.
- Emergency Response Plan.
- Fire Management Plan.
- Hazardous Materials and Waste Management Plan.
- Noise and Vibration Management Plan.
- Radiation Management Plan.
- Stakeholder Management Plan.
- Water Management Plan.

The new TSF will be covered by the measures in these plans. A summary of the main management and mitigation measures is provided below to demonstrate that the construction and operation of the new TSF can be appropriately managed.

6.1 Land Use

Impacts to land use in the vicinity of the new TSF site will be minimised by its proximity to the BOP mineral leases and the fencing of the site to prevent access by wandering stock. In addition, TSF design, construction and operation will be consistent with the objectives for developing the region in a manner that preserves its rural nature while allowing continued development at a sustainable level. This will be achieved by:

- Continued consultation and negotiation with NLC and traditional owners.
- Minimising the footprint of the new TSF.
- Implementing the environmental aspects of the BOP MMP.
- Developing appropriate post-closure land uses.

6.2 Flora and Fauna

6.2.1 Vegetation Clearing

Measures to minimise impacts as a result of vegetation clearing will include:

- Designing the new TSF to minimise vegetation loss.
- Retaining as much *Eucalyptus miniata* and *E. tetradonta* +/- *E. chlorostachys* open forest to woodland and *Eucalyptus papuana*/*Corymbia foelscheana*/ *Melaleuca* spp. open woodland to grassland as possible when siting the new TSF.

- Where possible, using previously disturbed and modified areas in preference to undisturbed areas.

6.2.2 Fauna Protection

Measures to minimise impacts to fauna, and threatened fauna in particular, will include:

- A pre-clearance survey to detect the presence of any nationally listed fauna species of conservation significance in the immediate area to be cleared, specifically:
 - Northern quoll (*Dasyurus hallucatus*).
 - Partridge pigeon (*Geophaps smithii*).
 - Red goshawk (*Erythronorchis radiatus*).
- In the event that these species are present, the potential for trapping and relocation of individuals will be discussed with NRETA.
- Fencing of the new TSF to prevent access by stock and large ground-dwelling mammals.
- A 40 km/hr speed limit along the access road to minimise the potential for vehicle collisions with fauna, and the partridge pigeon in particular.

6.2.3 Weed Control

Measures to minimise impacts due to weeds will include:

- Training and inducting all Compass and contractor personnel in the weed control management procedures before commencing activities at the new TSF site.
- Ensuring that all Compass and contractor personnel are aware of the location and extent of declared noxious and environmental weed species in areas to be disturbed during construction.
- Where possible, planning construction activity to minimise the movement of plant and equipment between areas of known noxious weed infestations.

6.3 Surface and Groundwater

6.3.1 Tailing Decant and Seepage

The existing groundwater monitoring bores (Table 4.1) will be used to monitor groundwater levels and quality. Measures to manage potential impacts due to tailing decant and seepage will include:

- Recovering tailing decant and returning it to the process circuit via the process water dam².
- Collecting 'shallow' seepage from the TSF through the embankment in a toe drain.

² The TSF is designed to retain sufficient volume for runoff from major rainfall events (1 in 200 year ARI) and no excess discharge is expected. In the event of rainfall exceeding a 1 in 200 year ARI, excess water would drain via a spillway to a sedimentation trap.

- Collecting 'deep' seepage via bores or the groundwater drawdown cone resulting from the pit dewatering and recycling.

The commencement of dewatering activities at the Browns Oxide deposit may assist with the recovery of any potential seepage from the new TSF.

6.3.2 Erosion, Runoff and Sediment Control

Measures to manage potential impacts due to erosion and runoff will include:

- Revegetating disturbed areas as soon as practical.
- Minimising continuous slopes where scouring can occur, lining drainage lines with crushed rock or geotextile fabric, installing baffles to reduce water-flow velocities and, if necessary, installing sediment control structures, e.g., sediment fences (refer to Biological and Land Management Plan).
- Constructing and maintaining clean water diversion drains around disturbed areas.
- Directing runoff to a sedimentation trap.

6.3.3 Acid Rock Drainage

Measures to minimise the potential for ARD will include:

- Potentially acid-forming (PAF) waste rock will be encapsulated in a designated area within the new TSF.
- Management and mitigation measures will be incorporated into the construction and operation of the new TSF to ameliorate the volume and/or quality of ARD.
- Monitoring new TSF runoff and drainage.
- Capturing runoff and seepage from the new TSF embankment as described above for tailing decant and seepage.

6.4 Cultural Heritage and Archaeological Sites

Measures to minimise potential impacts to sites of Aboriginal and/or European cultural or archaeological heritage significance will include:

- Maintaining the existing relationships between Compass and the NLC and traditional owners, which have resulted in the successful management of advised 'no-go' areas in surrounding tenements.
- Ensuring that Aboriginal and historical archaeologists are on call during project construction in the event that ground surface visibility is poor or archaeological material is detected.
- Through induction, instructing construction personnel in recognition of cultural heritage features for avoidance and reporting processes in the event that new cultural heritage features are uncovered during construction.

6.5 Air Quality

Measures to minimise impacts to air quality will include:

- Minimising exposed areas susceptible to wind erosion.
- Undertaking progressive revegetation.
- Defining trafficked areas and ensuring that vehicles remain on official roadways and travel at appropriate speeds at all times.

6.6 Noise

Measures to minimise impacts due to noise and vibration will include:

- Limiting construction activities to daylight hours.
- Using smart alarms on machinery rather than standard reversing alarms.
- Recording complaints regarding noise levels and introducing additional mitigation measure where necessary.

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Browns Oxide Project
New Tailing Storage Facility

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BROWNS OXIDE PROJECT

New Tailing Storage Facility

Notice of Intent – Additional Information

CR 9001_1_AttachA

August 2007

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WP/DTP	Jill O'Neill
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1 INTRODUCTION

1.1 Background

This document has been prepared to support the Notice of Intent (NOI) for the Browns Oxide Project New TSF and contains additional information pertaining to the potential environmental impacts of the proposed TSF, in particular:

- The existing environment in the vicinity of the proposed new TSF for the Browns Oxide Project.
- Potential environmental issues associated with the construction and operation of the new TSF, particularly associated with flora, fauna, surface water and groundwater.
- Management and mitigation measures to minimise the potential for environmental impacts.
- The predicted residual impacts due to the new TSF.

1.2 Response to Previous NOI Comment

It should be noted that the previously proposed TSF described in the NOI submitted in December 2006 and subsequently withdrawn on 25 May 2007, has been superseded by the new TSF proposed in this NOI. The new TSF proposal incorporates information from detailed site investigations and refinement of the TSF design and location. It addresses many concerns raised with the previous TSF NOI, including:

- **Concern regarding vegetation disturbance on MLN 1161 and MLN 1158.** The new TSF will be entirely located within MLN 1157. Vegetation in MLN 1161 and MLN 1158 will not be disturbed by the new TSF. There is no significant riparian or rainforest vegetation on the site of the new TSF.
- **Concern regarding the extent of disturbance associated with TSF construction and the existing quality of the land.** Approximately 35 ha of land will be disturbed for the new TSF. This area has been subject to some disturbance associated with ancillary activities (e.g., borrow, topsoil storage) for the Browns Oxide Project approved under the MMP for the project. Undisturbed areas on the site of the new TSF are characterised by native vegetation with a high level of gamba grass (*Andropogon gayanus*) infestation.
- **Concern regarding the extent of disturbance associated with the TSF and the existing flora and fauna baseline data for this area.** The new TSF site is located in an area surveyed for flora and fauna during 2002 as part of the larger sulfide project and is immediately adjacent to the area surveyed during 2005 for the oxide project. As such, Compass is confident that the characterisation of the existing environment, identification of issues and residual impacts for flora and fauna can be undertaken with the required level of certainty.

1.3 Information Sources

This document draws on the information that was gathered, analysed and reported during the preparation of the Public Environment Report (PER) and its supplement for the Browns Oxide Project in 2005 (Compass, 2005) as well as more recent data that has been collected as part of the Browns Oxide Project construction phase monitoring and management where available (e.g., groundwater).

2 PROJECT DESCRIPTION

2.1 Overview

The Browns polymetallic oxide deposit comprises weathered rock from surface to a typical depth of 20 to 25 m, with two deeper pockets reaching 50 m depth. The oxide deposit overlies a major strata-bound polymetallic sulphide deposit hosted by Proterozoic graphitic shales, calcareous sediments and dolomite. The deposit is located on the northern limb of a tightly folded synclinal structure adjacent to the Giants Reef fault zone.

Current oxidised resources at Browns, as reported in the 2006 Compass Annual Report, comprise 2.64 Mt of ore at 1.02% copper, 0.12% cobalt and 0.15% nickel. This tonnage is based on a cut off grade of 0.5% copper or 0.10% cobalt and due to high metal prices additional lower grade ore will be milled.

Development of the deposit involves open pit mining techniques over a mine life of approximately three years. Ore will be milled and processed at a rate of approximately 1.3 Mt/a using a conventional crushing, grinding, atmospheric acid leach and solvent extraction-electrowinning circuit to produce 10,000 tonne copper cathode. The project will also use a resin in pulp and chemical precipitation circuit to produce 1000 tonne cobalt and 700 tonne nickel as a mixed metal carbonate concentrate each year of operation. All products will be transported by road to the Port of Darwin for export by ship. Tailing will be disposed of on site to an engineered TSF.

2.2 Status and Development

The Browns Oxide Project is currently under construction. A summary of the development schedule and the key milestones for commissioning and operation of the mine are shown in [Table 2.1](#).

Current activities include construction of plant and facilities, TSF (i.e., the approved TSF) and earthworks. Exploration activities have also continued within Compass' exploration tenements.

Table 2.1 Key development milestones

Item	Month
Commence mining	July 2007
Commence construction of approved TSF	July 2007
Commissioning of plant and facilities	Q4 2007
Commence production	Q1 2008
Operation phase commences	Q1 2008
End of mining at Browns Pit	July 2010

2.3 Need for New TSF Location

The original TSF associated with the approved BOP (i.e., the approved TSF) has been found to overlie a zone of potentially economic mineralisation, known as the Browns Zinc or Browns West deposit. As reported in the Compass 2006 Annual Report (Compass, 2006):

The three deepest RC drill holes have returned the best grade and widest intersections, although are still only testing the system at around 100 m below surface. Intercepts such as 9 m at 6.3% Zn and 13 m at 6.6% Zn in hole 06BD019 and 58 m at 4.18% Zn in hole 06BD018 indicate the potential to develop a significant zinc resource with additional drilling, especially at depth.

Further Browns Zinc intersections during 2006 drilling (Compass, 2006) are listed in [Table 2.2](#).

Table 2.2 Browns Zinc intersections

Hole	From (m)	To (m)	Interval (m)	% Pb	% Zn	g/t Ag
06BD02	27	45	18	1.37	3.39	17
06BD03	32	48	16	1.05	4.42	18
06BD10	83	88	5	0.85	3.33	9
And	103	168*	65	0.67	2.76	15
Including	112	128	16	0.82	2.87	14
And	131	135	4	1.41	3.91	23
And	141	154	13	0.59	3.07	16
And	158	168*	10	0.64	3.79	18
06BD014	41	60	19	0.89	4.33	16
06BD015	46	73	27	0.90	3.82	20
Including	58	63	5	1.33	6.19	19
06BD018	61	70	9	1.04	3.00	12
And	73	131	58	0.96	4.18	23
Including	97	117	20	1.18	5.73	29
06BD019	75	120	45	0.79	4.53	19
Including	87	96	9	1.12	6.31	21
And	101	114	13	0.94	6.60	23
06BD020	75	154	79	0.50	2.64	16
Including	99	124	25	0.69	3.23	20
And	139	143	4	0.59	4.35	18
And	146	154	8	0.70	4.68	25

* End of hole.

A substantial RC and deep diamond drill hole program to further define this mineralization commenced in May 2007. Compass are currently undertaking a further 1,720 m of drilling to test this zinc mineralisation.

Compass has no immediate plans to develop this resource. However, to avoid sterilisation of this zone, Compass intends to construct a new TSF to contain the tailing from ore processed from the Browns oxide deposit in a location adjacent to the approved TSF location.

2.4 Stakeholder Consultation

Compass has consulted with the following stakeholders regarding the new TSF:

- Government of Australia Department of Environment and Water Resources (DEW).
- Northern Territory Department of Primary Industry, Fisheries and Mines (DPIFM).
- Northern Territory Department of Natural Resources, Environment and the Arts (DNRETA)
Environment Protection Agency Program.

Regular project updates are provided through Stop Press articles of the Coomalie Community Government Council newsletter and Australian Stock Exchange (ASX) announcements.

The Compass website (www.compassnl.com.au) has also recently been updated to provide further information on project status.

3 TAILING

3.1 Characterisation

3.1.1 Overview

Ore comprises either black shale (70%) or supergene material (30%), most of which will report as tailing after recovery of the copper, cobalt and nickel.

Physical characterisation of the tailing samples has shown that (ATC, 2007):

- The supergene tailing can be classified as clayey sand, with 43% being less than 75 µm and a particle density of 2.98 t/m³.
- The black shale tailing can be classified as sandy silt, with 79% being less than 75 µm and a particle density of 2.80 t/m³.

Geochemical characterisation of tailing samples has shown that (ATC, 2007):

- The supergene tailing has a low sulfur content (0.16%) and is classified as NAF.
- The black shale tailing has a sulfur content of about 1% (although possibly two thirds is present in forms that are not acid generating) and is classified as PAF.

The testwork has also shown that a lag time of at least several months is likely before the onset of acidic conditions.

This PAF classification of the black shale tailing is not consistent with the findings from the metallurgical testwork undertaken by Compass. The process for the recovery of copper, cobalt and nickel from the oxide ore will be a sulfuric acid leach, with the copper, cobalt and nickel rapidly being solubilised. Extending the leaching time results in the continued consumption of sulfuric acid with little or no consequent increase in the dissolution of copper, cobalt and nickel, i.e., the ore contains significant amounts of acid-consuming materials (and it is for this reason that heap leaching has not been used for the Browns Oxide Project since acid would continue to be consumed in the heap by the gangue minerals¹).

Further geochemical testwork is planned and will include chemical analysis of liquor in tailing samples representative of the final flowsheet and the orebody. Column leach testing has also been commissioned by Compass to provide additional information concerning the likely extent and rate of acid production and the leaching potential of elements of environmental significance from the different tailing types.

Tailing will also contain residual levels of process reagents, e.g., extractant.

¹ This is why tank leaching is proposed, whereby the leaching time can be controlled with the pregnant solution being separated from the remaining solids, which will then be washed to further recover dissolved metals.

