4. Project Description

4.1 Project Location

The Browns Oxide Project is located some 65 km south of Darwin and 7 km northwest of Batchelor, in the northwest of the Northern Territory (see Figure 1.1). The project footprint lies entirely within the 175 ha area (Figure 4.1) of granted mineral leases (MLs) MLN 139 to 147 and MLN 150 to 152 (Table 4.1), hereafter defined as the 'project area' (Figure 4.2). The deposit is located in the northern part of the project area and has an east–west orientation. The tailing storage facility (TSF), processing plant and other mine infrastructure are located in the western section of the project area.

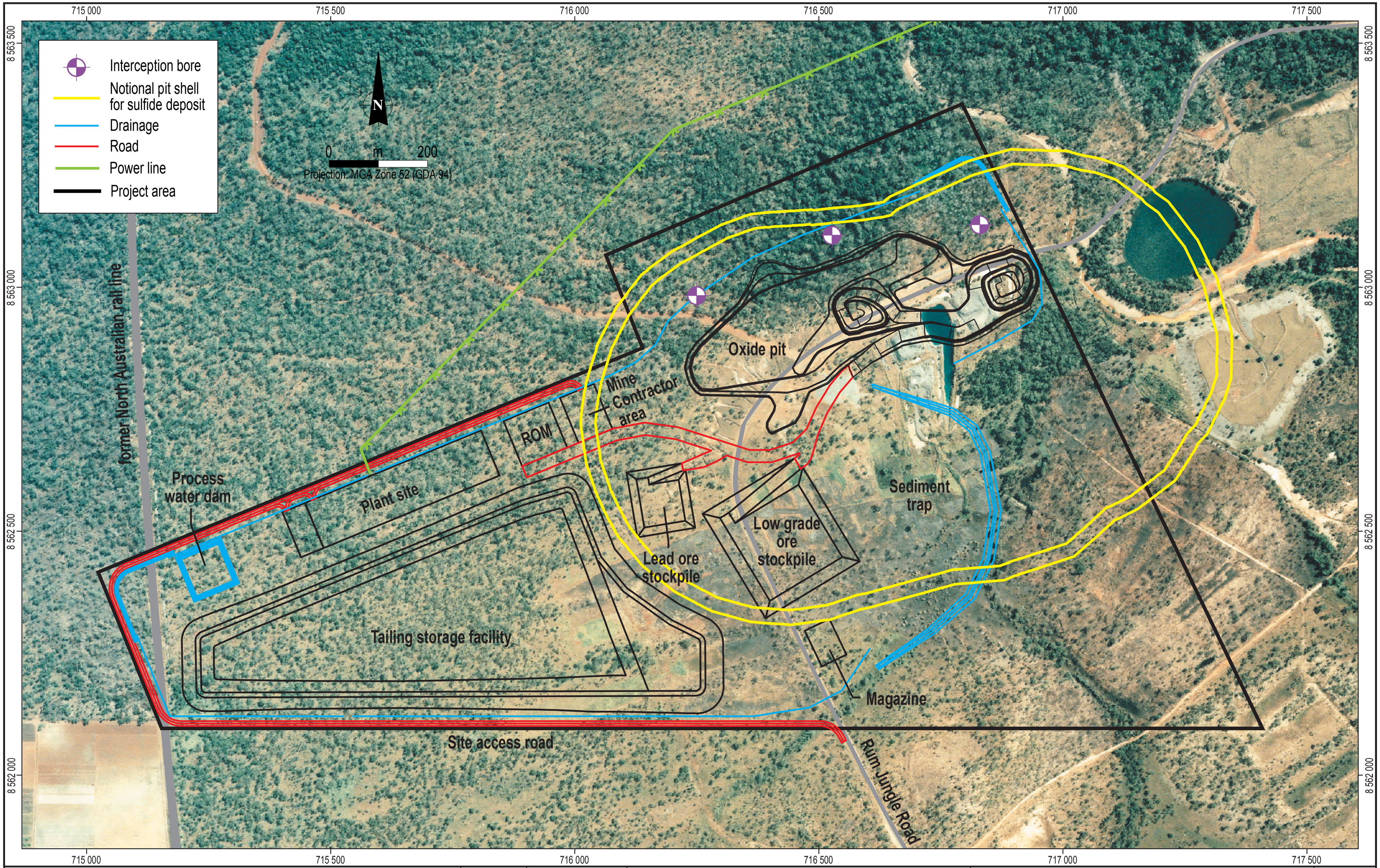
The historic Rum Jungle Mine site is located east of the project area and will not be disturbed by the project. The former Whites uranium and copper open pit is approximately 1 km at its nearest point from the Browns Oxide Project, and the Intermediate copper open pit is approximately 300 m to the east of the project.

The land tenure of the project area is mostly Aboriginal freehold land, with additional areas of road reserve, freehold land and crown land (see Figure 4.2). Compass has been undertaking mineral exploration in the project area since early 1995. The project area is not used for any other purpose, and land uses in the surrounding area are described in Section 7.7. Compass holds three exploration retention licences (ERL125, ERL146 and ERL148) around the project area and also has submitted applications for six nearby mining tenements (MLN 1157 to 1159 and MLN 1161 to 1163) (Figure 4.3).

Table 4.1 Project mining leases

Granted Tenements	Land Tenure*	Expiry Date
MLN139	Aboriginal freehold/road reserve	31/12/2022
MLN140	Aboriginal freehold/road reserve/crown land	31/12/2022
MLN141	Aboriginal freehold/road reserve	31/12/2022
MLN142	Aboriginal freehold/road reserve/crown land	31/12/2022
MLN143	Aboriginal freehold/road reserve	31/12/2022
MLN144	Aboriginal freehold	31/12/2022
MLN145	Aboriginal freehold/freehold	31/12/2022
MLN146	Aboriginal freehold	31/12/2022
MLN147	Aboriginal freehold	31/12/2022
MLN150	Aboriginal freehold/crown land	31/12/2022
MLN151	Aboriginal freehold/road reserve	31/12/2022
MLN152	Aboriginal freehold*	31/12/2022

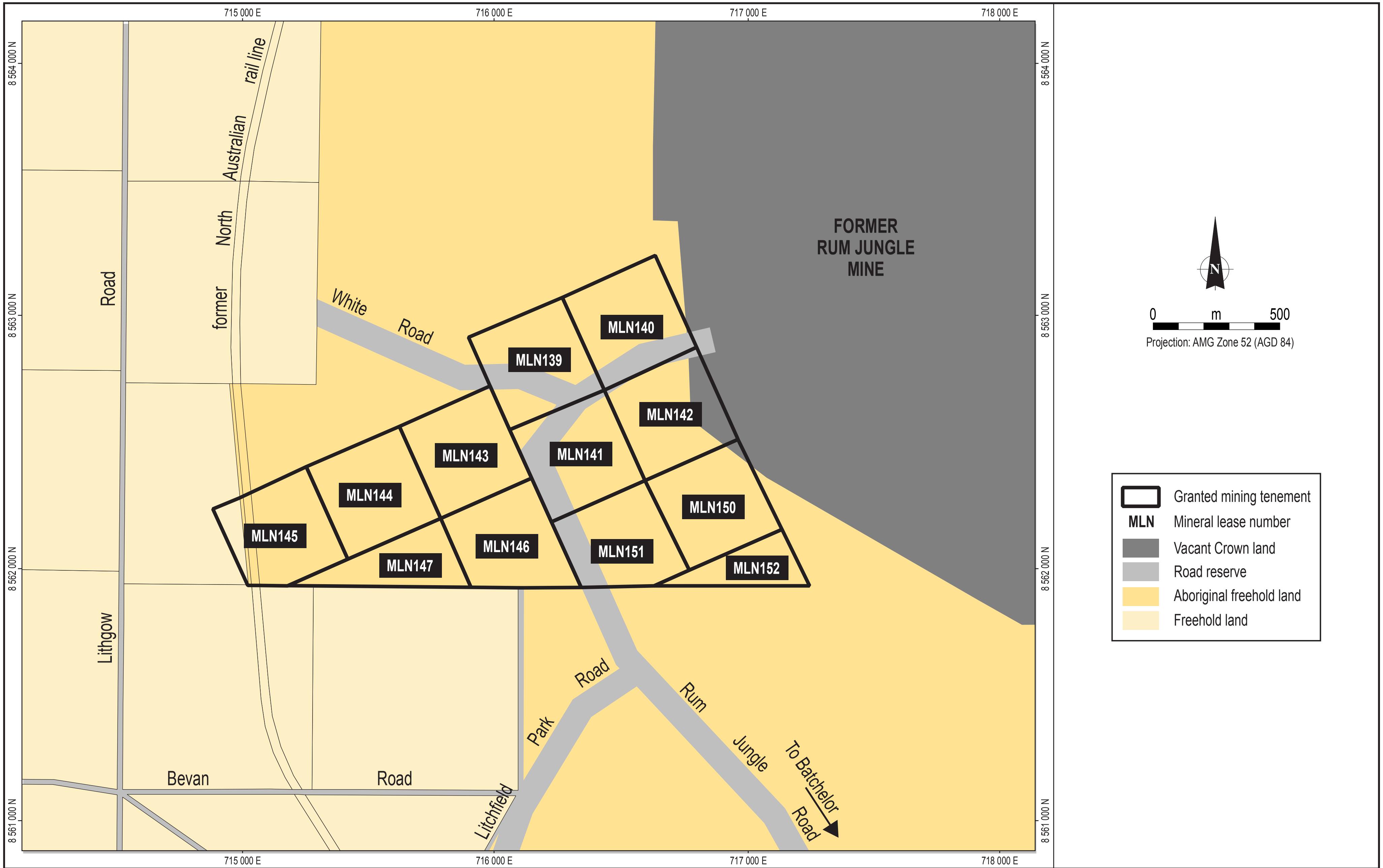
* The granted MLs are on Aboriginal freehold land but are excluded from the operation of Part IV of the *Aboriginal Land Rights (Northern Territory) Act 1976* due to the leases being granted prior to the Aboriginal freehold land grant.



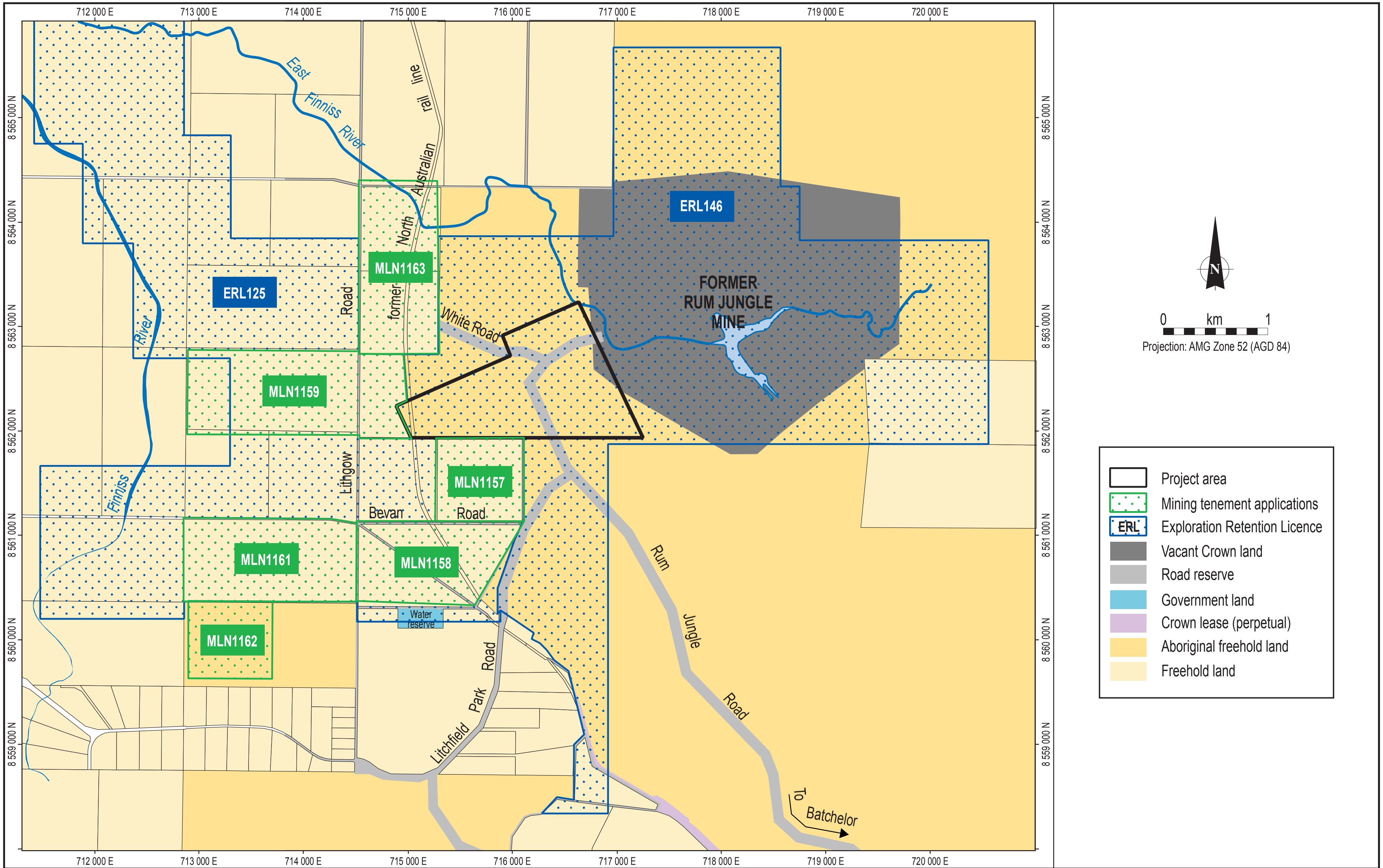
N.B Sulfide deposit not part of the Browns Oxide Project.
Pit shell is indicated as it impacted placement of project components.

Job No: 836	Compass Resources NL	Project footprint and components	Figure No: 4.1
File No: 836_08_4.01_HB	Browns Oxide Project		

Figure 4.1 Project footprint and components



enesar people and place	Job No: 836 File No: 836_08_F4.02_HB	Compass Resources NL Browns Oxide Project	Granted mining tenements	Figure No: 4.2



enesar people and place

Job No: 836	Compass Resources NL	Exploration retention licences and mining tenement applications	Figure No: 4.3
File No: 836_08_F4.03_HB	Browns Oxide Project		

4.2 Project Overview

The project involves the development of a 3.9 Mt polymetallic oxide deposit using open pit mining techniques over a mine life of approximately four years. Ore will be mined and processed at a rate of approximately 1 Mt/a using a conventional crushing, leach and solvent extraction-electrowinning circuit to produce copper cathode. The project will also use a chemical precipitation circuit to produce cobalt and nickel. Approximately 10,000 t of copper cathode, 1000 t of contained cobalt and 700 t of contained nickel as hydroxides or sulfides will be produced 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.

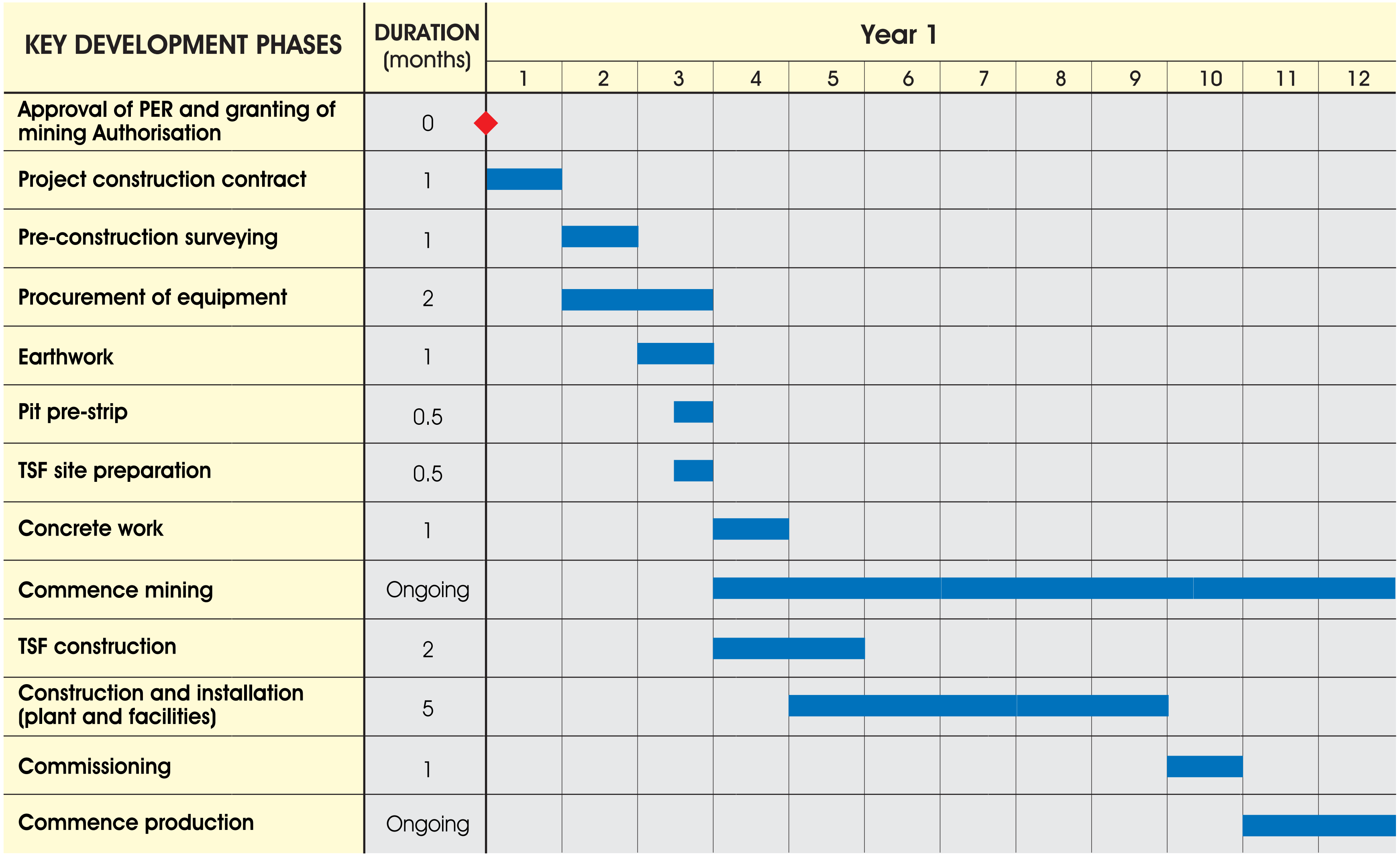
Key characteristics of the project are summarised in Table 4.2.

Table 4.2 Key characteristics of the project

Element	Description
Granted MLs	MLN 139 to 147 and MLN 150 to 152
Project area	175 ha
Life of project (mine production)	Four years
Size of deposit	3.9 Mt (confirmed resource of 2.8 Mt)
Mine production rate (maximum)	1 Mt/a
Resource grade	1.06% Cu, 0.13% Co and 0.11% Ni
Depth of mine pit	20 to 25 m on average with two deeper pockets up to 50 m
Extent of mine pit	776 m long and 225 m wide
TSF	35.71 ha, 2.7 Mm^3 capacity
Groundwater level	4 to 8 m below surface level depending on season
Mine operation	Open pit, excavator/truck mining
Raw water source	Interception bores
Raw water requirement (approximate)	40 m^3/hr, 350,000 m^3/a (350 ML/a)
Power source	Northern Territory grid
Power requirement	7.5 MW/a
Fuel storage capacity	65,000 L

4.3 Project Schedule

A summary of the development schedule is shown in Figure 4.4, and the key milestones from the approval of the PER and granting of the mining Authorisation are shown in Table 4.3. The construction contract will be awarded in the first quarter 2006 with a construction timetable of around nine months and commencement of production in the later part of the year. The scheduling of earthworks will take into account the Northern Territory wet season.