3.1.2 Radiation Content

A drilling and uranium analysis program was conducted in 2005, with data from 23 drill holes analysed. Conclusions from this data indicate (a) generally low levels of uranium with depth (median 13.7 ppm, mean 24.5 ppm), and (b) very short intersections of higher levels of uranium (up to 240 ppm). These pockets of higher uranium ore can be readily blended to reduce the level to below the 80 ppm uranium (or radioactive equivalent of 1 Becquerel per gram) cut-off value which defines ore as radioactive, as defined by The National Directory for Radiation Protection (APRANSA, 2007). As such, these low levels of uranium are considered not to require specific management measures (or impose specific constraints) concerning the use of waste rock in the construction of the TSF embankment and/or disposal of tailing in the TSF.

In addition, Compass will undertake a radiological monitoring program for the Browns Oxide Project in accordance with its Radiation Management Plan for the project. In particular, uranium (and other naturally occurring radioactive materials) will be sampled during grade control, which will allow blending to occur prior to introduction of ore into the process. A cross check on this will also be undertaken to analyse uranium in ore slurry after treatment in the mill. This monitoring program will allow Compass to determine the level of radiation entering the process and subsequently the tailings facility and to ensure that levels are at all times well below 80 ppm uranium.

3.2 Management

3.2.1 General

The tailing management strategy, design and operation will be based on:

- Placement of the tailing pipeline within a bund to ensure that no tailing can escape to the surrounding environment in the event of a leak or spill.
- Regular inspection of the pipeline and automatic monitoring of the pump pressure to detect line failure.
- Placement of a clayey lining on the internal face of the embankment and controlled tailing deposition.
- Maximum water re-use via collection in a decant pond and return to the process plant.
- Monitoring of:
 - Tailing and stored water levels/volumes, and water quality.
 - Installed instrumentation.
 - Seepage from the TSF during and after operations.
- Monitoring for the occurrence of significant dusting from the tailing beaches (and alteration of the tailing deposition regime if this is required).
- Annual surveillance audits.

3.2.2 Acid Rock Drainage (ARD)

3.2.2.1 Operations

Measures for the prevention and management of acid rock drainage from the TSF facility during operations include:

- The isolation and encapsulation of all potentially acid forming (PAF) waste rock in a designated area within the TSF structure to minimise exposure to water and oxygen and minimise potential for ARD generation. The PAF waste will be separated from the tailing by an internal dividing bund constructed of compacted layers of PAF waste.
- Design of a zoned soil and rockfill embankment, with the low permeability soil zone being located on the upstream face to minimise infiltration of water into the structure.
- Placement of non-acid forming rockfill in the external embankment of the TSF.
- The expected rate of rise of tailing within the TSF means that no single surface is likely to be exposed for any significant period of time during operations.
- Regular sampling and testing to confirm the geochemistry of the tailing.
- During operations, 'shallow' seepage through the embankment will be collected in a toe drain and recycled. 'Deep' seepage, i.e., that through the TSF base, will be either detected by monitoring bores, in which case it will be extracted and returned to the TSF and/or process plant, or captured by the groundwater drawdown cone resulting from the pit.
- 'Mature storage' seepage through the base of the TSF during operations is likely to be of the order of 50 m³/day. Mounding beneath the storage facility is expected to be a local response only, and seepage from the active storage will be captured by the drawdown cone resulting from the pit.
- Regular monitoring of groundwater bores.
- More detailed assessment of seepage from the TSF and the overall groundwater response to the pit will be carried out using the results from monitoring during production, with final closure protocols determined during this period.

3.2.2.2 Post-Closure

For TSF closure, a dry cover (also known as a 'store and release' cover) is proposed to minimise infiltration of water into the structure and minimise potential for acid rock drainage to occur. Dry cover systems are a common prevention and control technique for PAF waste rock and tailings used at numerous mine sites around Australia and the world. Dry covers can involve a single layer of oxidised rock or soil or they can be quite complex involving several layers of different material types.

The purpose of a dry cover system is to control or limit the quantity of water infiltrating into the PAF waste below. The amount of infiltration through the dry cover is therefore the key consideration in the design of the cover system. The volume of water which infiltrates through the cover system is dependent on:

- Rainfall.
- Evaporation.
- Transpiration.

- Soil moisture storage properties.
- Runoff.

The dry cover for the new TSF will be designed with these site-specific considerations taken into account.

On closure, indicative seepage rates are expected to range from 0.25 L/s in the wet season to zero in the dry season. The critical factor for seepage quality post-closure is the air/oxygen diffusion rate through the cap, not the rate of seepage. The primary design criteria for the TSF cap will be to ensure that there is sufficient depth of water available in the 'store and release' layer to protect the clay layer from drying out.

4 EXISTING ENVIRONMENT

4.1 Terrestrial Flora

4.1.1 Background

Two flora surveys have been undertaken of the Browns Oxide Project region over the past six years. Judy Egan, Botanical Consultant (Egan, 2005), undertook a flora impact assessment for the BOP PER, which focussed on the 1.75 km² (175 ha) BOP area and selected surrounding vegetation types. This area is located immediately to the north of the location of the new TSF. Egan's assessment built on the previous flora assessment of the broader region in and around the BOP mineral leases undertaken by Metcalfe in 2002 (Metcalfe, 2002), which covered a much larger area of 37.5 km² (3,750 ha), including the new TSF site.

Egan (2005) selected 20 sites across a range of vegetation communities for ground truthing in and around the Browns Oxide Project area. Of these, 17 were assessed using 20 m x 20 m quadrats (400 m²) and the following characteristics were recorded:

- Vegetation structure (height of upper, mid and ground stratum species).
- Species composition and dominance.
- Percentage canopy cover for each species.
- Presence or absence of introduced species (weeds).
- Level of disturbance (including fire, feral animal and anthropogenic impacts).
- Environmental features including landform, aspect, soils and drainage patterns.

4.1.2 Existing Conditions – Browns Oxide Project Area

Native vegetation distribution in the project area closely reflects the interplay of topography and soils, and the influence of seasonal fluctuations in fresh water supply and drainage. Consequently, the pattern of vegetation broadly corresponds to major topographic contours. Most of the project area comprises dryland savannah vegetation on gentle lower slopes and foothills that support eucalyptus-dominated communities. These communities comprise various formations ranging from open woodland to woodland.

In general, the plant species recorded within the project area are common and widespread in the region. There are no vegetation communities of declared conservation significance, at either the Commonwealth or territory level, in the project area. Similarly, there are no plant species of conservation significance listed under the EPBC Act in the project area, nor do records exist of any rare or endangered plant species. The only protected species found or likely to occur in the project area is the cycad *Cycas armstrongii*, which is listed as threatened under the *Territory Parks and Wildlife Conservation Act*. This species is present within several vegetation communities in the project area.

Metcalfe (2002) identified 10 major vegetation communities (VC) – in addition to previously mined or disturbed areas – within the 3,750 ha survey area ([Figure 4.1](#)).

4.1.3 Existing Conditions – New TSF Site

4.1.3.1 Summary

Vegetation of the site is dominated by *Eucalyptus tetradonta*/*E. miniata* Open Woodland, which largely comprises eucalypt-dominated open woodlands with minor areas of denser woodland habitat. Characteristic species in this vegetation association include (Egan, 2005):

- *Eucalyptus miniata*, *E. tetradonta* and *E. confertiflora*.
- *Erythrophleum chlorostachys*.
- *Brachychiton megaphyllus*.
- *Cycas armstrongi*.

An area of *Eucalyptus papuana*/*Corymbia foelscheana*/*Melaleuca* spp. Open Woodland to Grassland occurs in the northeast portion of the site. Characteristic species in this vegetation association include (Egan, 2005):

- *Eucalyptus papuana*.
- *Corymbia foelscheana*.
- *Lophostemon grandiflorus*.
- *Melaleuca dealbata*.
- *Acacia auriculiformis*.

Large areas of vegetation have been cleared across the site of the new TSF for the excavation of borrow and storage of topsoil. There are no riparian or groundwater-dependent vegetation communities (e.g., rainforest, vine forest or aquatic communities) in the new TSF site.

4.1.3.2 Vegetation Communities and Plant Species of Conservation Significance

There are no vegetation communities of declared conservation significance, at either the Commonwealth or territory level, in the area. There is no *Acacia auriculiformis* vine-thicket community, which is regionally significant, in the new TSF site.

The cycad *Cycas armstrongii*, which is endemic to the Northern Territory and is a common understorey species within Eucalypt-dominated woodlands, is listed as a threatened species under the *Territory Parks and Wildlife Conservation Act*. This plant is widespread within the new TSF site, with the estimated mean density of *Cycas armstrongii* being about 130 individuals per hectare.

4.1.3.3 Introduced Flora

Much of the new TSF site is subject to moderate to very dense weed infestation, with the most common weed species being gamba grass (*Andropogon gayanus*), calopo (*Calopogonium mucunoides*) and mission grasses (*Pennisetum* spp.).

4.2 Terrestrial and Aquatic Fauna

4.2.1 Background

Two fauna surveys have been undertaken of the BOP region since 2002. Ecological Management Services (EMS, 2005) undertook desktop assessment and field surveys during the wet season of 2005 which focussed on the 1.75 km² (175 ha) BOP mineral leases. This was immediately to the north of the location of the new TSF. This survey built upon the 2002 dry season survey by EMS of 37.5 km² (3,750 ha) of the broader region, including the new TSF site.

Eight terrestrial, 8 aquatic and 12 herpetofauna sites were systematically surveyed during the 2002 dry season, while 4 terrestrial and 2 aquatic sites were systematically sampled during the 2005 wet season. A summary of the fauna survey methods is given in [Table 4.1](#).

Table 4.1 Fauna survey methods

Type of Survey	Site Number		Method of Survey
	2002 Dry Season	2005 Wet Season	
Terrestrial Fauna	S1 – S7	S1, S2, S8, S9	Hair funnels
	S1 – S8	S1, S2, S8, S9	Tree-mounted traps
	S1 – S8	S1, S2, S8, S9	Elliot Type A traps
	S1 – S8	S1, S2, S8, S9	Elliot Type B traps
	S1 – S8	S1, S2, S8, S9	Wire cage traps
	S1 – S7	S1, S2, S8, S9	Pitfall trap
	S1 – S8	S1, S2, S8, S9	Timed area bird survey
	S1 – S8	S1, S2, S8, S9	Nocturnal call playback
	S1 – S8	S1, S2, S8, S9	Timed active area search (diurnal)
	S1 – S8	S1, S2, S8, S9	Timed active area search (nocturnal)
	S1 – S8	S1, S2, S8, S9	Spotlight survey
	S1 – S8, Aq1/Aq2, Aq5 – Aq8	S1, S2, S8, S9	Bat call detection (fixed point)
Aquatic Fauna	Aq1 – Aq8	Aq1, Aq9	Semi-aquatic vertebrates
	Aq1 – Aq8		Turtle trapping
Additional Reptile Search	H3 – H5, H9		Timed area search (rock outcrops)
	Aq6 – Aq8		Timed area search (riverine habitat)
	H2 – H6 – H7		Timed area search (upland Eucalypt habitat)
	H1 – H11 – H12		Timed area search (vine-forest habitat)
	Av1 – Av2		Timed area bird survey
Additional (Non-standard) Surveys	S1, S2, S4, S6, Aq5	S1, S2, S8, S9	Harp trap
			Vehicle spotlighting
			Bat roost searches
			Collection of scats and or skeletal remains

4.2.2 Existing Conditions – Browns Oxide Project Area

4.2.2.1 Summary

The project area and immediate surrounds support a range of fauna species including 18 amphibians (including the cane toad [*Bufo marinus*] which has only arrived to the area during the latest wet season), 38 reptiles, 120 birds and 33 mammal species (29 native and 4 introduced).

Amphibians. The number and abundance of amphibian species in the region is consistent with that of the wider 'Top End' of the Northern Territory, with diversity comparable to that of the nearby Litchfield National Park. Seventeen native amphibian species were observed during the combined dry and wet season surveys.

Reptiles. A high diversity of reptile species occurs in and around the site. The open forest and woodland habitat that dominates the site supports a high diversity of skinks and lizards, while the acacia regrowth/monsoon vine-forest habitat in the north and the open drainage areas to the north and east of the BOP mineral leases (but not in the new TSF site), respectively, support a reduced reptile diversity and abundance.

Mammals. Twenty-eight native mammal species have been identified in and around the site, including microchiropteran bats, rodents and macropods. The highest diversity of mammals is in the upland eucalypt forest habitat to the north of the site, while the open drainage and floodplain habitats in the region have low species diversity. Similar species are present throughout the dry and wet seasons.

Birds. There are approximately 120 bird species in and around the site, and this is about half the number of species in surrounding areas, including Litchfield National Park. The majority of species are widely distributed in the open forest/woodland habitats that are common in and around the area, with the remaining species usually associated with wetlands or freshwater habitats; a limited number occur primarily in riparian forests or vine thickets to the north of (but outside) the new TSF site.

4.2.2.2 Fauna of Conservation Significance

Three species listed as vulnerable or endangered under the EPBC Act are present, or potentially present, within the project area (Figure 4.2):

- Northern quoll (*Dasyurus hallucatus*).
- Partridge pigeon (*Geophaps smithii*).
- Red goshawk (*Erythrotriorchis radiatus*).

Additional species listed as vulnerable or near threatened under the TPWC Act that are present, or potentially present, within the project area are:

- Northern death adder (*Acanthophis praelongus*).
- Yellow-spotted monitor (*Varanus panoptes*).
- Brush-tailed phascogale (*Phascogale tapoatafa*).
- Bush stone-curlew (*Burhinus grallarius*).
- Black-footed tree rat (*Mesembryomys gouldi*).
- Arnhem Land pebblemound mouse (*Pseudomys calabyi*).
- Pale field-rat (*Rattus tunneyi*).
- Arnhem sheath-tail bat (*Taphozous kapalgensis*).