Job No: 836	Compass Resources NL	Project development schedule
File No: 836_08_F4.04_HB	Browns Oxide Project	Figure No: 4.4

Table 4.3 Key development milestones

Item	Month
Approval of PER and granting of mining Authorisation	0
Project construction contract	1
Pre-construction surveying	2
Procurement of equipment	2
Commence earthworks	3
Commence pit pre-strip	3
TSF site preparation	3
Commence concrete works	4
Commence mining	4
Commence TSF construction	4
Commence construction and installation (plant and facilities)	5
Commissioning	10
Commence production	11
Operation phase commences	11
End of mining	51
Anticipated project closure	57

4.4 Project Components

The major components of the project are identified in Table 4.4 and are described in detail in the following sections. The project components have been located within the confines of the ML area (see Figure 4.1).

Table 4.4 Maximum area of project components

Component	Area
Mine pit	15.3 ha
Low-grade ore stockpile	5.6 ha
Lead ore stockpile	1.6 ha
ROM stockpile area	1.0 ha
Process plant	3.9 ha
TSF	35.7 ha
Process water dam	1.0 ha
Haul road	2.3 ha
Access road	2.8 ha
Mining contractor area	0.8 ha
Offices and car park	0.5 ha
Magazine	0.6 ha
Surface water cut-off drains	2.2 ha
Northwest and northeast sedimentation traps	2.5 ha
Main sedimentation trap	10.3 ha
Topsoil stockpile area	3.8 ha
Total	**89.9 ha**

The project will mine the near-surface oxide ore, although a much larger sulfide deposit lies beneath the oxide pit base. Development of this sulfide material is not part of the current project and, if progressed, will be subject to a separate assessment and approvals process.

A design criterion for the current project is that the underlying sulfide deposit is not sterilised with respect to possible future mining. A simple pit shell has therefore been projected for the sulfide deposit to a depth of 350 m (see Figure 4.1), where this is likely to encompass any future pit or the subsidence profile from underground mining. Only temporary or relocatable elements such as the ore stockpiles and the mining contractor's area have been located within this area.

4.5 Construction

4.5.1 Construction Materials and Waste

Construction materials will be sourced from the Batchelor–Darwin region where possible. Specialist materials such as the stainless steel tankage and mixer-settler unit liners may need to be sourced from outside the region and transported to site. The main construction materials that will be used are listed in Table 4.5. The main requirement for external borrow material will be the first stage of the TSF construction, and this material will be sourced from within the project footprint or, if this is not possible, from within the footprint of a possible future pit for the sulfide deposit. This list is preliminary and will be refined once detailed engineering is completed (during which time national pollution inventory requirements will also be determined).

Table 4.5 Anticipated construction material requirements

Materials	Approximate Quantities
Concrete for footings and plinths	2,000 m^3
Mechanical and electrical equipment for site	As required
Structural steel	300 t
Site office and facilities	Port-a-cabin
Steel-framed roof for workshop	6 t
Security fencing	1,200 m
TSF embankment	1,945,000 m^3 (waste rock from the mine)
	194,000 m^3 (external borrow material)
Road base	10,000 m^3 (waste rock from the mine)

Wastes to be generated during construction are listed in Table 4.6. As with the construction materials, this list is preliminary and will be refined once detailed engineering is completed (and, again, national pollution inventory requirements will be determined upon completion of detailed engineering). Construction contractors will be instructed (and appropriately supervised) to ensure that they apply the waste management principles of reduce, reuse and recycle, and comply with the Waste Management Plan (see Section 9.8.7).

Table 4.6 Anticipated construction wastes

Waste Materials	Approximate Quantities	Disposal Method
Scrap steel	50 t	Collection by steel recycling contractor
Wooden pallets	500	Majority returned to supplier for reuse, damaged/excess buried in on-site landfill
Diesel drums	20	Collection by supplier
Domestic waste	1,200 kg	Burial at Batchelor or on-site landfill
Waste oil and grease	200 kg	Removed from site for recycling
Waste paint	50 kg	Disposal by licensed contractor
Sand blast grit	5 t	Burial at on-site landfill, or in TSF
Sewage effluent	100 kL	Disposal by port-a-loo supplier

4.5.2 Construction Methods

The extent of site disturbance will be minimised wherever possible, with the construction footprint (including clearing for pit and ore stockpiles) being similar to the ultimate project footprint. Laydown areas will be located at the western end of the plant site and, during construction, the future office car park area.

Prior to major earthworks commencing, the site drainage system will be constructed to manage site runoff water. The drainage system (see Figure 4.1) will divert surface runon water away from areas to be disturbed and collect sediment-laden (dirty) water from the disturbed areas. Dirty water will be directed to sedimentation traps where most of the suspended sediment contained in the water will settle. The system will be designed and managed to minimise the potential for off-site release of dirty water. All drainage will be constructed to minimise erosion or sedimentation. If necessary, erosion control measures, such as the use of loose-rock check dams, will be put in place along drainage channels.

Vegetation clearing and grubbing will be the first step in the development of areas required by the project. The vegetation will be pushed into windrows and, where possible, will be used to assist with initial erosion control and establishment of soil structures on the rehabilitated areas. Topsoil will then be progressively stripped and stockpiled as areas are prepared for the construction of project facilities and infrastructure. Topsoil stockpiles will be designed with appropriate diversion and collection drains for the control of surface water runon and runoff. The total amount of topsoil to be stripped over the life of the project is estimated to be 75,200 m^3. Stripped topsoil will be used for the rehabilitation of disturbed areas.

The topsoil stockpiles will be formed into low, uncompacted, flat-topped mounds, up to 2 m high. Unnecessary compaction of the topsoil will be avoided in order to minimise degradation of soil structure. Where stockpiles are to be left for more than several months before re-use, they will be sowed with cover crops of fast-growing annual grass species to prevent them becoming a source of dust or sediment.

Earthmoving will be undertaken after topsoil stripping and stockpiling for rehabilitation, by the mining fleet using a conventional excavator/truck configuration and possibly self-loading scrapers. Major earthworks will be undertaken to provide suitable levels for site infrastructure and for mine pre-stripping, with the area of disturbance approximating the area of project components, i.e., 89.9 ha (see Table 4.4). Drill and blast methods are not envisaged for civil works, although some bulldozer ripping may be required. Haul roads and the site access road will be constructed to ensure that soil erosion is minimised. Revegetation of stripped areas will be encouraged to reduce potential erosion.

4.6 Mineral Resources

4.6.1 Deposit

The Browns 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 sulfide 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.

4.6.2 Resource Estimates

Work is in progress to complete drilling and determine the necessary technical and economic planning to prepare a Reserves Statement in accordance with the Joint Ore Reserves Committee (JORC) Code (2004). However, almost all of the target mineralisation is in either measured or indicated resource status and the technical, cost and revenue issues are well understood. Announced resources are 2.8 Mt as shown in Table 4.7 and it is anticipated that, on completion of the final reserve calculations, the resource status will reflect the anticipated 3.9 Mt deposit size upon which the preliminary mine scheduling for this project has been based.

Table 4.7 Resource estimate

Mineral Resource Category	Resource Mt	Copper Grade % Cu	Cobalt Grade % Co	Nickel Grade % Ni	Contained Metal		
					Copper (t)	Cobalt (t)	Nickel (t)
Measured	2.2	1.14	0.12	0.11	25,150	2,727	2,361
Indicated	0.4	0.77	0.14	0.11	3,427	604	476
Inferred	0.1	0.78	0.12	0.11	1,115	174	151
Total	**2.8**	**1.06**	**0.13**	**0.11**	**29,691**	**3,504**	**2,987**

Note: Apparent inconsistencies in totals are due to rounding.

4.6.3 Mine Plan

The open pit presented in this document is an expanded version of a pit designed to accommodate the currently defined resource likely to be converted to economic mineralisation (Figure 4.5). The expansion increases the pit area by approximately 20% and is to allow for anticipated extensions to the deposit pending further drilling programs.

The open pit will be mined to an average depth of around 20 to 25 m below the relatively flat surface topography. The pit extends 776 m along strike (west-southwest to east-northeast) and is 225 m across at its widest point. Two zones of deeper oxidation with high-grade mineralisation occur half way along the pit length and at the northeast end. The pit will be mined to 50 m depth at these points.

Source: AMDAD.	Job No: 836	Compass Resources NL	Browns oxide pit schematic	Figure No: 4.5
	File No: 836_08_F4.05_HB	Browns Oxide Project		

The design of the open pit will include:

- Wall batter angles: 50° to 65° with overall slope angle of 45°.
- Ramps: one main and two internal ramps at a gradient of 10%.
- In-pit berms: as required to ensure wall stability and safe working conditions.
- Dewatering: interception bores plus a floor sump.
- Overall waste: ore ratio 1:1.

A plan and typical cross sections are shown in Figure 4.6.

Initial planning suggests a staged approach to mining, whereby the northeast end of the pit will be mined first, followed by the southwest end. Although this strategy is based on metal distribution, it also allows a more even balance of non-acid–forming (NAF) and potentially acid-forming (PAF) waste rock over the mine life, which facilitates encapsulation of the PAF rock in the TSF embankment (see Section 4.9.2).

The final mine plan will be developed once final drill results are interpreted and modelled.

4.6.4 Acid Rock Drainage

The project involves mining the shallow oxidised (and partially oxidised) mineralised material. While most of the deeper sulfidic material will not be mined, excavation of ore and waste rock may expose sulfide-bearing rocks in the pit walls and floor to oxidation, with consequent possible generation of acidic minewater. Arrangements to treat such minewater have been incorporated in the water management section (see Section 4.14).