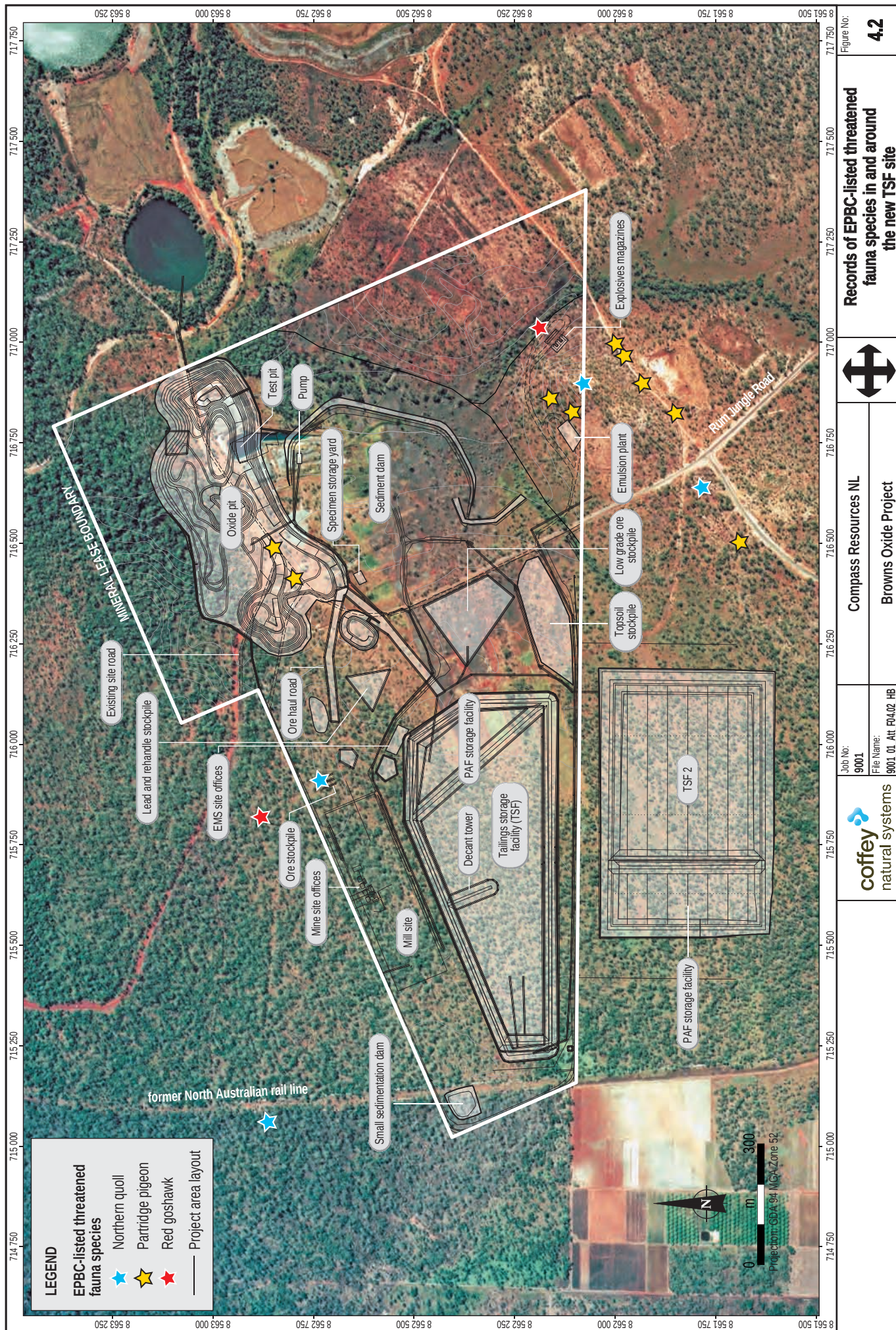


Figure No:

Records of EPBC-listed threatened fauna species in and around the new TSF site



Compass Resources NL

Browns Oxide Project

Job No:

9001

File Name:

9001_01_Alt_P0402_HB

coffey
natural systems

9001_01_Alt_P0402_HB

4.2.2.3 Introduced Fauna

Four introduced vertebrate fauna species have been identified in the project area and are common in the region: the domestic dog, feral pig, cane toad and feral cat. Of these, the feral pig, cane toad and feral cat are of most concern within the project context.

4.2.3 Existing Conditions – New TSF Site

4.2.3.1 Summary

Fauna of the new TSF site is expected to be similar to that of the Browns Oxide Project area, with the exception that there is no riparian, rainforest, vine forest or aquatic habitat in the new TSF site. As such, fauna is likely to be dominated by species characteristic of the open savannah woodland habitat that comprises most of the site and surrounding region.

4.2.3.2 Fauna of Conservation Significance

The absence of riparian, rainforest, vine forest or aquatic habitat is likely to limit the presence of threatened species such as the red goshawk (although this species may overfly the area) in the new TSF site. However, species found in the *E. tetradonta* and *E. miniata* open woodland may be present.

There is no habitat suitable for migratory wetland bird species in the new TSF site.

4.2.3.3 Introduced Fauna

Introduced fauna recorded in the Browns Oxide Project area during 2005 such as the cane toad and feral cat are likely to be present in the site.

4.3 Surface Water

4.3.1 Existing Conditions

4.3.1.1 Hydrology

East Finniss River. The East Finniss River is an ephemeral stream that drains to the northwest, meeting the Finniss River some 8 km downstream from the project area. A gauging station (GS8150097) is located on the East Finniss River, 5.6 km downstream of the former Rum Jungle Mine site and 2.3 km upstream of the confluence with the Finniss River ([Figure 4.3](#)). This station has been the designated site for estimating annual pollutant loads for the Rum Jungle Rehabilitation Project. A continuous gauging station (GS8150200) also operated immediately downstream of the former Rum Jungle Mine site during the periods 1981–1988 and 1991–1998.

Base flow is generally not established in the East Finniss River until sustained monsoonal rains arrive in January and is generally sustained until April. Flow usually commences up to one month later at GS8150097 than at GS8150200, due to early wet season rainfall patterns and the time required to wet-up the river bed (Lawton and Overall, 2002a). Salts evaporated on the river bed following the recessionary flow of the previous year are remobilised during these first rain events. Contaminant inputs to the East Finniss River then occur due to flows from the open cut pits and seepages from the overburden heaps at Rum Jungle.

Finniss River. During the dry season, the Finniss River typically consists of a series of long still pools of about 3 m water depth connected by shallower sections. During the wet season, overbank overflow often occurs and the depth and speed of flow along the river is more uniform than during the dry season (Jeffree and Williams, 1980).

A stream gauging station (GS8150204) operated on the Finniss River several kilometres downstream of the confluence of the East Finniss River (see Figure 4.3) during 1982–88 and 1993–95. Stream gauging stations that are currently operating on the Finniss River are located upstream of the confluence with the East Finniss River (Batchelor; GS8150010) and some distance downstream from the confluence (Gitchams; GS8150180), both at potential dam sites.

4.3.1.2 Water Quality

Information on water (and sediment) quality of the East Finniss and Finniss rivers is mostly provided by monitoring undertaken by the Department of Natural Resources, Environment and the Arts (DNRETA) and Australian Nuclear Science and Technology Organisation (ANSTO) as part of the Rum Jungle Rehabilitation Project. Additional data is also provided by First National Assessment of River Health (FNARH) macroinvertebrate surveys in 1998–99 and Charles Darwin University (CDU) surveys undertaken during 2003–2005.

East Finniss River. Metal loads and concentrations have decreased compared to levels prior to remediation of the Rum Jungle Mine site, however, they remain sufficiently elevated to impact on the freshwater ecosystem of the East Finniss River (Lawton, 1998b). Median total Cu concentrations at GS8150097, 5.6 km downstream of the former Rum Jungle Mine site, have decreased from about 7 mg/L pre-remediation (1968–81) to less than 0.5 mg/L post-remediation (1990–95), i.e., greater than a 90% reduction in concentration (Lawton and Overall, 2002a). Median total Zn concentrations have reduced from about 1.6 mg/L pre-remediation to about 0.4 mg/L post-remediation, i.e., a 75% reduction in concentration. Median total Mn concentrations have reduced from about 3 mg/L pre-remediation to about 1 mg/L post-remediation (1990–95), i.e., a 67% reduction in concentration.

Concentrations of pollutants in the East Finniss River tend to be highest during the first flush of the wet season and during the late wet season recessional flows when dilution effects are minimal.

Approximately 70 t/a of Cu, 80 t/a of Mn and 25 t/a of Zn was estimated to be delivered to the Finniss River from the former Rum Jungle Mine site via the East Finniss River during years of normal rainfall before remediation. Jeffree et al. (2001) determined post-remediation loads (for the period 1990–93) to have been reduced seven times for Cu, five times for Zn, four times for Mn and three times for sulfate. The latest data obtained by CDU in 2003–04 (see Enesar, 2005) indicates that annual loads of Cu, Mn and Zn remain generally similar to loads reported by Lawton and Overall (2002a) during the late 1990s.

Summary statistics of metal concentrations from 14 sampling occasions undertaken by CDU during the wet seasons of 2003–04 and 2004–05 near GS8150097 are shown in [Table 4.2](#). Also shown in the table are ANZECC/ARMCANZ (2000) Australian water quality guideline (AWQG) trigger values (TVs) for protection of slightly to moderately disturbed ecosystems, which apply to filtered metal concentrations. Values are adjusted for water hardness, based on water being classified as ‘very hard’².

² Data presented in Lawton and Overall (2002a) show water hardness of the East Finniss River to range from ‘extremely hard’ (400 mg CaCO₃/L) about 1 km downstream from the Rum Jungle Mine site to ‘very hard’ (180–240 mg CaCO₃/L) towards the confluence with the Finniss River.

There is some evidence of a further decrease in metal concentrations since 1990–95. However, concentrations of Cu on all sampling occasions have exceeded TVs for protection of slightly to moderately disturbed ecosystems, which are based on protecting 95% of species with 50% confidence. For ecosystems that can be classified as highly disturbed, it may be considered appropriate to apply a less stringent trigger value, such as TVs that protect 90% of species, or perhaps even 80% (ANZECC/ARMCANZ, 2000). The trigger value for Cu that protects 80% of species and is adjusted for 'very hard' water hardness is 0.013 mg/L, and is still exceeded on all sampling occasions. The median Cu concentration is over four times higher than this less stringent TV.

Table 4.2 Metal concentrations in East Finniss River at GS8150097 during wet seasons of 2003–04 and 2004–05

Metal (n=14)		Minimum (mg/L)	Maximum (mg/L)	Median (mg/L)	Mean (mg/L)	% of Metal Present in Filterable Form	AWQG TVs (95% protection level) (mg/L)
Al	Total	0.016	0.483	0.284	0.248	-	-
	Filtered	0.005	0.095	0.032	0.034	14	ID
Cd	Total	0.0002	0.0009	0.0003	0.0004	-	-
	Filtered	0.0002	0.0009	0.0003	0.0003	93	0.0011
Co	Total	0.072	0.215	0.111	0.120	-	-
	Filtered	0.071	0.214	0.110	0.118	99	ID
Cu	Total	0.053	0.182	0.134	0.136	-	-
	Filtered	0.018	0.143	0.057	0.062	46	0.0073
Fe	Total	0.127	0.411	0.278	0.269	-	-
	Filtered	0.0007	0.023	0.0006	0.0007	2	ID
Mn	Total	0.221	1.36	0.439	0.534	-	-
	Filtered	0.215	1.29	0.445	0.531	99	1.9
Ni	Total	0.066	0.204	0.099	0.109	-	-
	Filtered	0.065	0.202	0.097	0.107	98	0.057
Pb	Total	0.0003	0.0015	0.0010	0.0009	-	-
	Filtered	0.00002	0.0002	0.00002	0.00004	5	0.040
U	Total	0.005	0.014	0.008	0.009	-	-
	Filtered	0.003	0.011	0.005	0.005	58	ID
Zn	Total	0.063	0.277	0.115	0.126	-	-
	Filtered	0.054	0.289	0.107	0.118	94	0.072

ID = insufficient data to establish trigger value.

Values in bold exceed AWQG TV for protection of slightly to moderately disturbed ecosystems (95% protection level).

Concentrations of Ni and Zn also exceed TVs that protect 95% of species.

There is a consistent pollution gradient in the East Finniss River downstream from the former Rum Jungle Mine site. An extensive survey conducted during late wet season flow in 1994 showed that concentrations decrease in a gradient to about half the initial concentration 5.6 km downstream at GS8150097 (Lawton and Overall, 2002a). The recent water quality surveys undertaken by CDU during the 2003–04 and 2004–05 wet seasons also found that metal concentrations near the former Rum Jungle Mine site were up to about two-fold higher than measured further downstream at GS1850097 (see Table 4.2).

The same pollution gradient is evident during the dry season. Dostine (2002) reports that total Cu concentrations in the early 1998–99 dry season were 1.6 mg/L immediately downstream of the former Rum Jungle Mine site, decreasing to 0.02 mg/L near the confluence with the Finnis River. Total Cu concentrations along the East Finnis River were lower during the late dry season, ranging from 0.32 to 0.015 mg/L. The same trend of decreasing concentrations along the East Finnis River and lower concentrations during the late dry season compared to the early dry season were also observed for total Mn and Zn.

The CDU surveys in 2003 and 2004 also included sampling of water pools formed in the East Finnis River during the dry season. At site GS8150097, metals concentrations in these pools were lower compared with concentrations in water flowing down the stream during the wet season, with the exception of Mn. In contrast, concentrations of metals in pools at GS8150200 near the former Rum Jungle Mine site were much higher than concentrations in water flowing down the stream during the wet season.

Extensive dolomite and magnesite formations underlie the former Rum Jungle Mine site. The acid-buffering capacity of these minerals has attenuated many of the impacts from acid rock drainage, although the buffering capacity of carbonate-dominated groundwater pre-remediation was often overwhelmed by the acid generated in the waste rock dumps (Lawton and Overall, 2002a). The median pH of water at GS8150097 was pH 4.2 pre-remediation (1967–81), but has improved since remediation such that the median pH for the period 1990–95 was pH 6.3 (Lawton and Overall, 2002a). CDU surveys in 2003–05 determined the pH at this location to range between 6.2 and 7.5 during the wet season (Enesar, 2005). The pH of water in two pools formed during the dry season of 2004 was more alkaline, with pH of 7.9 and 8.1. In contrast, upstream near the mine site at GS8150200, water in pools formed during the dry season was acidic with pH ranging between 3.5 and 4.4. The pH increased with the onset of wet seasons flows, ranging between 5.3 and 6.4.

There is limited data for total suspended solids (TSS) in the East Finnis (and Finnis) River, with most of the available data collected during the 1993–94 wet season. This data showed that approximately 111 t of suspended solids passed GS8150200 in the East Finnis River immediately downstream of the former Rum Jungle Mine site, while twice this load (219 t) passed GS8150097, 5.6 km further downstream (Lawton and Overall, 2002a). Concentrations of TSS in 12 flow-weighted composite samples collected at GS8150097 during that wet season ranged between <0.1 and 20.4 mg/L, with 11 of the 12 samples being less than 5 mg/L. The mean concentration of all of these samples was 3.3 mg/L.

More recent sampling between 3 and 28 January 2005 (by CDU) during periods of flow near GS8150097 showed TSS concentrations to range between 3.1 and 6.0 mg/L, with a mean concentration of 4.9 mg/L (Enesar, 2005). Slightly higher TSS concentrations were measured immediately downstream of the former Rum Jungle Mine site, ranging between 7.4 and 9.5 mg/L. During the same period, TSS concentrations in three samples from the Finnis River (immediately upstream of the confluence with the Finnis River) ranged between 10 and 37 mg/L.

Finnis River. Measurements of water quality of the Finnis River were undertaken during post-remediation fish surveys in the dry seasons of 1992 (July–August) and 1995 (July–August). General water quality characteristics of the Finnis River during these dry seasons were generally similar and can be summarised as follows (Jeffrey et al. 2001):

- Shallow water depths (2 to 4 m).

- Water temperatures ranging from 19 to 24°C.
- Dissolved oxygen concentrations typically ranging from 70 to 100% saturation near the surface decreasing to approximately 10 to 30% saturation in bottom waters.
- pH ranging between 6 and 8, except at the site downstream from the confluence with Florence Creek (i.e., the furthestmost downstream site, 18 km downstream from the confluence with East Finniss River) where pH at the surface was approximately pH 6 decreasing to pH 4.5 at depth.
- Conductivity ranging from 0.01 to 0.38 mS/cm, with the lowest values measured downstream of Florence Creek due to the influence of softer waters from this watercourse which is fed by perennial springs from a sandstone aquifer.
- Low turbidity, ranging from <1 to 7 NTU.

Concentrations of total metals measured in the Finniss River pre- and post-remediation during dry season biological surveys are presented in Jeffree et al. (2001). Average concentrations of Cu, Zn, Co and Ni measured post-remediation in 1992 and 1995 decreased by one to two orders of magnitude downstream of the confluence of the East Finniss River compared with concentrations measured pre-remediation in 1973–74. Manganese concentrations also decreased but to a lesser extent. A decline in metal concentrations was also evident between 1992 and 1995. Concentrations measured along the Finniss River in the 1995 survey are shown in [Table 4.3](#). There is only a small increment in metal concentrations, if any, downstream of the East Finniss River compared with upstream locations.

Table 4.3 Total metal concentrations in Finniss River during the 1995 dry season

Distance from East Finniss River Confluence (km)	Co	Cu	Ni	Mn	Ca	Mg
	mg/L					
-18.0	0.0004	0.001	0.002	0.007	22	31
-0.1	0.0006	0.002	0.002	0.021	18	38
1.0	0.0005	0.004	0.005	0.005	24	39
3.0	0.0011	0.007	0.005	0.003	18	38
15.0	0.0002	0.003	0.003	0.0004	16	26
30.0	0.0008	0.003	0.004	0.021	1	1.4
AWQG TVs	ID	0.0073	0.057	1.9	-	-

ID = insufficient data to establish trigger value.

Also shown in Table 4.3 are AWQG TVs for protection of slightly to moderately disturbed ecosystems. Values are adjusted for water hardness, which is classified as being 'very hard' near the confluence with the East Finniss River. Concentrations of total Cu, Ni, and Mn at all locations in the Finniss River during the 1995 dry season sampling event complied with the TVs (which are applicable to filtered concentrations).

More recent surveys were undertaken in the 1998–99 dry season for the Australia-wide Assessment of River Health (AWARH) (Dostine, 2002). Results presented in Enesar, 2005 show no evidence of an increase in metal concentrations in the Finniss River downstream of the confluence with the East Finniss River. Total Cu concentrations measured in the 1998–99 are generally similar to concentrations measured in 1995.

Intensive water sampling was undertaken in the Finniss River at two locations, 1.2 km and 2.5 km downstream of the confluence with the East Finniss River, prior to and during the first flush of the East Finniss River in the 1997–98 wet season (Jeffree et al., 2001; Twining et al. 2002). Filtered metal concentrations in the Finniss River at the time when the impact of the first flush from the East Finniss River was greatest are shown in **Table 4.4**. Concentrations of Cu were over an order of magnitude higher than the AWQG TV, and Ni and Zn concentrations also exceeded respective TVs. However, metal concentrations were substantially reduced from concentrations measured during the first flush in 1973–74 and 1974–75, i.e., prior to remediation of the former Rum Jungle Mine site, particularly Cu which was about two orders of magnitude lower (Jeffree et al., 2001).

More recent wet season surveys have been undertaken by CDU during 2003–04 and 2004–05 in the Finniss River at Litchfield Park Road, located upstream of the confluence with the East Finniss River. Maximum filtered concentrations of all metals were less than AWQG TVs (Enesar, 2005).

Table 4.4 Filtered metal concentrations in Finniss River during the first flush of the 1997–98 dry season

Distance Downstream from East Finniss River Confluence	Co	Cu	Mn	Ni	Zn
	mg/L				
1.2 km	0.098	0.155	0.502	0.082	0.301
2.5 km	0.084	0.120	0.396	0.075	0.134
AWQG TVs	ID	0.0073	1.9	0.057	0.072

ID = insufficient data to establish trigger value.

Values in bold exceed AWQG TV for protection of slightly-moderately disturbed ecosystems (95% protection level).

4.3.1.3 Sediment Quality

East Finniss River. A sediment survey was undertaken during April 1993 at 27 sites along the East Finniss River between sites GS8150097 and GS8150200 (Lawton, 1998b). Bed sediments in the East Finniss River were found to be appreciably contaminated with metals. No appreciable decrease in metal concentrations was evident with increasing distance (over 5.6 km) from the former Rum Jungle Mine site. Mean 'total' metal concentrations in the <2000 µm fraction measured in that survey are shown in **Table 4.5**, along with mean background metals concentrations from control sites and interim Australian sediment quality guidelines (ISQG) recommended by ANZECC/ARMCANZ (2000). The guidelines contain two values, ISQG-low and ISQG-high, which delineate three biological effects ranges:

- Concentrations below the ISQG-low represent a range where adverse biological effects on benthic biota will rarely be observed.
- Concentrations between the ISQG-low and ISQG-high represent a range where adverse biological effects on benthic biota will occasionally be observed.
- Concentrations above the ISQG-high represent a range where adverse biological effects on benthic biota frequently occur.

Table 4.5 Mean ‘total’ metal concentrations in East Finniss River

Site	Cu	Zn	Mn	Ni
	mg/kg (dry weight)			
1993 survey				
East Finniss River (0–5.6 km downstream of mine; n=27)	695	95	240	80
Control sites	16	3.5	3.9	3.9
2003/04 survey				
East Finniss River at GS8150097 (n=4)	632	35	193	79
ISQG-low	65	200	-	21
ISQG-high	270	410	-	52

Values in bold are exceeding the ISQG-low and/or ISQG-high.

Copper and Ni concentrations in sediment of the East Finniss River are well in excess of the upper ISQG, therefore being in the range where adverse biological effects are frequently expected to occur.

A more recent sediment survey was conducted by CDU during 2003–04 (Enesar, 2005). These data indicate that there has been no improvement in sediment quality in the East Finniss River over the last decade.

Finniss River. Sediment sampling was undertaken in the Finniss River during 1996 at two sites (up to 18 km) upstream of the confluence and three sites (up to 11 km) downstream of the confluence with the East Finniss River (Jeffrey et al., 2001). Total metal concentrations in those samples are shown in [Table 4.6](#), along with ISQG recommended by ANZECC/ARMCANZ (2000). There is a marked elevation in metal concentrations at sites downstream of the confluence, decreasing with distance downstream. Metal concentrations in sediment of the Finniss River downstream of the confluence with the East Finniss River are markedly higher than metals concentrations in the sediment of the East Finniss River (see Table 4.5). Copper and Ni concentrations in sediment 4 km downstream of the East Finniss River confluence are about an order of magnitude higher than the ISQG-high, at which levels adverse biological effects frequently occur. At the furthestmost downstream site sampled (11 km downstream), Cu and Ni concentrations remain approximately two times higher than ISQG-high values. Zinc and Pb concentrations downstream of the confluence are also at levels where adverse effects could frequently be expected to occur.

Table 4.6 Total metal concentrations in sediment of the Finniss River during 1996

Distance from East Finniss River Confluence	Cd	Co	Cu	Fe	Mn	Ni	Pb	U	Zn
	(mg/kg dry weight)								
-18 km	0.05	5	17	5,454	101	5	16	4	<DL
-0.2 km	0.04	11	30	9,221	230	5	15	2	<DL
4 km	0.30	269	3643	12,284	582	371	127	129	1,896

Table 4.6 Total metal concentrations in sediment of the Finniss River during 1996 (cont'd)

Distance from East Finniss River Confluence	Cd	Co	Cu	Fe	Mn	Ni	Pb	U	Zn
	(mg/kg dry weight)								
8 km	0.35	193	1061	8,426	209	191	45	45	1,748
11 km	0.22	202	404	10,510	551	98	37	17	112
ISQG-low	1.5	-	65	-	-	21	50	-	200
ISQG-high	10	-	270	-	-	52	220	-	410

Values in bold exceed the ISQG-high.

4.3.1.4 Aquatic Ecology

East Finniss River. Pre-remediation fish surveys during low flow showed that very few fish survived in the 10-km section of the East Finniss River downstream of the former Rum Jungle Mine to the Finniss River confluence, where concentrations of Cu and Zn measured in the water were 55 and 44 mg/L, respectively (Jeffree and Twining, 2000). Fish kills were observed to be associated with fish entering the East Finniss River from side streams (Twining, 2002). Post-remediation, in 1996 and 1997, fish kills were still observed to occur in the East Finniss River (Twining, 2002). However, up to seven species of fish have been seen living in the stream, indicating some ecological recovery post-remediation, although this is well short of the potential diversity of up to 18 fish species in similar habitats elsewhere in the Finniss River system (Twining, 2002). Twining (2002) does not list Lorentz's grunter (*Pingella lorentzi*) as one of the seven species observed in the East Finniss River, or 18 species present in the Finniss River system. However, this species is reported to occur in the East Finniss River below the former Rum Jungle Mine site by Allen et al. (2002) and Stirrat (2002) (as cited in EMS, 2005). This species is known to occur in Australia only in this location and northern Cape York and is listed as vulnerable under the *Territory Parks and Wildlife Conservation Act*. It is not listed under the EPBC Act.

Pre-remediation surveys of benthic macroinvertebrates in the East Finniss River undertaken in 1973–74 showed similar results to the fish surveys, i.e., numbers of species and individuals were reduced in the 10-km section of the East Finniss River downstream of the former Rum Jungle Mine. A post-remediation survey was undertaken in 1993 (Jackson and Ferris, 1998). The study found that macroinvertebrates remained significantly less diverse and less abundant in the lower reach of the East Finniss River compared with control sites; however, there was evidence of some recovery compared to the severe degradation observed in the pre-remediation survey. A survey of benthic macroinvertebrates was also undertaken on eight occasions over a one year period during 1994–95 to investigate the spatial and temporal effect of effluent from the former Rum Jungle site (Twining et al., 2002; Edwards, 2002). There were significant spatial and temporal changes in macroinvertebrate community composition, which were highly correlated with changes in water quality. The poorest water quality was observed to occur late in the dry season at sites closest to the former Rum Jungle Mine. During the wet season, there was little difference in water quality between impact and reference sites due to the large dilutions and flushing out of any contaminants. Impacts on macroinvertebrates during the wet season are attributed to the physical impacts of high flows rather than toxicity from contaminants (Edwards, pers. com., 2001).

A decapod crustacean survey was undertaken in the East Finniss River on one occasion during 1994, and opportunistically during 1996 (Twining et al., 2002). This taxonomic group was chosen because of

its known sensitivity to pH and metals, particularly copper. Numbers of decapod genera were low, which was not unexpected since the East Finniss River is an ephemeral stream. Nonetheless, the survey indicated that contaminants from the former Rum Jungle Mine site were affecting decapods in the East Finniss River, since populations declined to zero upstream of the confluence with the Finniss River and re-appeared only in unaffected sidestreams or upstream of the mine site. However, the distribution of decapods in 1994 had improved from 1974–75 when no decapods were found in the East Finniss River downstream of the former Rum Jungle Mine to its confluence with the Finniss River (Twining et al., 2002).

More recently, extensive macroinvertebrate sampling and AUSRIVAS assessment of the East Finniss River was undertaken between 1995 and 1999 as part of the Australia-wide Assessment of River Health (AWARH), undertaken as part of the National River Health Program. These investigations, which involved 38 early dry season and 34 late dry season site visits, found most locations in the East Finniss River to be severely or extremely impaired.

Finniss River. Pre-remediation, fish kills occurred in the Finniss River for at least 15 km downstream of the confluence with the East Finniss River during the first flush of the wet season when moderate inflow from the East Finniss River coincided with low flows in the Finniss River (Jeffree and Williams, 1975). Post-remediation fish surveys were repeated in the Finniss River during the dry seasons of 1992 and 1995 (Jeffree et al., 2001). Comparison of these results with those of the pre-remediation surveys showed appreciable changes to fish communities downstream of the confluence with the East Finniss River (Jeffree et al., 2001). Prior to remediation, the impacted region of the Finniss River had reduced diversity and abundance of fish compared to sites unexposed to elevated concentrations of contaminants. Post-remediation, no statistically significant differences were observed in fish diversity or abundance between impact sites, i.e., sites downstream of the confluence with the East Finniss River, and unimpacted sites (sites upstream of the East Finniss River confluence and downstream of the Florence Creek confluence). An average of seven species were taken from the unimpacted zone compared with nine to ten species collected at sites in the impact zone.

The recovery in the abundance and diversity of fish species in the impacted zone of the Finniss River is attributed to the reduction in metal loads and concentrations following remediation (Jeffree et al. 2001). Prior to remediation, fish kills during the first flush were thought to be responsible for the residual impact on fish populations observed in the dry season surveys (Jeffree et al., 2001). The recovery in fish abundance and diversity may also possible be due to evolutionary tolerance to elevated concentrations of contaminants over four decades of exposure (Jeffree et al., 2001).

Pre-remediation surveys of decapod crustaceans in the Finniss River undertaken in 1973–74 showed similar results to the fish surveys, i.e., numbers of species and individuals were reduced downstream of the confluence with the East Finniss River. Below the confluence with Florence Creek, 30 km downstream of the confluence with the East Finniss River, no effect was observed. Post-remediation surveys of decapod crustaceans in the Finniss River were undertaken during the dry seasons of 1994, 1995 and 1996 (Twining et al., 2002). In the 1994 survey, there was a marked reduction in the population of shrimps and prawns for at least 14 km downstream of the confluence, similar to trends obtained in fish surveys prior to remediation (Jeffree and Williams, 1975). However, in 1996, decapod populations were higher immediately downstream of the confluence with the East Finniss River than at control sites. These data suggest that there was an improvement in the Finniss River system over the three years of the surveys (1994–96) which was attributed to a decrease in the impact of mine wastes, although such an interpretation is complicated by some inconsistencies in the surveys (Twining et al., 2002).

Macroinvertebrate sampling and AUSRIVAS assessment was also undertaken in the Finniss River under the National River Health Program between 1995 and 1999 (Dostine, 2002). Assessment using a model considered the least sensitive to seasonal bias showed the Finniss River immediately downstream of the confluence with the East Finniss River to be significantly impaired, whereas upstream of the confluence was similar to reference conditions (Dostine, 2002). However, assessments using alternative models showed that conditions at sites downstream of the East Finniss River confluence were similar to reference conditions.

4.3.2 New TSF Site

There are no significant surface water features in the new TSF site. Drainage of the site is generally from a south to north direction towards the Browns Oxide Project area (see Figure 5.1).