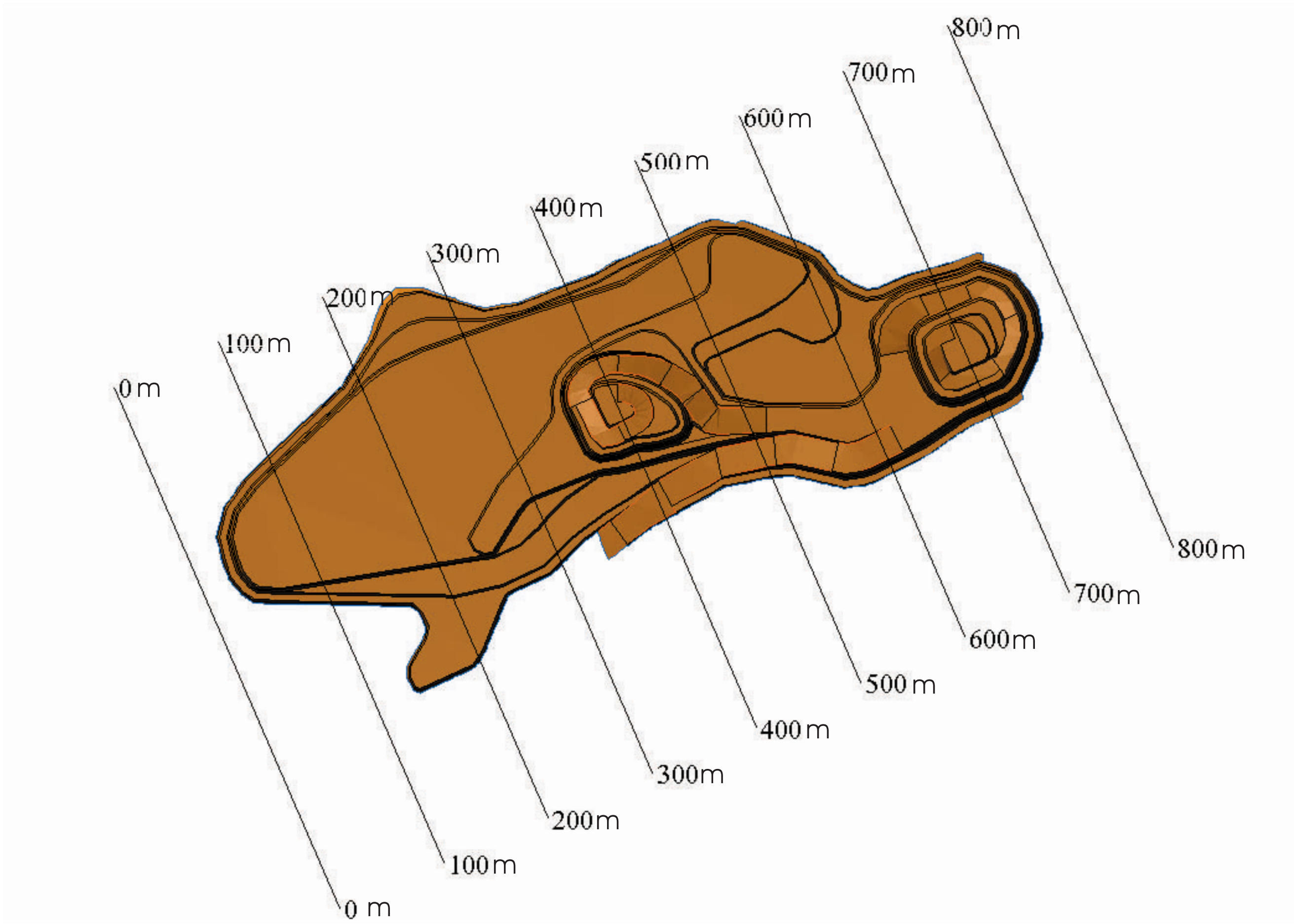
4.7 Mining

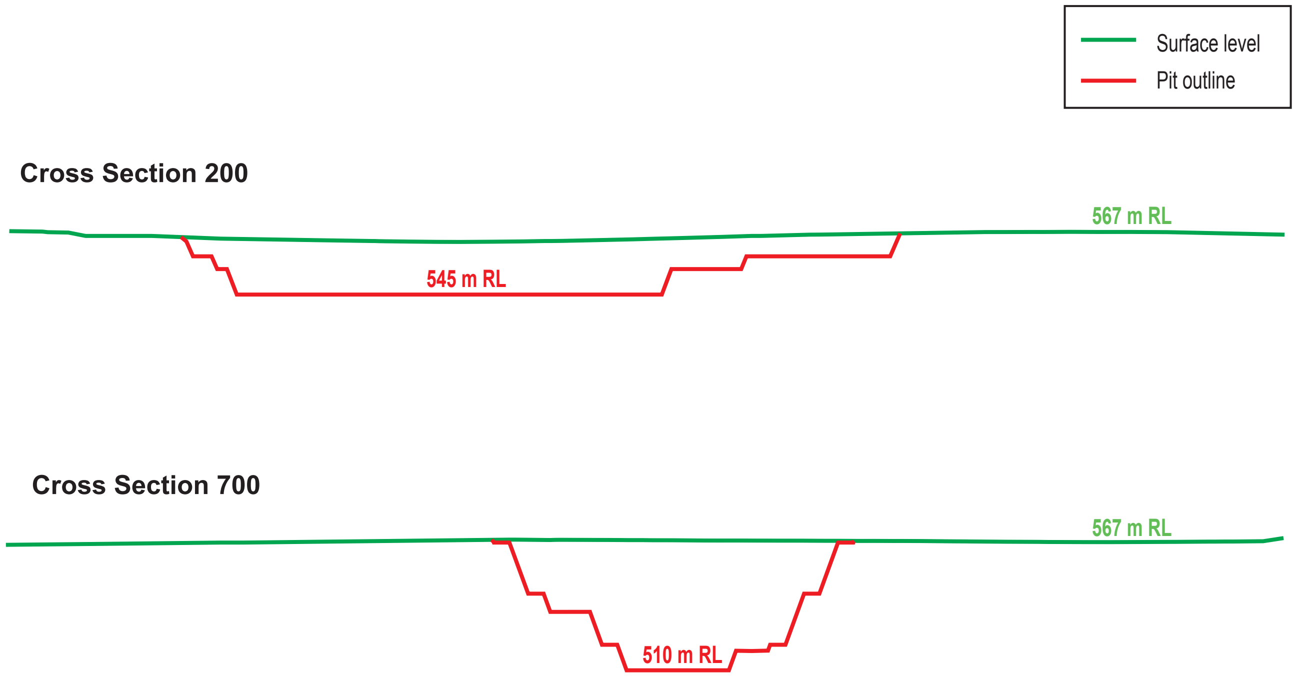
4.7.1 Mining Schedule

Mining is planned to continue throughout the year with reductions in the production rate during periods of heavy or prolonged rainfall. The mine will have a very low waste to ore ratio of approximately 1:1 and mining should be possible based on one 10.5-hour shift per day, six days per week.

4.7.2 Mine Access and Development

The oxide open pit will be located in the northeast corner of the project area (see Figure 4.1). A haul road will exit the southern side of the pit and run southeast to provide access to the run of mine (ROM) ore stockpile and crusher area, the TSF embankment (which will form the waste dump), the low grade ore stockpile and a lead ore stockpile. Access to the mine offices, process plant and mining contractor's area will occur via a road formed around the southern, western and northwestern boundaries of the project area. There will be no interaction between the site access road and the mine haul road.





Source: AMDAD.

Job No: 836	Compass Resources NL	Browns oxide pit cross-sections	Figure No: 4.6
File No: 836_08_F4.06_HB	Browns Oxide Project		

4.7.3 Ore Stockpiles

Ore mined from the pit will be delivered to the ROM stockpile located to the west of the pit adjacent to the northwestern tenement boundary. Up to one month of ore supply (85 kt) will be stored on the ROM pad to provide continuity of feed to the process plant during periods of mining delays that may be caused by factors such as wet weather.

A low-grade ore stockpile (see Figure 4.1) will be formed southwest of the pit to hold ore which is of marginal economic grade but which may be viable to treat in the future at higher metal prices or lower processing costs. If this material remains uneconomic at the end of the project life, it will be returned to the mined-out pit [C]. The low-grade ore stockpile is designed to hold up to 1.5 Mt.