4.4 Groundwater

4.4.1 Groundwater System

Groundwater occurs at depths ranging from 2 to 12 m below surface in the project area, with an average depth of about 4 m. The groundwater levels fluctuate seasonally, with an average range of about 5 m. Groundwater hydrographs coincide with the monsoonal climate, with rainfall recharging aquifers during the wet season. Groundwater levels commence to rise about December in the early wet season and peak in February. The peak is followed by recession that continues until the annual rise starts again in the following wet season.

The rapid cyclic groundwater response to rainfall indicates that the aquifers in the project area are unconfined. The regular recessions also indicate that the groundwater system is dynamic, with groundwater discharging to creeks or taken up by transpiration. There is some evidence that groundwater levels have increased over recent years, which is thought attributable to the above average rainfall that has occurred during the 1990s.

Previous studies have proposed that there is both a shallow and deep aquifer system in the east of, and extending towards, the project area (Coffey, 2005). The shallow aquifer was considered to be only a few meters deep in the shallow lateritic soil and responsible for most of the contaminant migration from the old Rum Jungle dumps. The deeper aquifer was regarded as being a fractured system that is poorly connected and has little groundwater movement.

More recent studies undertaken for the Browns Oxide Project suggest a different conceptual model for the groundwater system (Coffey, 2005). Analysis of hydrographs shows that there is dynamic groundwater recharge and discharge in both deep and shallow bores. The uniformity of the responses suggests that similar groundwater processes such as recharge and discharge are occurring over a wide area and through a deep, relatively continuous saturated zone. Fracture zones may enhance this connectivity between shallow and deep aquifers. The aquifer boundaries and extent of connectivity are therefore considered to be uncertain, although it is thought that the aquifer may be regarded as a single unit rather than as separate and shallow deep aquifers. A trial pit was excavated to 31 m depth in 1999 to obtain bulk ore samples for the project. Observations during the excavation were that groundwater inflows were observed to occur from the footwall carbonates, faulted ground and hanging wall amphibolites. It is therefore thought likely that some separation in groundwater levels occurs between individual water-bearing features.

Testing of the Coomalie Dolostone aquifer for water supply purposes at Batchelor in the early 1980s indicated a transmissivity somewhat higher than values obtained for the aquifer at the project site. It is also worth noting the presence of transmissive karstic features within the fresh to slightly weathered aquifer.

4.4.2 Groundwater Flow

General trends in groundwater flow can be predicted based on the conceptual model of the groundwater system. If the aquifer is unconfined, groundwater movement would be expected to reflect the surface topography. Groundwater would therefore move towards the major creeks where it may sustain baseflow following the wet season or may sustain water in pools in otherwise dry creek beds.

During excavation of the trial pit, groundwater was intercepted approximately 8 m below surface. Evaluation of groundwater monitoring undertaken during dewatering of the pit indicates that drawdown is also influenced by lithology or geological structure (Coffey, 2005). Groundwater might therefore be intercepted by mine excavations at between 4 and 8 m below surface, depending on the time of the year.

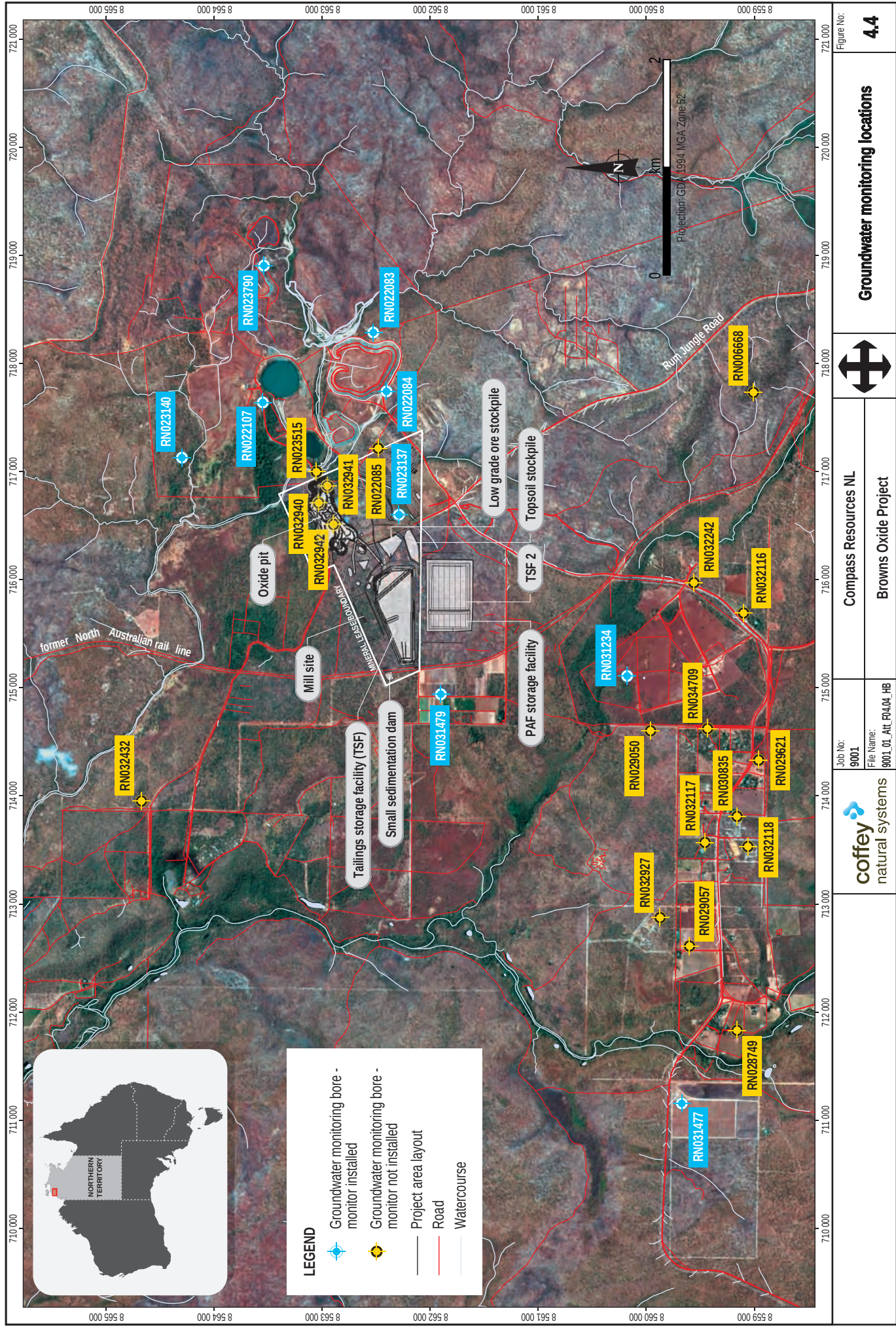
Groundwater drawdown in most of the bores monitored during the trial pit dewatering is considered to be attributable to the natural recession with season and not due to dewatering (Coffey, 2005). However, three bores (TPB1, 2, and 3) located between 140 and 240 m from the centre of the trial pit showed clear responses to pumping, with drawdown ranging from 0.8 to 3.3 m. A fourth bore (RN 23516) located 360 m from the trial pit also exhibited a drawdown of 0.14 m attributable to dewatering. Geological mapping indicates that this bore is linked to the pit by a fault. The drawdown registered at this bore may therefore not be representative of other locations in the aquifer equidistant from the trial pit.

4.4.3 Groundwater Users

The registered bore data for the project area and surrounds indicates 116 registered bores within a 3-km radius of the proposed mine. Of these, 15 appear to be production bores and 10 are located at the groundwater irrigation area (where crops such as mangos and vegetables are grown) located southwest of the mine.

Current and proposed groundwater bore monitoring locations for the Browns Oxide Project are shown in [Figure 4.4](#). These bores are being, or will be, monitored and sampled fortnightly for:

- Water level.
- pH.
- Electrical conductivity.
- Selected filtered metals and ions (i.e., Ca, Mg, Na, K, Cl, SO₄, CO₃, HCO₃).



4.4.4 Groundwater Quality

Monitoring of groundwater quality to the east of the project area has occurred as part of the Rum Jungle Rehabilitation Project. The 'shallow aquifer' was found to be contaminated with high levels of metals, high salinity and low pH due to leachate from the waste dumps, with typical concentrations being 10 to 100 mg/L copper, manganese, nickel and cobalt, pH of 3 to 4 and conductivity of 2,000 to 13,000 $\mu\text{S/cm}$ (Coffey, 2005). This contaminated shallow groundwater generally flows radially away from the dumps before deviating with the regional groundwater flow towards the East Finniss River (Coffey, 2005). Monitoring conducted up to 1986 indicated that the contamination of the 'deep aquifer' was confined to the immediate vicinity of the former Rum Jungle overburden heaps and open cuts. Water quality near Whites overburden heap had a conductivity in excess of 30,000 $\mu\text{S/cm}$ and pH of about 4. Pollutant transport is thought to be minor in the 'deep aquifer' compared with the 'shallow aquifer' (Coffey, 2005). There is considered to be insufficient data to make reasonable estimates of pollutant loads in groundwater originating from the former Rum Jungle Mine site (Gibson, 1998).

Investigations undertaken for the Rum Jungle Rehabilitation Project indicate that, although there is in-flow of groundwater to the East Finniss River approximately 500–700 m downstream of GS8150200, this is not a source of contaminants from the former Rum Jungle Mine site. Rather, the acid buffering capacity of the carbonate-dominated groundwater discharge at this location may be attenuating impacts on the East Finniss River from acid drainage by increasing pH and thereby precipitating metals (Lawton and Overall, 2002a).

For the actual project area, groundwater quality was measured in observation bores impacted by drawdown during dewatering of the trial pit. The results are summarised in [Table 4.7](#). Shallow groundwater in the weathered zone of the Whites Formation is poorer quality and slightly acidic compared with the deeper water reported in Table 7.22 (Coffey, 2005).

Table 4.7 Groundwater quality in trial pit monitoring bores

Bore	Aquifer	pH	Conductivity ($\mu\text{S/cm}$)
TPB1	Weathered carbonate aquifer	7.1	235
TPB2	Weathered Whites Formation/carbonate contact	5.9	3,550
TPB3	Fault zone	6.9	260

4.4.5 New TSF Site

During the recent site investigation for the new TSF, conducted by Australian Tailings Consultants in June 2007, eight new monitoring bores were established. The shallow subsurface geology at the new TSF site, as determined by the construction of these bores as well as soil test pits, comprises shale, clay, lateritic clayey gravel and amphibolite. At depth, the site is underlain by shale and amphibolite of the Whites Formation and Coolmalie Dolostone in the southeast portion of the site. From the test work to date, no faults have been identified within the vicinity of the site.

Aquifers are likely to occur within:

- Lateritic clayey gravel.
- Weathered, vuggy or fractured magnesite of the Coolmalie Dolostone.
- Weathered or fractured shale or amphibolite of the Whites Formation.
- Faults that intersect weathered or partially weathered zones of the bedrock.

Groundwater occurs at depths ranging from 3.0 to 8.4 m below surface around the new TSF site, with the direction of flow generally following topography. Groundwater under the new TSF location is likely to flow towards the Browns Oxide deposit open pit, whereas in the southern portion of the lease, the groundwater is likely to flow south and southeast (URS, 2007). In general, shallow groundwater monitoring bores have higher groundwater levels than deeper bores, indicating a downward groundwater flow gradient (Table 4.8).

Table 4.8 Groundwater monitoring bores for the new TSF

Bore	Water level (RL) 19-7-07	Water level (m below ground level)	Bore depth (m)	Cased interval (m below ground level)		Permeability (m/sec)	Permeability (m/day)
7a	72.70	6.16	10	4	10	3.0E-07	2.6E-02
7b	72.70	6.53	30	24	30	3.0E-07	2.6E-02
8a	66.50	8.20	10	4	10	3.0E-07	2.6E-02
8b	66.40	8.40	30	24	30	2.0E-07	1.7E-02
9a	68.90	3.00	10	4	10	6.0E-07	5.2E-02
9b	68.50	3.40	30	24	30	2.0E-08	1.7E-03
10	70.50	7.20	23.8	18	24	2.0E-07	1.7E-02
11	63.80	5.90	14.5	9	15	3.0E-07	2.6E-02

Permeability testing on groundwater monitoring bores indicated values ranging between 1.7E-02 and 5.2E-02 m/day. The results indicate relatively low permeability strata was intersected for the test intervals within Coolmalie Dolostone and Whites Formation.

4.5 Air Quality

An air quality impact assessment for the Browns Oxide Project was undertaken by Holmes Air Sciences (Holmes, 2005). The project area is remote from pollution sources and the only air pollutant that is likely to be present at significant concentrations is particulate matter from wind-blown dust and bushfire smoke during the dry season.

No direct monitoring of existing air quality has been undertaken.

4.5.1 New TSF Site

Air quality at the new TSF site is expected to be influenced by activity resulting from the construction of the Browns Oxide Project (e.g., dust, exhaust emissions).

4.6 Greenhouse Gas Emissions

Greenhouse gas emissions produced during the construction and operation phases of the Browns Oxide Project have been estimated using AGO [Australian Greenhouse Office] Factors and Methods Workbook (AGO, 2004). Estimates do not include the one-off greenhouse emission from vegetation clearing (see Section 7.1) or minor emissions from the hydrometallurgical process.

During construction, it is estimated that 25 t of diesel (30 kL) will be consumed each week by transport, earthmoving and similar activities, and by one or more on site generators. This will result in an annual point source production of 4,200 t CO₂-e (Table 4.9) and, over the peak nine months of construction, a total of 3,200 t CO₂-e.

Table 4.9 Greenhouse gas emissions

Energy Source	Use	Amount per Year	Energy Content*	Energy per Year (PJ)	Emission Factor*	GHG Emissions per Year (t CO ₂ -e)
<i>Construction</i>						
Automotive diesel	Transport, earthmoving equipment, construction equipment, generators	1,300 t (1,560 kL)	38.6 GJ/kL	0.06	2.7 t CO ₂ -e/kL (point source)	4,200
Energy Source	Use	Amount per Year	Energy Content*	Energy per Year (PJ)	Emission Factor*	GHG Emissions per Year (t CO ₂ -e)
<i>Operations</i>						
Automotive diesel	Transport, earthmoving equipment, mining equipment	2,600 t (3,120 kL)	38.6 GJ/kL	0.12	2.7 t CO ₂ -e/kL (point source)	8,400
Electricity	Processing plant, on site power	0.19 PJ (54 GWh)	-	0.19	206 Gg CO ₂ -e/PJ (full fuel cycle)	39,000
Operations total		-	-	0.31	-	47,400

* AGO (2004).

During operations (excluding exploration), it is estimated that 50 t of diesel (30 kL) will be consumed by the project each week, with a maximum electrical load of 7.5 MW being sourced from the Power and Water Corporation (PAWC)³. Therefore, annual greenhouse gas emissions are estimated to be 47,400 t CO₂-e during operations (see Table 4.9).

4.6.1 New TSF Site

The new TSF is expected to contribute a minor amount to the annual greenhouse gas emissions of the project.

³ Energy for the project area will be sourced from the Northern Territory PAWC through gas turbine generators at the Channel Island Power Station.

4.7 Noise

A noise impact assessment for the Browns Oxide Project was undertaken by Holmes Air Sciences (Holmes, 2005). Anecdotal evidence indicates that existing noise levels in the project area are low, although no quantitative noise survey has been undertaken.

4.7.1 New TSF Site

Given its proximity, noise levels at the new TSF site are likely to be influenced by noise associated with the construction of the Browns Oxide Project.

4.8 Infrastructure and Transport

The existing infrastructure and transport in the region remains as documented in the Browns Oxide Project PER, with the exception of <<BOP construction and new roads as proposed in PER >>.

4.8.1 New TSF Site

There is no infrastructure or roads located on the new TSF site.

4.9 Land and Resource Use

The description of land and resource use is drawn from DLPE (2000).

4.9.1 Land Tenure

The project is located within the Coomalie Community Government Council (Coomalie), which covers a total area of 1,507 km². In 2002, approximately 80% of the properties in the area were under freehold title (and this is considerably higher than in any other Northern Territory region, with the exception of urban centres) (Price and Baker, 2003).

Less than 2% of the land was vacant Crown land, including the former Rum Jungle Mine site. Only one property, comprising about 0.01% of the region, is classified as a reserve, and this is located along Coomalie Creek where it intersects the Stuart Highway (Price and Baker, 2003).

The Power and Water Corporation owns or manages 17% of the Coomalie region for protection of the Darwin River Dam catchment. The Northern Territory Land Corporation also holds Crown leases over approximately 5% of the area, these being old pastoral stations in the west of the region, and riparian corridors along the Adelaide River. The Finnis River Aboriginal Land Trust owns several freehold blocks covering 180 km² (12% of the region) (Price and Baker, 2003).

The project is located in areas of predominantly Aboriginal freehold land immediately west of, and adjacent to, the historic Rum Jungle Mine.

4.9.2 Land Use Objectives

The Northern Territory *Planning Act* provides for a single integrated Northern Territory Planning Scheme, which comprises land use objectives (policy), development provisions (town, area and community plans) and incorporated documents (assessment criteria and guidelines). For the Browns Oxide Project area, the relevant document under this act is the Coomalie Planning Concepts and Land Use Objectives (DLPE, 2000). Mining activity in this area is consistent with the planning scheme.

The key land use objectives for the Coomalie region are to (DLPE, 2000):

- Protect land and water resources.
- Promote and use the natural attributes of the region.
- Provide an integrated transport network.
- Promote human health.
- Promote tourism development.
- Promote development of mining and extractive industries.
- Protect vegetation and prevent land degradation.
- Protect sites with significant heritage status.

Additional land use objectives in relation to the mining and extractive industry include:

- Providing mine access routes.
- Establishing appropriate land uses on mine sites, as part of the rehabilitation program, prior to mining lease surrender.
- Minimising the impact of mining and extractive industries on human health.

4.9.3 Land Use

Current and proposed land use in Coomalie is defined in DLPE (2000).

Residential development in Coomalie is either urban, as occurs at Adelaide River and Batchelor, or rural.

Commercial and retail activity is primarily focused in Adelaide River and Batchelor, with some additional services along the Litchfield Park Road. Three zones within the Batchelor Town Plan are allocated for business use.

The main industrial precinct within Coomalie is located at Batchelor where 19 lots cater for industrial, light industrial and service commercial land uses. A second industrial area of 30 lots is located near Batchelor, approximately 2.5 km southwest of the proposed project site.

Horticulture/agriculture is considered to be one of the major and more sustainable contributors to the local economy. There is a strong and growing interest in horticulture with an increasing number of landowners entering the industry, particularly in areas with high ground water potential around Batchelor and along the fertile levees of the Adelaide and Finnis rivers.

Cattle grazing occurs mainly in the southeastern and southwestern parts of Coomalie, although there is property to the south of the project site that is also used for cattle grazing.

The Litchfield National Park is located approximately 30 km west of Batchelor and provides reserved and recreational land use. The 1,800-km² park is a large wildlife reserve that protects extensive examples of 'Top End' habitat and is capable of supporting viable populations of most species that live there. The park also includes numerous waterfalls, historical sites and landscape features of geomorphological interest.

The Browns Oxide Project is located in an area delineated as 'grazing (natural pastures)' in the Coomalie Land Use Structure Plan.

4.9.4 Resource Use

The Coomalie region provides the main source of potable water for greater Darwin, via the Darwin River Dam (and the Manton Dam, now rarely used). It is proposed that Coomalie will play an important role in Darwin's future water supply with two additional dams being planned.

Good supplies of groundwater are generally available in a range of locations within Coomalie, including the town of Batchelor and areas to the northwest of Batchelor (where the project is located).

Coomalie is recognised as being highly prospective and mineral-rich and the mineral and extractive industry is considered one of Coomalie's strongest sources of employment and economic growth.

4.9.5 New TSF Site

The new TSF site is currently used as a topsoil storage area and as a source of borrow for the construction of the Browns Oxide Project.

4.10 Socio-economic

In general the socio-economic environment of the Batchelor region remains as documented in the Browns Oxide Project PER, with the exception that the BOP is now being constructed and as a result the socio-economic benefits (and to some extent, constraints such as accommodation pressure) are likely to be occurring.

4.11 Biting Insects

The project is located in an area with distinct dry and wet seasons. Surface drainage is ephemeral and distinct ponds and billabongs form during the dry season, in contrast to extensive flooding during the wet season, that often results in large areas of shallow-ponded water. These conditions are conducive to mosquito breeding.

The Medical Entomology Branch (MEB) of the Centre for Disease Control in the Department of Health and Community Services in Darwin has determined that breeding populations of mosquitoes and biting midges are present in the vicinity of the Browns Oxide Project, e.g., Batchelor and surrounding areas such as Mt Grace Magnesium Mine and Woodcutters Mine (Whelan, P. et. al., 2000 and MEB, 2001).

4.11.1 New TSF Site

The new TSF site does not contain any permanent water sources or any significant drainage lines, and as such there are limited mosquito breeding sites.

4.12 Archaeology and Heritage

The following is a summary of the AAPA authority certificates, a desktop study of the Australian Heritage Database and findings of the archaeological survey performed by Bengaze Pty Ltd (Begnaze, 2005).

4.12.1 AAPA Authority Certificates

Compass has previously obtained Authority Certificate No. 95/013 and No. 98/104 in relation to works within or adjacent to the project area, and intends to obtain a further Authority Certificate from the AAPA in relation to the construction of the new TSF.

The Australian Heritage Database lists five locations of heritage significance in the general area surrounding the project site (AHC, 2005b). These are listed in [Table 4.10](#).

There are no previously recorded archaeological places or objects and no National Trust-listed properties within a 5 km radius of the project site (NTNT, 2005).

Begnaze Pty Ltd (2005) undertook an archaeological survey in August 2005 to describe the nature and significance of any archaeological material located within the boundaries of the proposed mine site. Four archaeological sites, seven areas of isolated artefacts (background scatters) and three historic sites were located during the survey.

Table 4.10 Australian Heritage Database listings for the Batchelor region

Place	Location	List, Class & Legal Status	Description
Coomalie Dolomite site, Batchelor	Batchelor Road, 2.5 km east of Batchelor	All sites are listed on the Register of the National Estate as 'indicative places'.	Prominent outcrop of Coomalie Dolomite containing stromatolite fossils of regional significance.
Coomalie Creek cut	Stuart Highway, 11 km northeast of Batchelor		Perennial freshwater stream between two steep rocky hills.
Finniss and Reynolds rivers floating grass mats	Finniss and Reynolds rivers floodplains, Batchelor		Series of billabongs with well-developed floating grass mats, an important habitat for the estuarine crocodile.
Kubiling Springs jungle	10 km west-northwest of Labelle Downs Outstation		Floristically diverse Group 4 monsoon rain forest.
Reynolds River Tabletop Range	Channel Point Rd, 12 km west of Batchelor to coast		Very large area that includes a wide variety flora and fauna species and communities (including many rare and endangered species).

Source: AHC (2005b).

4.12.2 New TSF Site

No known sites of European historical or archaeological significance are present in the new TSF site.

Several Aboriginal archaeological sites, areas of isolated artefacts, artefact scatters and historic sites have been located on the site during previous surveys. Compass will obtain existing site data from the Aboriginal Areas Protection Authority to inform further surveys of the site to be carried out as part of the assessment process for the new TSF.

Compass carries out its exploration and mining activities in accordance with authority certificates issued by the Aboriginal Areas Protection Authority pursuant to the *Northern Territory Aboriginal Sacred Sites Act*. The authority certificate currently held by Compass and relevant to the project area is C98/124.

4.13 Radiology

While the Browns Oxide Project is adjacent to the historic Rum Jungle copper and uranium mine, the concentration of naturally occurring radioactive material (NORM) in Browns oxide ore is very low and is below the regulatory exemption level (1 Bq/g of any naturally occurring radionuclide other than ⁴⁰K).

Uranium concentrations have been measured in a series of ten composite ore core samples collected from 4 to 10 m depth. The mean uranium concentration was 13.9 mg/kg (8.1 to 28.6 mg/kg), while the

total combined activity of the ore was 5.32 ± 0.59 Bq/g. The ^{238}U in the ore contributed 0.29 Bq/g to this total and each of its progeny contributed less than 0.43 Bq/g. The activity of ^{232}Th and its progeny are all less than 0.022 Bq/g. The concentration of uranium and thorium in waste rock has not been measured, as the concentrations of these elements are expected to be higher in the mineralised ore than in the waste rock.

The concentrations of uranium and thorium in groundwater were both found to be <1 $\mu\text{g/L}$ with the corresponding radionuclide activities being less than the detection limits (<0.02 to <3.6 Bq/L).

4.13.1 Recent Information

A drilling and uranium analysis program was conducted in 2005, with data from 23 drill holes. Conclusions from this data indicate (a) generally low levels of uranium with depth (median 13.7 ppm, mean 24.5 ppm), and (b) short intersections of higher levels of uranium (up to 240 ppm).

5 POTENTIAL ISSUES, MANAGEMENT AND MITIGATION MEASURES AND RESIDUAL IMPACT ASSESSMENT

This chapter describes the potential impacts of the new TSF on the existing environment. Compass will endeavour to minimise the adverse effects and maximise the beneficial aspects of its operation wherever possible. This involves evaluating each impact to assess its significance, establish mitigative or ameliorative measures and present environmental and socio-economic safeguards.

The prediction and evaluation of the key impacts are based on a knowledge of the existing environments likely to be affected, the results of specific investigations, surveys and monitoring programs, identification of site-specific issues, experience gained from mining projects in comparable environmental settings, reviews of scientific literature and professional judgement.

Residual environmental impacts are those that remain after avoidance, management and mitigation measures have been applied. For some impacts, quantitative predictions can be made and subsequent monitoring need only be minimal to validate the predictions. For impacts where accurate predictions are not possible, based on currently available information, a correspondingly greater emphasis will be placed on monitoring.

The BOP MMP contains the following issue-specific management plans that outline the measures that will minimise and mitigate potential environmental impacts as a result of that project:

- Air Quality Management Plan.
- Biological and Land Management Plan.
- Cultural Heritage Management Plan.
- Emergency Response Plan.
- Fire Management Plan.
- Hazardous Materials and Waste Management Plan.
- Noise and Vibration Management Plan.
- Radiation Management Plan.
- Stakeholder Management Plan.
- Water Management Plan.

The new TSF will be covered by the measures in these plans.

5.1 Terrestrial Flora

5.1.1 Potential Issues

Clearing of Vegetation

The clearing of approximately 35 ha will remove individual plants from the broader regional population. This has the potential to impact on the distribution, dispersal and genetic diversity of populations of species in the region. The removal of vegetation also has the potential to further fragment and reduce the area of habitat available for fauna species dependent on it for resources.

Remnant vine forest (VC 10) and degraded vine forest (VC 12) will not be cleared.

Weed Density and Distribution

Vegetation clearing can lead to a change in the environmental conditions along vegetation corridors (such as increased light, wind and temperature). This can often favour the establishment and spread of 'edge' species, which are usually exotic, leading to a shift in vegetation community composition. A total of 33 introduced plant species have been recorded in the region, with several of these such as gamba grass and mission grass being of particular concern.

Project-related vehicles and equipment (especially earth-moving equipment) also have the potential to introduce and/or spread weed species within the project area.

Increases in weed density and distribution have the potential to further reduce the available local habitat for fauna species that are dependent on specific vegetation communities. Several weed species also have the potential to alter the extent and intensity of fire in the project area.

Fire

Fire is a natural, annual event in the landscape of northern Australia, with up to 50% or more of the region burnt each year (Williams 1995, cited in Egan, 2005). Early-season, low intensity fires are common, although project-related activities have the potential to alter fire frequency, intensity and timing in the region. For example, gamba and mission grass both form extremely dense clumps of vegetation 3 to 4 m tall and are capable of supplying large fuel loads that can create fires up to eight times as intense as those in native grasses (Rossiter et. al., 2003, cited in Egan, 2005). These altered fire regimes can lead to further changes in vegetation structure and composition.

5.1.2 Management and Mitigation Measures

Vegetation Clearing

Measures to minimise impacts as a result of vegetation clearing will include:

- Designing the new TSF to minimise vegetation loss.
- Retaining as much *Eucalyptus miniata* and *E. tetradonta* +/- *E. chlorostachys* open forest to woodland and *Eucalyptus papuana*/*Corymbia foelscheana*/ *Melaleuca* spp. open woodland to grassland as possible when siting the new TSF.
- Where possible, using previously disturbed and modified areas in preference to undisturbed areas.

Weed Control

Measures to minimise impacts due to weeds will include:

- All Compass and contractor personnel will be trained and inducted in the weed control management procedures before commencing activities at the new TSF site.
- All Compass and contractor personnel will be aware of the location and extent of declared noxious and environmental weed species in areas to be disturbed during construction.
- Where possible, construction activity will be planned to minimise the movement of plant and equipment between areas of known noxious weed infestations.