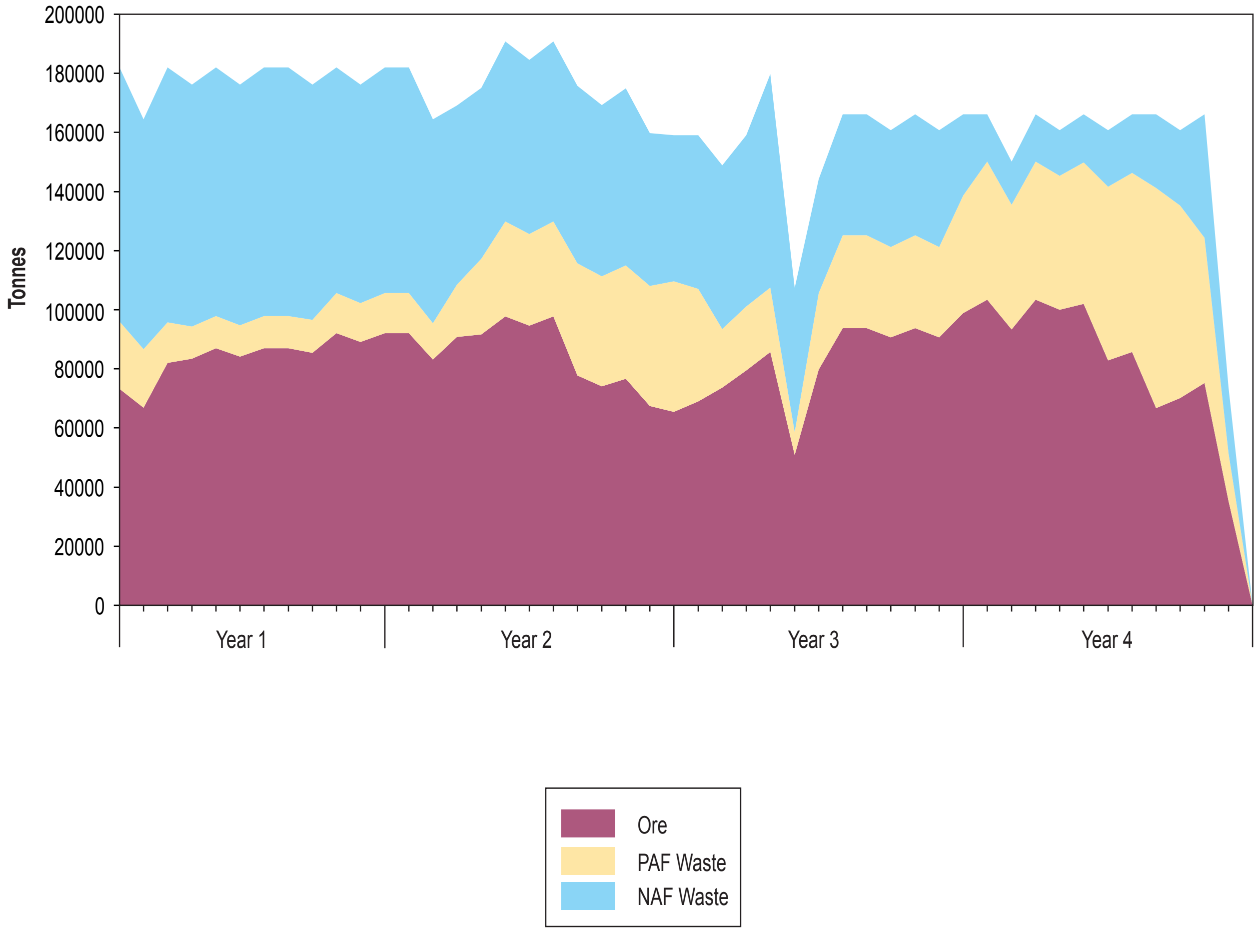
A lead ore stockpile will also be formed adjacent to the low-grade ore stockpile. The process plant will not initially include a gravity circuit (although the project footprint allows for its installation) to recover lead, hence lead ore (containing 4.2% Pb) will be stockpiled. A lead gravity circuit will be installed later in the mine life, once the copper/cobalt/nickel ore is depleted. It is anticipated that the processing of this material will achieve 65% recovery and will involve crushing and wet gravity treatment by a pressure jig to produce a carbonate end product. The lead ore stockpile has 275,000 t capacity. If the material is uneconomic by the end of the project life, it will be returned to the mined-out pit [C].

4.7.4 Mining Methods

Mining will be undertaken as a conventional excavator/truck operation. Much of the oxidised material is relatively weak and will be mined without blasting, but the occurrence of harder, silicified bands means that some drilling and blasting will be required throughout the mine life. Detailed blasting requirements will be established as mining progresses but the initial assumption is that half the material will require light blasting. Blasting frequency will depend on the competency of the rock being mined in a given period but will generally be at the rate of one to two blasts per week, with between 80 and 170 holes being fired on a 5-m-high bench in each shot. Gravel stemming, inter-hole delays and low-impact blast-hole connections, such as Nonel tubing, will be used to minimise ground vibration, air blast and fly rock.

Ore will be mined at the rate of approximately 1.00 Mt/a and waste rock will be mined at the rate of 0.89 to 1.13 Mt/a over a period of up to four years (Figure 4.7). A single 60-t hydraulic excavator and three 50-t off-highway dump trucks will form the main mining fleet, and these will be supported by a bulldozer, grader, water cart, blast-hole drill, grade-control drill and small ancillary items such as pit pumps and light vehicles (see Table 4.15 in Section 4.13). A compactor roller will be used to ensure dump compaction.

Mined ore will be hauled to either the ROM, low-grade or lead ore stockpile. Most of the ore delivered to the ROM stockpile will be either direct dumped into the crusher or dumped adjacent to the crusher hopper to allow short haul rehandling into the crusher by front end loader.



enesar peopleandplace	Job No: 836	Compass Resources NL	Mined ore and NAF/PAF waste rock production	Figure No: 4.7
	File No: 836_08_F4.07_HB	Browns Oxide Project		

The TSF embankment has been designed to contain all of the waste rock material. Potentially acid-forming waste will be selectively placed within the TSF wall, compacted and encapsulated with compacted non-acid–forming waste (see Section 4.9.2 and Appendix 8 for details).

4.8 Processing

4.8.1 Process Plant

The process plant will be located along the northern boundary of the western end of the tenements (see Figure 4.1) and will comprise a crushing/grinding circuit and leach tanks. The layout and general arrangement of the process plant is shown in Figure 4.8.

The process plant will operate 24 hours per day, seven days per week, at a rate of approximately 1 Mt/a, although the crushing circuit will operate on a dayshift only basis. The process plant will produce three products at an estimated rate of:

- 10,000 t/a of copper cathode.
- 1,000 t/a of cobalt, as a cobalt hydroxide or sulfide.
- 700 t/a of nickel, as a nickel hydroxide or sulfide.

The cobalt and nickel are likely to be produced as a combined product.

4.8.2 Process Description

The process flowsheet is shown schematically in Figure 4.9 and is described as follows.

Crushing and Grinding

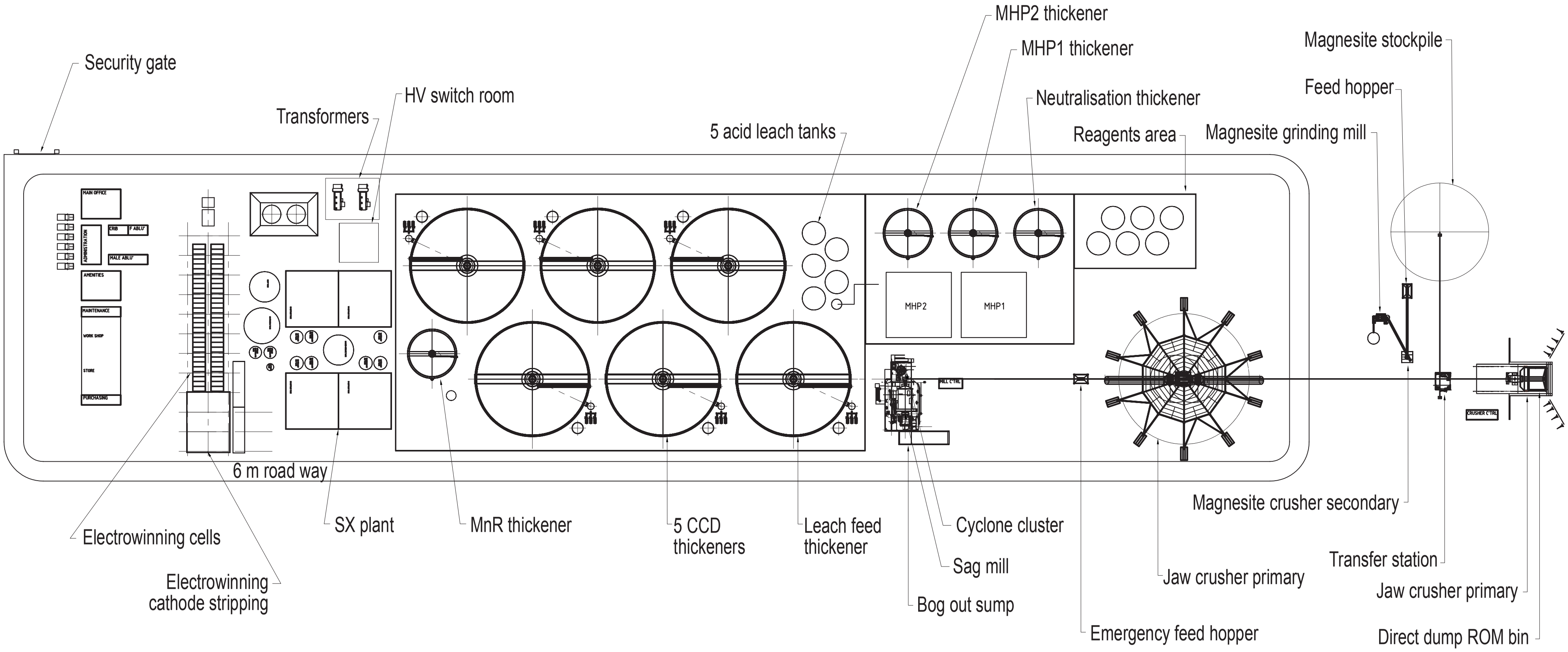
Ore will be conveyed from the ROM pad to a single stage crushing circuit consisting of a jaw crusher. The crushed product will be ground in a SAG mill to achieve a particle size of 80% smaller than 150 μm. Ground product is then sent to the leach circuit.

Leaching

Feed from the grinding circuit is diluted to approximately 40% solids. Sulfuric acid, recycled from other components of the plant, is added to the slurry to leach the minerals at 60 to 80°C. Design leaching time is five hours, after which the slurry is sent to the counter-current decantation circuit for solid/liquid separation.