5.1.3 Residual Impact Assessment

Clearing of Vegetation

The vegetation to be cleared contains common and widespread vegetation types of no declared conservation significance within the local and regional contexts (Egan, 2005). The terrestrial vegetation communities within the project area are typical of eucalypt forest and woodland of the 'Top End' and comprise part of an extensive bioregion i.e., the Pine Creek bioregion that covers 30,404 km². Thus, in the regional context, the conservation value of the terrestrial flora found in the new TSF site is not significant and clearing represents a minor vegetation loss in an area where disturbance and other impacts from current land use (i.e., removal of borrow and storage of topsoil), clearing, fires, roads and tracks, and the introduction of weeds, have impacted on the condition and structure of vegetation communities. The nearby Litchfield National Park contains at least comparative, if not greater, composition and diversity of species in an undisturbed area. Additionally, approximately 43% of the Pine Creek bioregion is currently reserved, predominantly for conservation purposes (Woinarski, Connors and Oliver, 1996, cited in Egan, 2005).

Natural regeneration of vegetation, and ultimately rehabilitation, will compensate for vegetation lost during clearing (apart from areas such as the pit).

In terms of specific species, the *Eucalyptus tetradonta*/*E. miniata* open woodland is the dominant vegetation community in the new TSF site. The significant species *Cycas armstrongii* is found within this vegetation community, and is present as part of a widespread, and relatively common, population in the region and is represented in a range of conservation reserves, including the Litchfield National Park.

Areas of riparian, floodplain and vine forest communities will not be cleared for the new TSF.

Weed Density and Distribution

Vegetation clearing and other project-related activities have the potential to accelerate the spread of gamba grass over the project area and into adjacent woodlands and forests. This species is capable of spreading into undisturbed bushland, although its easiest and most rapid mode of spreading is along roads and cleared corridors. Mission grasses (*Pennisetum* spp.), *Mimosa pigra* and *Grewia asiatica* are also examples of species with the potential for expansion in distribution as a result of vegetation clearing. These species are present in the new TSF site in significant densities.

The implementation of the Biological and Land Management Plan will mitigate the risks associated with an increase in the density and abundance of weed species in the TSF area. Active weed management will reduce the density and extent of weed distribution, thereby leading to an improvement in the composition and structure of remnant vegetation communities.

5.2 Terrestrial and Aquatic Fauna

5.2.1 Potential Issues

Habitat Loss and Fragmentation

The proposed project will require the clearing of 35 ha of land, some of which is already disturbed due to topsoil storage and borrow removal. None of the habitats or ecosystems that are to be cleared or affected by the proposed project are listed as threatened ecological communities under the EPBC Act (DEH, 2005). There are no World Heritage properties in close proximity, and the nearest conservation reserve is the Litchfield National Park, approximately 30 km west of Batchelor.

Vegetation clearing will potentially increase fragmentation of habitats in the local area, with possible consequences including increased inter- and intra-specific competition for resources due to reduced foraging areas, increased hunting pressure from prey species due to a reduction in habitat providing cover, and the isolation of breeding populations.

Habitat fragmentation can also lead to a change in the environmental conditions along vegetation corridors (such as increased light, wind and temperature). This can often favour the establishment and spread of 'edge' species, which are usually exotic, leading to a shift in vegetation community composition.

Eucalyptus miniata and *E. tetradonta* (+/- *E. chlorosachys*) open forest to woodland (VC 2 and 3) supports the highest diversity of fauna in the project area, including the northern quoll, the red goshawk and the brush-tailed phascogale. Near-threatened species are also found in this habitat type. The project is not expected to fragment the eucalypt open woodland on rocky rises, riparian, or melaleuca woodland habitat types.

Significant Species

The project will clear vegetation that could support three fauna species of national (and Northern Territory) significance, i.e., the northern quoll, partridge pigeon and the red goshawk. Species that are listed as vulnerable or near threatened under the TPWC Act potentially present in the new TSF site include the northern death-adder, yellow-spotted monitor, bush-stone curlew, brush-tailed phascogale, Arnhem sheath-tail bat and several rodent species. Habitat used by these species may also be cleared.

It is likely that threatened species such as the northern quoll will have been significantly affected by the spread of cane toads in the region.

Acid Rock Drainage

Toxic metal concentrations at low pH, most likely the result of acid rock drainage, are considered the main factor in fish kills and the low fish abundance and diversity in the east branch of the Finnis River below the former Rum Jungle Mine site (Jeffree and Twining, 1998 cited in EMS, 2005). However, current practices appear to be aiding the recovery of fish populations.

In the event that the construction and operation of the new TSF significantly increased erosion, sedimentation, inflows of toxic metals and changes in pH (e.g., acid rock drainage), then this is likely to have an impact on local aquatic fauna populations.

Sedimentation of Waterways

Disturbance to soils from construction activities may result in increased soil erosion and transport of soils to local waterways, such as the East Finnis River. This can affect water quality parameters such as total suspended solids, pH and dissolved oxygen, which can alter the quality of habitat for aquatic species.

5.2.2 Management and Mitigation Measures

Measures to minimise impacts to fauna, and threatened fauna in particular, will include:

- A pre-clearance survey to detect the presence of any nationally listed fauna species of conservation significance in the immediate area to be cleared, specifically:
 - Northern quoll (*Dasyurus hallucatus*).

- Partridge pigeon (*Geophaps smithii*).
- Red goshawk (*Erythrotrorchis radiatus*).
- In the event that these species are present, the potential for trapping and relocation of individuals will be discussed with NRETA.
- Fencing of the new TSF to prevent access by stock and large ground-dwelling mammals.
- A 40 km/hr speed limit will be maintained along the access road to minimise the potential for vehicle collisions with fauna, and the partridge pigeon in particular.
- Management and mitigation measures to prevent ARD (see Section 3.2.2)

5.2.3 Residual Impact Assessment

Habitat Loss and Fragmentation

The project's footprint is about 35 ha. Construction will result in habitat loss and fragmentation by the clearing of *Eucalyptus miniata* and *E. tetradonta* (+/- *E. chlorosachys*) open forest to woodland. This habitat supports high species diversity and significant species in the dry season. However, within the regional context, this represents a minor vegetation and habitat loss in an area where disturbance and other impacts from current land use (i.e., removal of borrow and storage of topsoil), clearing, fires, roads and tracks and the introduction of weeds and the feral pig have impacted on the condition and structure of fauna habitat. The nearby Litchfield National Park contains at least comparative, if not greater, composition and diversity of species in an undisturbed area.

Natural regeneration of vegetation, and ultimately rehabilitation, will at least partially compensate for habitat lost during clearing.

Significant Species

Significant species may be impacted by the removal of vegetation during clearing of the TSF site. Specifically, the project may have an impact on the following EPBC and TPWC listed species:

- Disturbance resulting in sub-optimal conditions for the northern quoll, although previous disturbance of areas may have already influenced the population of northern quolls at this location.
- Refuge habitat for the brush-tailed phascogale is removed and/or fragmented. The local population of this species is likely to utilise large areas of open forest and woodland habitat in the region as part of a home range. Areas of suitable open forest and woodland habitat surrounding the project area may provide compensatory habitat for this species.
- The project results in altered fire regimes that remove preferred native grass habitat for the partridge pigeon. Carefully managed fire regimes will address this.

Fragmentation of habitat may impact on significant species, making them more vulnerable to predation. Vegetation clearing may also improve conditions for introduced predators such as feral cats, although this is already a significant problem across the Northern Territory.

Vegetation clearing will result in significant species being faced with a reduction in, rather than the complete removal of, suitable habitat. Natural regeneration and rehabilitation of vegetation following project closure will (at least partially) reinstate this habitat for fauna species.

There is the potential large impact of cane toads on significant species in the project area, although this would not be expected to be greater than the impact across the region as densities of the cane toad increases.

Sedimentation of Waterways

This has been addressed in Section 5.3.3.

Acid Rock Drainage

This has been addressed in Section 5.3.3.

Fire

The impact of a large-scale wildfire on fauna would be extensive, notwithstanding the fact that the mine site will form a natural fire break against fire coming from the north and northwest. Implementation of appropriate measures is expected to satisfactorily manage the risk of smaller-scale fires to fauna.

Introduced Pests

Management measures are expected to adequately control the impact to fauna of introduced pests such as the feral pig and feral cat within the project area. These species are relatively common in habitats in the wider area.

5.3 Surface Water

5.3.1 Potential Issues

A range of activities associated with the project will generate stressors that could report to the local drainage, as shown in [Table 5.1](#).

Given the nature of the project, i.e., construction and operation of a TSF, the primary contaminants at issue are sediments and trace metals and tailing.

Table 5.1 Summary of project activities and potential water quality stressors

Activity	Consequence	Primary Stressors
Land clearing/earth works	Erosion	TSS Metals
Ore processing	TSF discharges (if required)/runoff/spills/seepage	TSS Metals Sulfate Process reagents

Key potential issues are those associated with impacts on downstream water quality that may occur due to the following:

- General stormwater runoff.

- Runoff from TSF embankment (containing encapsulated PAF material)⁴.
- Discharge of excess water from the main sedimentation trap.
- Seepage from the TSF.
- Pit water/intercepted groundwater (during operations and post-closure).

5.3.2 Management and Mitigation Measures

General Stormwater Runoff

Surface water from disturbed areas will be collected and directed to the sedimentation trap to allow settling of suspended sediments. Water from this trap will be recycled to the process water dam for reuse in the plant. If the capacity of the main sedimentation trap is exceeded, water will be discharged to the East Finniss River. This water will be monitored to determine if it is of suitable quality for release and treated as required.

Acid Rock Drainage

Waste rock. Key features of the proposed waste rock management strategy include:

- Using most of the waste rock mined as bulk fill in the TSF embankment construction.
- Encapsulating all PAF rock generated by the project within the TSF embankment.
- Providing direct supervision by suitably experienced personnel during construction to ensure that the required high degree of geotechnical and structural control is obtained.

Tailing. Key features of the proposed tailing management strategy (see Section 3.2.2) include:

- Construction of a TSF that will comprise an embankment around all sides, where this embankment will consist of various 'zones' of different material.
- Subaerial deposition of the tailing.
- Collection of excess water in a decant pond for re-use in the process plant.
- Monitoring for variables such as dusting (from the tailing beaches) and seepage (through the TSF embankment).
- Installation of a suitable cover on the TSF on closure, such as a 'store and release'- type.

Discharge of Excess Water from the TSF

Tailing decant will be recovered and returned to the process circuit via the process water dam. The TSF is designed to retain sufficient volume for retention of runoff from major rainfall events, including the wettest year on record (1996/97) for the period 1958 to 2004. Under extreme conditions, water would be released via the emergency spillway and drain to the main sedimentation trap. As described above,

⁴ Acid rock drainage is, and has been, an issue at a number of operations in the Northern Territory and hence also requires consideration in this project.

if the capacity of the main sedimentation trap is exceeded, water would be discharged to the East Finniss River, after monitoring and treatment as required.

5.3.3 Residual Impacts

General Stormwater Runoff

Surface water from the new TSF will be engineered to drain to the Browns Oxide Project sedimentation dam. As such, there will be limited potential for direct impacts to surface water as a result of the new TSF.

Increased loads of TSS may report to the East Finniss River, despite the incorporation of design and management measures specifically aimed at minimising and mitigating off-site releases. Issues associated with delivery of sediment to receiving waters primarily relate to elevation of suspended sediment loads and in-stream sediment deposition downstream of the mine site. The majority of suspended sediment will be transported downstream during high-flow events. Therefore, during TSF construction and operations significantly increased TSS concentrations are likely to be associated with storm events.

The main impacts are therefore expected to be:

- Changes in water quality (increased TSS and, to a lesser extent, metal concentrations).
- Physical alteration of stream habitats (in-stream deposition).
- Changes in stream trophic structure including fish and macroinvertebrate food supplies.

These impacts may cause a temporary decrease in the abundance and biomass of fish and macroinvertebrates in the already-stressed East Finniss River, and the displacement of sediment-intolerant species into clear water tributaries. Predictions concerning impacts on the aquatic environment are generally difficult to accurately quantify. Correspondingly greater emphasis will therefore be placed on monitoring, with Compass establishing a comprehensive monitoring program of the East Finniss and Finniss rivers.

Impacts on water quality due to excess water discharges from the main sedimentation trap are considered further below.

Acid Rock Drainage

The management and mitigation measures that are to be incorporated into the construction, operation and closure of the TSF are expected to ameliorate the volume and/or quality of ARD. Nevertheless, given the difficulties in quantitatively predicting the effectiveness of these measures, Compass will obtain improved estimates of ARD during project development and will closely monitor TSF runoff and drainage.

In addition to examining indicators of ARD (e.g., pH, conductivity and sulfate concentrations), the monitoring program will include trace metals that may occur in elevated concentrations in the waste rock, as indicated by recent geochemical testwork (EGi, 2007). The observed enrichments of greatest environmental significance were arsenic, copper, cobalt and lead. It is also possible that other non-enriched metals, such as manganese, nickel and zinc, could occur at elevated concentrations in the event that sulfide oxidation occurs and acid generation occurs. The findings of that testwork will be reviewed in light of additional information to be obtained from further geochemical testwork that has

been commissioned by Compass, and the monitoring program revised as required. Monitoring for these elements will reflect the possibility that runoff and drainage can contain elevated concentrations of certain metals (and salt), even in the absence of acid conditions (NTMC, 2004).

Additional management and mitigation measures will be investigated as required (incorporating information obtained as the mine is developed), including options for ongoing collection and treatment of ARD prior to discharge should this prove to be warranted.

Seepage from the TSF

'Shallow' seepage through the embankment will be collected in a toe drain and recycled, while 'deep' seepage will be captured during operations by either interception bore(s) or the groundwater drawdown cone resulting from the pit. On closure, indicative seepage rates are expected to range from 0.25 L/s in the wet season to zero in the dry season. Flow in the East Finniss River at GS 8150200 during the wet season is in the order of 1000 L/s (Lawton and Overall, 2002a). Seepage from the TSF reporting to the East Finniss River would therefore comprise less than 0.03% of the total volume of water in the river and is therefore expected to have insignificant impact on existing water quality.

5.4 Groundwater

5.4.1 Potential Issues

General

There is potential for seepage to occur through the TSF base, with possible effects on local groundwater quality. Seepage rates from the new TSF are likely to be low, based on the proposed construction of the TSF (low permeability of the compacted clay base and embankment and low permeability of the underlying shales at the site).

Note that the impact on surface water quality due to discharge of groundwater produced from interception bores and/or pit dewatering, and issues associated with drawing contaminated groundwater from the Rum Jungle Mine site, were addressed in the Browns Oxide Project PER and PER Supplement.

Darwin River Dam

The Darwin River Dam is located in a different catchment to the Browns Oxide Project and beyond the area of predicted groundwater drawdown. There is no evidence of direct groundwater connection between the TSF site and the catchment of the Darwin River Dam. Therefore, no potential issues with the quality of groundwater in the Darwin River Dam are expected due to the new TSF.

5.4.2 Management and Mitigation Measures

The existing groundwater monitoring bores will be used to monitor groundwater levels and quality. Measures to manage potential impacts due to tailing seepage will include:

- Collecting 'shallow' seepage from the TSF through the embankment in a toe drain.
- Collecting 'deep' seepage via bores or the groundwater drawdown cone resulting from the pit dewatering and recycling.