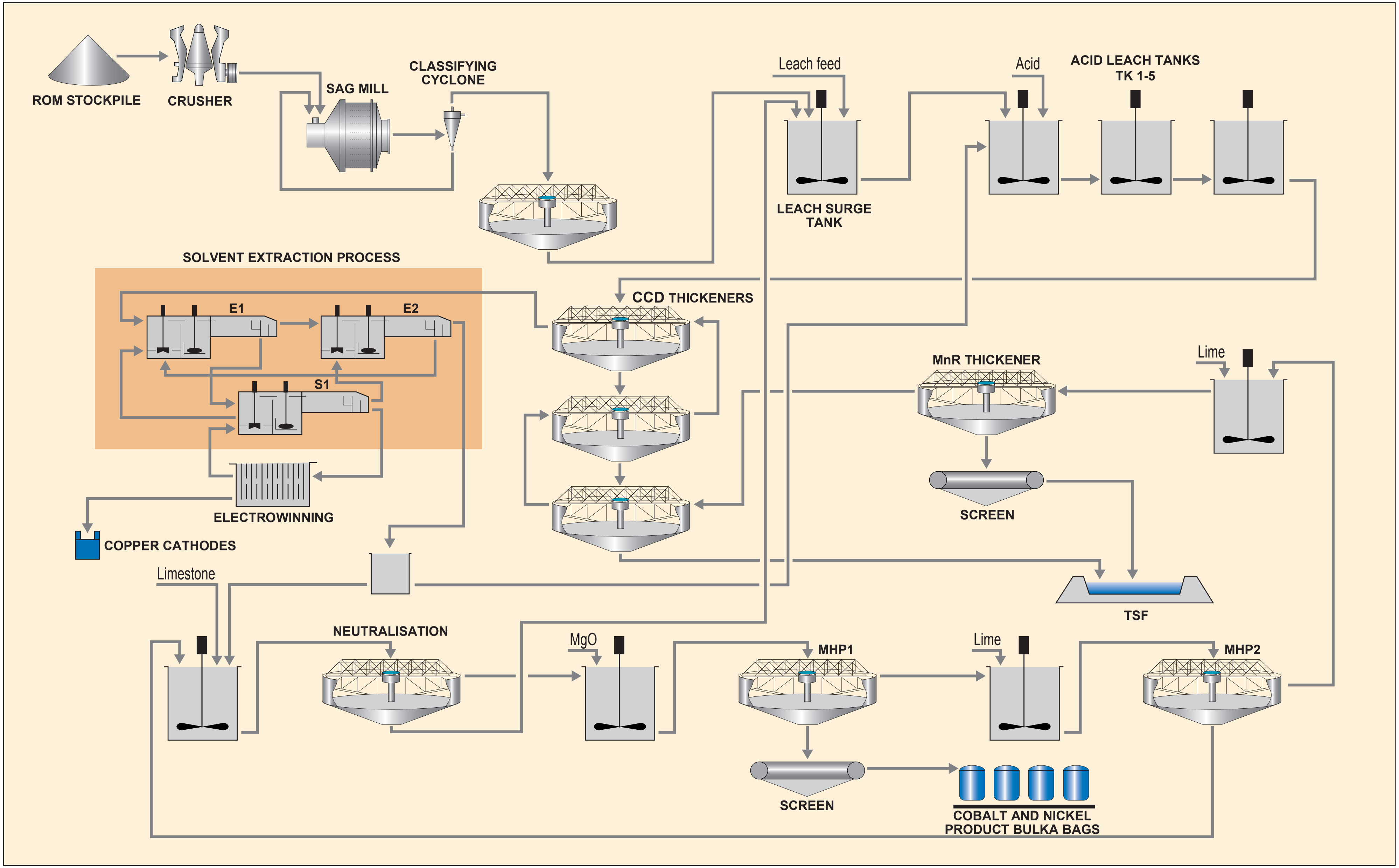
Counter-current Decantation

The counter-current decantation circuit separates soluble minerals from solid residues. In the process the solids are washed free of acid. The clear liquor is then sent to the solvent extraction circuit to increase its tenor suitable for copper electrowinning.



Source: Wilshaw Engineering, Drawing No 182-L-002.

Job No: 836	Compass Resources NL	Process plant general arrangement	Figure No: 4.8
File No: 836_08_F4.08_HB	Browns Oxide Project		



enesar	Job No: 836	Compass Resources NL	Simplified process flowsheet	Figure No: 4.9
	File No: 836_08_F4.09_HB	Browns Oxide Project		

Solvent Extraction

The solvent extraction circuit purifies and concentrates the copper from the solution. This high-copper pregnant liquor solution is then sent to the electrowinning circuit.

Electrowinning Circuit

Copper is removed from the loaded electrolyte solution onto stainless steel starter cathodes. The remaining solution is sent to the precipitation stage. The plated copper cathodes are then washed and the copper is stripped off the steel plates as Grade A copper cathode sheets. The copper sheets are then weighed, sampled and bound in pallets for transport from site.

Precipitation of Cobalt and Nickel

The copper-free solution is neutralised with site-mined magnesite in preparation for nickel and cobalt precipitation. The magnesite lies within the oxide pit area and will mined as part of the mine pre-strip. Solids formed during neutralisation are returned to the leach stage.

The cobalt and nickel products will be precipitated from the copper-depleted leachate (either separately or together) as hydroxides or sulfides. Selection of the final product form will depend largely on marketing outcomes. These crystalline precipitates will be filtered and packed in 1-t bulka bags for containerised transport off site. Solutions will be recirculated for reuse.

Tailing from the processing circuit will be discharged to the TSF at a slurry density of 45% solids (Section 4.10).

4.8.3 Concentrate Storage and Transport

Copper cathode will be transported on strapped pallets to the Port of Darwin for export via ship. The 1-t bulka bags containing the cobalt and nickel products will be placed inside 20-ft containers that will be transported by road to Darwin.

Product transport will occur via Rum Jungle Road, through Batchelor to the Stuart Highway and then to the Port of Darwin. Product transport will occur two or three days per week. Each truck will carry approximately 50 t of cobalt and nickel product and 100 t of copper cathode.

At the port the containers containing cobalt and nickel products will be unloaded by wheeled fork-lift truck or crane. Product will be loaded onto ships at the Darwin container-handling terminal for export.

4.8.4 Reagents and Consumables

Inputs to the process are ore, water, acid, steam, organic solvents and diluent for solvent extraction, and various other reagents (Table 4.8). Acid will be supplied to site in tankers and stored in tanks in a lined and bunded area, as will organic solvents and diesel fuel.

All chemical transportation and storage will be in accordance with the relevant Australian standards. All products will be stored in a product load-out facility and loaded onto trucks for transport off site.

Table 4.8 Annual reagent and chemical useage

Reagent or Chemical	Annual Useage
Steam	33,000 t
Sulfuric acid (98%)	20,800 t
Cobalt sulfate	7.3 t (as $CoSO_4.6H_20$)
Guar	7.3 t
Diluent	70 m^3
Extractant	17.5 m^3
Flocculant	350 t
Lime	9,700 t
Magnesia	1,700 t
Locally mined magnesite	40,200 t

4.9 Waste Rock

4.9.1 Waste Rock Characterisation

Waste rock will consist of either oxidised sulfidic shales or carbonate-rich sediments. For mine planning purposes, the different lithologies have been categorised on the basis of acid-forming potential (i.e., either non-acid forming (NAF) or potentially acid-forming (PAF)) (Table 4.9). When potentially acid-forming or acid-forming waste rock is exposed to water and oxygen, oxidation of sulfur may produce an acidic leachate. This is less likely for oxidised sulfidic shales since most of the contained sulfur has already been oxidised. Carbonate-rich sediments do not produce acid and have some capacity to neutralise acid.

Table 4.9 Waste rock acid-forming potential categories

Lithology	Sulfur (%)	Assigned ARD Category	ARD Type
Dolomite	<0.5	NAF	1
Shale	<0.5	NAF	2
Dolomite	0.5 to 1.5	NAF	3
Shale	0.5 to 1.5	PAF	4
Dolomite	>1.5	PAF	5
Shale	>1.5	PAF	6

Three campaigns of geochemical testwork have been undertaken on samples from the Browns deposits:

- The first in 1997 on six drill hole samples that relate to the present oxide resource (and are nearly all above the zone of oxidation).
- The second on 40 samples in 2002, focussing on the deeper sulfide deposit rather than the oxide material that is to be mined for the current project.

- The third, in 2005, on 16 drill core samples of near-surface rock that will be mined over the life of the Browns Oxide Project (Appendix 9).

Results from this testwork suggest the following:

- Carbonates with total sulfur up to 0.5% will be NAF. This supports the definition used for category 1 in Table 4.9.
- Well-oxidised shale with low (<0.5%) sulfur levels is likely to be NAF, supporting the definition used for category 2.
- Pyritic dolomite with elevated total sulfur (e.g., 5.6%) is likely to be NAF, despite the elevated sulfur concentration. This supports the definition used for category 3 in Table 4.9, where the total sulfur is <1.5%, and suggests that category 5 is conservative, i.e., material included in this category is not likely to be PAF.
- Shale with somewhat elevated total sulfur (e.g., 1.4%) may be either PAF or NAF. However, the limited sample numbers and the dependence of this finding on the availability of sufficient acid neutralising capacity has resulted in a conservative approach being adopted for this project, whereby category 4 has been classified as PAF.
- Shale with substantially elevated total sulfur (e.g., 2.2% to 10.2%) is likely to be PAF, which supports the definition used for category 6, i.e., most material in this category is likely to be PAF.

Using this approach, about 36% of all of the waste rock that will be generated during mining may be classified as PAF (Table 4.10). Examination of the mine schedule (Table 4.11) indicates an increasing percentage of PAF material with each successive year of mining, from 14% in Year 1 to 70% in Year 4. This is consistent with an increasing sulfur concentration in the waste as the pit becomes deeper and the lower boundary of the oxidation zone is approached.

Table 4.10 Total waste rock

ARD Category and Type	Total Waste Rock Production (t)	Waste Rock Type as % of all Waste Rock
NAF1	375,737	9.7
NAF2	2,022,743	52.0
NAF3	83,079	2.1
PAF4	416,618	10.7
PAF5	126,831	3.3
PAF6	865,511	22.2
All NAF	**2,481,559**	**63.8**
All PAF	**1,408,960**	**36.2**
All waste	3,890,518	100.0

Note: NAF/PAF waste rock definitions are as described in Table 4.9.

Table 4.11 Waste rock NAF and PAF breakdown

ARD Category and Type	Waste Rock Production Schedule (t)				Waste Rock Types as % of all Waste Rock			
	Year 1	Year 2	Year 3	Year 4	Year 1	Year 2	Year 3	Year 4
NAF1	35,710	125,483	127,893	86,651	3.1	11.6	14.5	11.0
NAF2	931,594	585,538	416,969	88,641	82.2	53.9	47.1	11.3
NAF3	4,411	12,313	9,433	56,922	0.4	1.1	1.1	7.2
PAF4	87,799	114,158	125,856	88,805	7.7	10.5	14.2	11.3
PAF5	0	0	10,351	116,481	0.0	0.0	1.2	14.8
PAF6	74,422	248,711	194,341	348,037	6.6	22.9	22.0	44.3
All NAF	971,715	723,334	554,295	232,214	**85.7**	**66.6**	**62.6**	**29.6**
All PAF	162,221	362,869	330,548	553,322	**14.3**	**33.4**	**37.4**	**70.4**
All waste	1,133,936	1,086,203	884,843	785,536	100.0	100.0	100.0	100.0

Note: NAF/PAF waste rock definitions are as described in Table 4.9.

The geochemical testwork undertaken on waste rock in 2005 also included multi-element analyses of one sample of pyritic dolomite, one sample of NAF black shale and three samples of PAF black shale (Appendix 9). Elements that were significantly enriched in the samples, relative to literature values for median soil abundances, were:

- Dolomite—arsenic (148 ppm), molybdenum (254 ppm) and magnesium (20%).
- NAF black shale—copper (1,642 ppm), lead (2,588 ppm), cobalt (95 ppm) and beryllium (5.6 ppm), with minor enrichment of arsenic (44 ppm) and molybdenum (8.1 ppm).
- PAF black shale—copper (up to 4,866 ppm), lead (up to 5,709 ppm), cobalt (up to 205 ppm), beryllium (up to 2.8 ppm), arsenic (up to 260 ppm), antimony (up to 9 ppm), molybdenum (up to 45 ppm) and selenium (up to 6.1 ppm).

Elements of most concern from an environmental perspective are copper, lead, cobalt and arsenic, therefore particular attention will be given to monitoring these metals in site water quality monitoring programs. In the event that sulfide oxidation and acid generation occurs, it is also possible that other non-enriched metals, such as manganese, nickel and zinc, could occur at elevated concentrations; these metals will also be included in the monitoring program.

Kinetic NAG testing was undertaken on three of the PAF black shale samples in the 2005 testwork program to provide information on the likely lag time in acid production (Appendix 9). These tests showed that there was an immediate downward trend in pH with time, indicating the generation of acid by sulfide oxidation and an absence of acid neutralising capacity within the samples. Waste rock represented by these samples is therefore likely to become a source of ARD within a short time of exposure to atmospheric conditions, i.e., within weeks to months rather than years, if not appropriately managed.

Further column leach testing has been commissioned by Compass to provide a more realistic assessment of the likely extent and rate of acid production, and the leaching potential of elements of environmental significance from the different rock types. The first results from this program will be reported in the Mining Management Plan [C].

4.9.2 Waste Rock Management

The TSF embankment has been designed by Australian Tailings Consultants (ATC) (Appendix 8)[1] to incorporate all of the waste rock that will be mined. The embankment, which will enclose all sides of the storage, will be a substantial structure with a base width of over 80 m and an outside perimeter length of approximately 3 km (Figure 4.10). This allows for selective placement of waste types so that PAF rock can be encapsulated by compacted NAF material within the wall.

Using the classification described above for NAF and PAF waste rock, the TSF embankment design includes an ‘overlay’ of sections of the embankment considered to be suitable for inclusion of PAF material. This design overlay provides for a zone to be constructed using NAF material only, and another zone for mixed PAF material and NAF material (Figure 4.11). The use of pit waste material in the TSF embankment is summarised in Table 4.12 which shows that, in general, the pit waste production will be able to match the sequential requirements for embankment construction.

Table 4.12 Summary waste rock use in TSF embankment

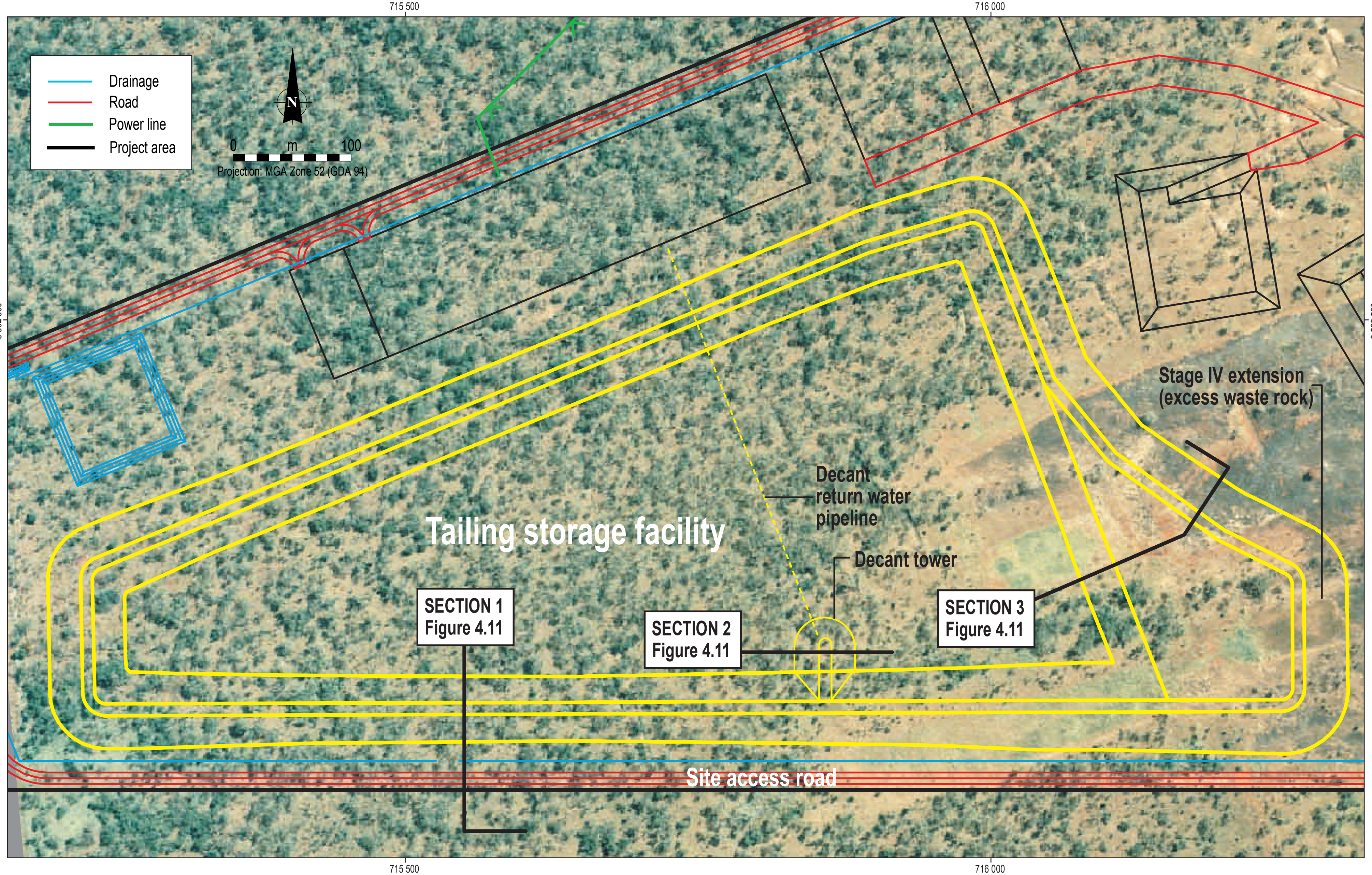
Mine Year	Pit Waste Production ‘000 (m^3)			Waste Rock Use in TSF Embankment ‘000 (m^3)				
	NAF	PAF	Total available	Construction stage	Pit waste: NAF only zone	Pit waste: PAF & NAF zone	External borrow required (All NAF)	Total
0	–	–	–	1	0	0	194	194
1	486	81	567	2	75	312	0	387
2	361	181	542	3	301	387	0	688
3	277	165	442					
4	116	277	393	4	220	650	0	870
Total	**1,240**	**704**	**1,944**	**Total**	**596**	**1,349**	**194**	**2,139**

Note 1: Material placed in the TSF embankment has an assumed density of 2.0 t/m^3.
Note 2: Tables 4.10, 4.11 and 4.12 reflect a total waste rock production of about 4 Mt; slight discrepancies will be reconciled during preparation of the revised mine schedule and the subsequent detailed design of the TSF, which will also allow further alignment of these two aspects of the project.

This selective placement of PAF material in the TSF embankment will therefore involve the following strategies:

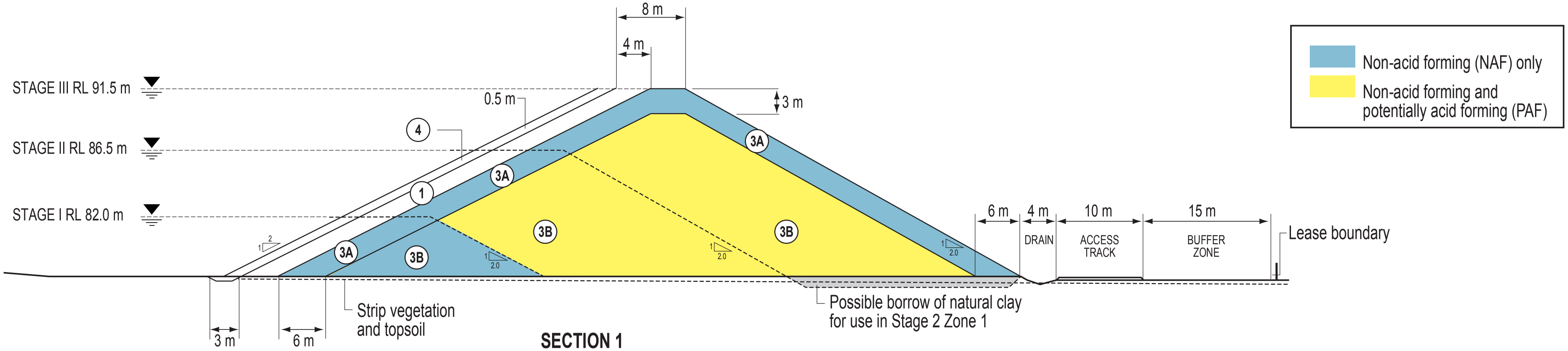
- Limiting exposure of PAF material to atmospheric oxygen, thereby minimising the rate at which oxidation can occur within the PAF material.