The commencement of dewatering activities at the Browns Oxide deposit may assist with the recovery of any potential seepage from the new TSF.

Further management and mitigation measures are outlined in Section 3.2.

5.4.3 Residual Impact Assessment

Potential impacts to local groundwater levels, baseflows to the East Finniss River and water levels in the Rum Jungle Mine pits addressed for the Browns Oxide Project are not associated with the new TSF.

In the absence of boundary conditions, drawdown impacts due to mine dewatering are calculated to extend to between 1,000 and 1,500 m from the mine pit. The extent of the drawdown is shown in [Figure 5.1](#), considering both constraintment by catchment boundaries and no such constraintment. It should be noted that this assessment does not consider the influence of faults, and no faults were detected during recent site investigations (URS, 2007). The drawdown cone and/or interception bores will capture seepage from the new TSF, as described in sections 5.3.3 and 5.3.4. As such, the likelihood of reduced groundwater quality specifically as a result of the new TSF is limited.

5.5 Air Quality

5.5.1 Potential Issues

The main potential air quality issue is liberation of particulate matter (measured as total suspended particulates (TSP), PM₁₀ and PM_{2.5}) from the handling and transport of waste rock, and from wind erosion.

Emissions of combustions products from construction vehicles will be minor and will be too widely dispersed, to impact air quality other than in the immediate vicinity of their discharge.

5.5.2 Management and Mitigation Measures

Measures to minimise impacts to air quality will include:

- Minimising exposed areas susceptible to wind erosion.
- Undertaking progressive revegetation.
- Defining trafficked areas and ensuring that vehicles remain on official roadways and travel at appropriate speeds at all times.

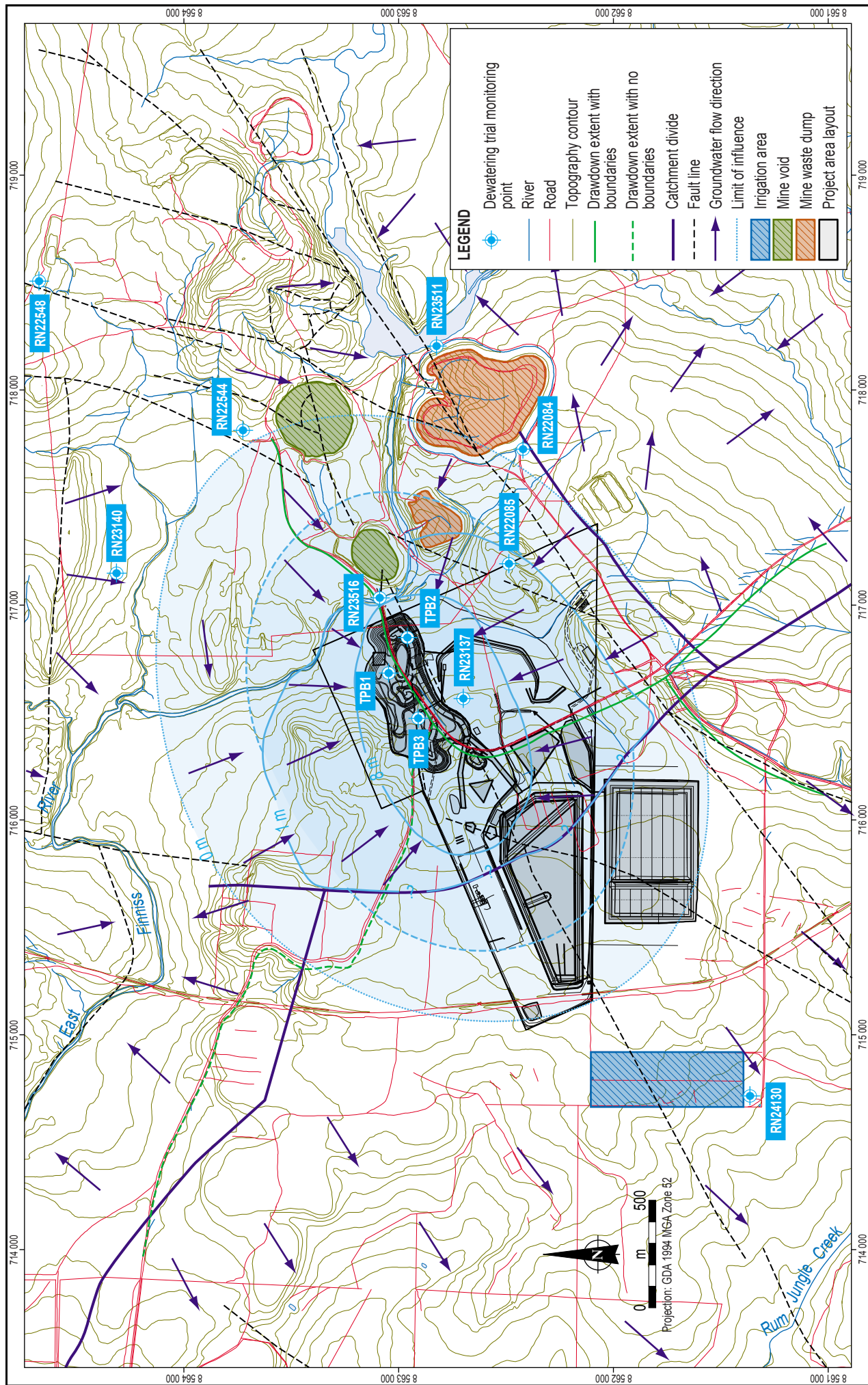
5.5.3 Residual Impact Assessment

The use of the standard dust control measures during construction and operation are expected to ensure that relevant dust assessment criteria (generally based on NSW Department of Environment and Conservation and National Environment Protection Measures for Ambient Air Quality) are met.

5.6 Greenhouse Gas Emissions

5.6.1 Potential Issues

Compass aim to minimise emissions wherever practicable to ensure compliance with the Northern Territory Government's objective that greenhouse gas emissions from new and expanding operations are as low as practicable.



5.6.2 Management and Mitigation Measures

Methods used throughout construction and operation of the Browns Oxide Project will also be applied to the new TSF and will reflect best practice for greenhouse gas emission reduction. Specific activities will include:

- Minimise haul distances.
- Monitor energy consumption (e.g., diesel and electricity), calculate greenhouse emissions and compare to target emissions.
- Identify and assess economically viable opportunities for improvement.
- Where appropriate, establish measurable greenhouse emission targets that reflect ongoing improvement.
- Consider use of alternative fuels (e.g., bio-diesel).
- Present a summary of Compass' commitment to minimising the project's contribution to greenhouse gas emissions in the company's annual reports.

5.6.3 Residual Impact Assessment

In 1990, total Australian emissions were 395,061 Kt CO₂-equivalent, of which the predicted operations emissions from the Browns Oxide Project will represent an increase of about 0.012%. The construction of the new TSF will represent a minor portion of this, and will therefore have a negligible impact on national greenhouse gas emissions.

5.7 Noise

5.7.1 Potential Issues

The main potential noise issue is noise increment above background at the closest non-company residence (approximately 1 km to the southwest of the new TSF). Potential sources of noise and vibration such as earthmoving equipment are likely to be greatest during construction of the new TSF, with minimal noise during operation.

5.7.2 Management and Mitigation Measures

Measures to minimise impacts due to noise and vibration will include:

- Limiting construction activities to daylight hours.
- Using smart alarms on machinery rather than standard reversing alarms.
- Recording complaints regarding noise levels and introducing additional mitigation measure where necessary.

5.7.3 Residual Impact Assessment

Noise impacts will be controlled to a level that will meet the assessment criteria that would apply to similar mines in NSW based on the use of acoustic treatment and smart alarms on items of mobile

plant. The noise associated with the construction of the New TSF is unlikely to present a significant change in noise levels from the existing construction noise at the Browns Oxide Project.

5.8 Infrastructure and Transport

The construction and operation of the new TSF are unlikely to place additional demands on infrastructure and transport resources in the region. As such, no specific management and mitigation measures are necessary and there are no residual impacts specifically associated with the new TSF.

5.9 Land and Resource Use

5.9.1 Potential Issues

The use of approximately 35 ha of land for the new TSF site has the potential to alter the current landform and possibly impact future land and resource use.

5.9.2 Management and Mitigation Measures

Impacts to land use in the vicinity of the new TSF site will be minimised by its proximity to the BOP mineral leases and the fencing of the site to prevent access by wandering stock. In addition, TSF design, construction and operation will be consistent with the objectives for developing the region in a manner that preserves its rural nature while allowing continued development at a sustainable level. This will be achieved by:

- Continued consultation and negotiation with NLC and traditional owners.
- Minimising the footprint of the new TSF.
- Implementing the environmental aspects of the BOP MMP.
- Developing appropriate post-closure land uses.

5.9.3 Residual Impact Assessment

Development of the new TSF will be an extension of the Browns Oxide Project. Given the relatively small footprint of the new TSF within an existing mining area, development of the site will not significantly change the existing land use and will facilitate the expansion of the resource development industry (which is a key land use objective for the Coomalie region).

The project is not located within Darwin's current potable water catchment area; therefore, impacts on the water supply area are not anticipated.

Residual impacts on groundwater resources are discussed in Section 5.4.

5.10 Socio-economic

The construction and operation of the new TSF are unlikely to raise any socio-economic issues separate to those of the Browns Oxide Project. As such, no specific management and mitigation measures are necessary and there are no residual impacts specifically associated with the new TSF.

5.11 Biting Insects

5.11.1 Potential Issues

Twenty different pest mosquitoes occur in the Northern Territory, some of which are capable of spreading harmful diseases such as Murray Valley encephalitis, Ross River and Barmah Forest virus disease (CDC, undated).

The potential for large and uncontrollable mosquito and biting midge breeding presents a potential nuisance and health risk (DLPE, 2000). Inappropriate of surface drainage and TSF decant water associated with the new TSF could exacerbate existing, or create new, mosquito-breeding habitats.

5.11.2 Management and Mitigation Measures

Biting insect control implemented as part of the Browns Oxide Project will be applied to the new TSF as applicable and includes eliminating breeding areas and provide personal protection in accordance with:

- Guidelines for preventing mosquito breeding sites associated with mining sites (MEB, 1997).
- The prevention of mosquito breeding in sewage treatment facilities (Whelan, 1997).
- Recommendations for design details of sewage pond effluent reuse or disposal facilities to prevent mosquito breeding (Whelan, 1998).
- Personal protection from mosquitoes and biting midges in Northern Territory (Whelan, 2004).

Advice will be sought from the MEB if mosquito breeding is detected within the project area or biting insects become pests.

5.11.3 Residual Impact Assessment

Appropriate design of water storages (including the TSF which will contain standing water) with respect to depth and slope and management of marginal semi-aquatic reeds and grass will reduce the potential for mosquito breeding.

Biting insect problems, when they occur, are likely to be greatest one hour either side of sunset and sunrise.

5.12 Archaeology and Heritage

5.12.1 Potential Issues

Issues relating to the conservation of Aboriginal and non-Aboriginal heritage in the TSF site focus on the need to:

- Avoid, where possible, current known locations of significance.
- Minimise the potential disturbance to locations of archaeological significance discovered during project activities.
- Manage adverse impacts where they are unavoidable.

As such, any sites of Aboriginal cultural significance identified will be taken into account during planning and design of the new TSF.

5.12.2 Management and Mitigation Measures

Measures to minimise potential impacts to sites of Aboriginal and/or European cultural or archaeological heritage significance will include:

- Maintaining the existing relationships between Compass and the NLC and traditional owners, which have resulted in the successful management of advised 'no-go' areas in surrounding tenements.
- Ensuring that Aboriginal and historical archaeologists are on call during project construction in the event that ground surface visibility is poor or archaeological material is detected.
- Through induction, instructing construction personnel in recognition of cultural heritage features for avoidance and reporting processes in the event that new cultural heritage features are uncovered during construction.

5.12.3 Residual Impact Assessment

There will be limited residual impacts. If the sites of archaeological significance are not to be disturbed during the development then they will be considered restricted areas and will not be entered.

5.13 Radiology

5.13.1 Potential Issues

The potential radiological issues are:

- Radiological doses to the workforce and the public.
- Uranium concentrations in tailing.
- Radiological impacts on the environment.
- Radiological issues at mine closure such as NORM in the new TSF.

5.13.2 Management and Mitigation Measures

The entry of NORM into the environment will be minimised through the physical control of waste rock and tailing (see Section 3.1 and 3.2), erosion and surface water (see Sections 5.3.2), discharge of excess water from the TSF (see Section 5.3.2), seepage from the TSF (see Section 3.2.2) and dust (see Section 5.5.2).

Section 3.1.2 provides further detail regarding the management of radiation for the Browns Oxide Project (and therefore the new TSF).

5.13.3 Residual Impact Assessment

ANSTO (2005) concludes that 'the use of available modelling tools for dose calculation indicates that the impact of the Browns project on the environment will be minimal' under normal operating conditions. It follows that the radiological impact of the new TSF will be minimal.

Ore Processing

It is expected that uranium will dissolve in the process leach stage. The uranium will accumulate in recycled process water to be removed as part of the neutralisation waste. In addition, ^{226}Ra may also be present at low concentrations in the leach solutions and appear at high concentrations in scales on equipment surfaces and/or absorbed into synthetic materials such as filter cloths and rubber linings.

Radiological Impacts on the Environment

Current regulatory controls on radiological impact are based on the assumption that the protection of humans will result in the protection of the environment. On this basis, given that the radiation dose to the public is well below the allowed exposure limit, the environment is considered to be adequately protected.

A radiological risk assessment (RRA) has been undertaken by ANSTO (2005) examining two worst-case scenarios: 1) a tailing spill resulting in tailing solids covering the bottom of a pool in the East Finniss River and 2) tailing dust containing the highest recorded ^{238}U concentrations is not suppressed and blankets an area of naturally vegetated ground.

For Scenario 1, the initial (tier-1) RRA dose estimates indicate that the maximum dose to the most susceptible wildlife group (frogs), 4,800 $\mu\text{Gy/h}$, may exceed the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) guideline (4,800 $\mu\text{Gy/h}$).

For Scenario 2, the initial (tier-1) RRA dose estimates indicate that the maximum dose to fungi is 26 $\mu\text{Gy/h}$, which is lower than the UNSCEAR guideline of 40 $\mu\text{Gy/h}$.

Given that these scenarios will be avoided by the implementation of an environmental management program, ANSTO concludes, '[t]he use of available modelling tools for dose calculation indicates that the impact of the Browns project on the environment will be minimal' (ANSTO, 2005).

TSF Closure

The tailing will contain some NORM, and the TSF will be constructed and operated to prevent mobilisation of tailing solids as dust and to prevent environmentally significant radionuclide concentrations entering groundwater or surface water after mine closure.

Following closure, any radioactively contaminated process plant equipment will require appropriate decontamination and disposal.

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