[1] This is a preliminary design report; a final TSF design will be produced upon completion of the site geotechnical assessment, the final mine schedule and the final metallurgical process flowsheet.



Source: Appendix 8, figure 1.	Job No: 836 / File No: 836_08_F4.10_HB	Compass Resources NL / Browns Oxide Project	TSF general layout

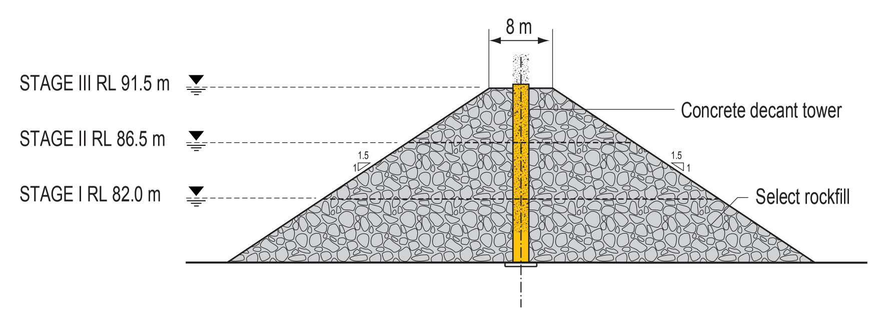
Figure No: 4.10



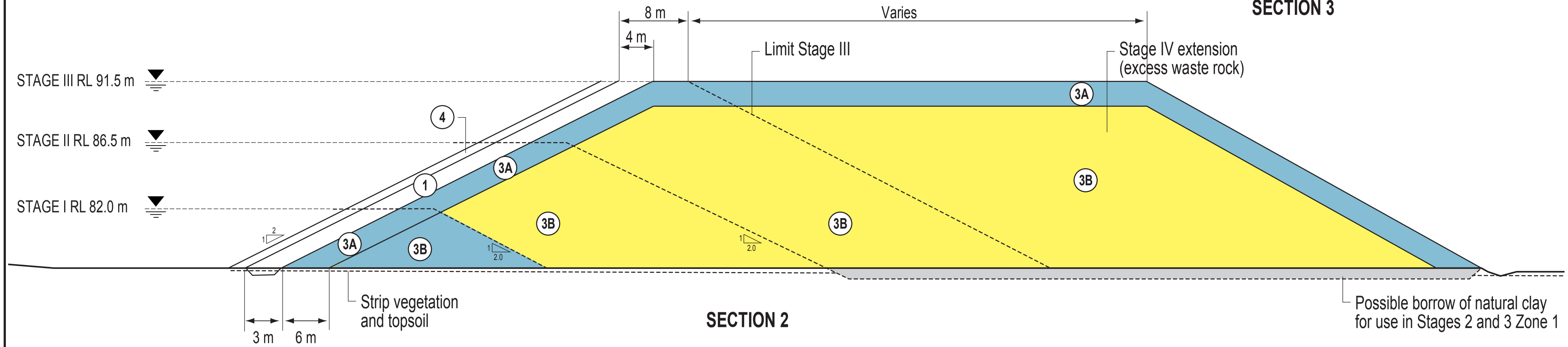
SECTION 1

Summary of material zones

1	CLAY: Sandy clay, clayey sand (low permeability material)	Stage 1: Internal borrow Stage 2: Borrow from footprint Stage 3: External borrow	Place in layers 0.15 m max compacted thickness, compact at not less than 95% standard DD at moisture content in range (omc - 2%) to (omc + 2%).
3A	ROCKFILL: EW, HW, MW NON-ACID FORMING	Stage 1: External borrow Stage 2, 3, 4: Pit waste rock	Spread and compact in 0.3 m thick layers (compacted thickness). Compaction to comprise of 8 passes of a 10-t vibrating foot roller.
3B	ROCKFILL: All weathering categories NON-ACID FORMING AND POTENTIALLY ACID FORMING		
4	ROCKFILL: NON-ACID FORMING		Spread on face. Compaction not required.



SECTION 3



SECTION 2

Not to scale

Source: Appendix 8, Figure 3.

enesar	Job No: 836 File No: 836_08_F4.11_HB	Compass Resources NL Browns Oxide Project	TSF cross-sections	Figure No: 4.11

- Reducing water infiltration into the embankment, thereby minimising the volume of ARD produced should the PAF rock oxidise and acidify.

Blending of PAF and NAF material may also provide additional buffering capacity, although the extent to which this may occur is not currently known.

At this stage of project development it is expected that the success of the encapsulation strategy will rely primarily on oxidation control that, in turn, will depend of the internal embankment structure and the design of barrier layers. A key factor here is the need to prevent the development of major conduits for transfer of air into the embankment. However, some air movement into the embankment will still occur, and the following factors will be considered in detailed design of the cover layer (so as to provide effective oxidation control):

- The greater the cover layer thickness, the slower the rate of oxygen movement to the site of sulfide oxidation.
- Compaction under controlled moisture conditions, e.g., construction of a barrier with a saturated hydraulic conductivity[1] (K_{sat}) less than 10^{-8} m/s and degree of saturation greater than 0.85[2], can ensure an effective barrier to oxygen diffusion.
- A cover layer containing NAF material with a high carbonate content, e.g., dolomitic rock, will assist in preventing the onset of acid conditions by providing a source of alkaline seepage into the underlying PAF rock.

On mine closure, the TSF and waste embankments will be rehabilitated as described in Chapter 9.

Compass will ensure direct supervision by a qualified person during construction of the TSF and, upon completion, sign off by that qualified person on submission of the ‘as constructed’ designs and plans [C]. This will ensure that the required high degree of geotechnical and structural control is obtained. The implementation of selective handling of PAF material requires integration with the mine plan, with identification of material types involving continuous in-pit sampling, logging, mapping and testing during mining [C]. Consideration will also be given to the level of discrimination of NAF and PAF material that is likely to be achievable within the pit (i.e., the minimum block size that can be accurately delineated in a bench and selectively mined).

As noted by ANSTO (Appendix 7), ‘The concentration of uranium in Browns oxide ore is very low’, with levels of uranium in composite ore samples ranging from 8.1 to 28.6 ppm. For comparison, the ore at the Ranger uranium mine averages 2,300 ppm uranium, i.e., about 80 times more than the highest value measured in Browns oxide ore, while the

[1] Saturated hydraulic conductivity is the rate at which water moves through saturated soil.

[2] Where this may be achieved by watering during construction.

average crustal abundance of uranium is 2.4 ppm (Emsley, 1991). The low degree of mineralisation in waste rock means that uranium concentrations are likely to be lower again in this material. These low levels of uranium are not considered likely to require specific management measures (or impose specific constraints) concerning the use of waste rock in the construction of the TSF embankment.

4.10 Tailing

4.10.1 Tailing Characterisation

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 (Appendix 8):

- The supergene tailing can be classified as clayey sand, with 43% being less than 75 μm and a particle density of 2.98 t/m^3.
- 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/m^3.

Geochemical characterisation of tailing samples has shown that (Appendix 8):

- 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 (see Section 4.8.2), 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 minerals[1]).

Further geochemical testwork is planned to address this matter after finalisation of the metallurgical process flowsheet [C]. This testwork will include chemical analysis of liquor

---

[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.

in tailing samples representative of the final flowsheet and the orebody. Column leach testing will also be 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 [C].

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

4.10.2 Tailing Storage Facility

As indicated in Section 4.9.2, the TSF will be constructed with an embankment around all sides, where this will consist of (Appendix 8) (see Figure 4.11):

- An internal lining of compacted clayey soil (Zone 1), comprising a number of layers of a minimum thickness of 150 mm after compaction.
- A transition zone of highly weathered material (Zone 3A), placed and compacted in 300-mm-thick layers.
- A core zone of weathered rockfill for the bulk of the embankment (Zone 3B), placed and compacted in 300-mm-thick layers.
- A 0.5-m-thick layer of protective rockfill (Zone 4) placed (loose) over the face of the Zone 1 layer.

Existing clayey soils in the tailing storage area will be compacted immediately prior to the commencement of deposition to provide a base for the TSF. The exposed foundations beneath the embankment will also be compacted. All tree roots and stumps beneath the embankment footprint will be grubbed and removed, while vegetation within the storage area will be cleared and topsoil stockpiled.

Preliminary design suggests that the embankment will be constructed in three stages. Factors such as the rate of filling, water management requirements and the physical characteristics of the tailing means that each embankment raising will be undertaken using ‘downstream’ methods, i.e., the new wall will be built on the downstream (outer) slope) of the previous wall (see Figure 4.11).

Tailing will be deposited sub-aerially from a ring pipeline and multi-point spigots will be used to form beaches to assist drying and consolidation of the tailing. The tailing is expected to have an ‘end of filling’ dry density of 1.3 t/m^3, which gives an overall storage capacity requirement of 2.7 Mm^3 and is sufficient to accommodate 3.5 Mt of tailing[1].

---

[1] The initial design of the TSF is based on 3.5 Mt of ore (and tailing). While this is less than the 3.9 Mt of ore that is the basis of this PER, Appendix 8 notes that ‘the tailings dam site and embankment design has sufficient flexibility that additional tailings could be retained’, and this is within the context of mining 3.9 Mt (Seddon, pers. com., 2005). As indicated previously, the final TSF design will be produced upon completion of the site geotechnical assessment, the final mine schedule and the final metallurgical process flowsheet.

The TSF is designed to retain variable volumes of water in the decant pond, up to a maximum 125,000 m^3 in very wet periods. The actual retained volume will depend on recycle requirements for the process plant and, in extreme events, overflow will occur via a spillway along the eastern section of the TSF embankment.

4.10.3 Tailing Management

A number of factors suggest that acidification of tailing during operations is not likely to be problematic:

- Only the black shale tailing has been classified as PAF (see Section 4.9.1) and this will be deposited first into the TSF, with the NAF supergene tailing following.
- Under oxidising conditions, acidification of the PAF black shale would occur after a lag of several months.
- 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.

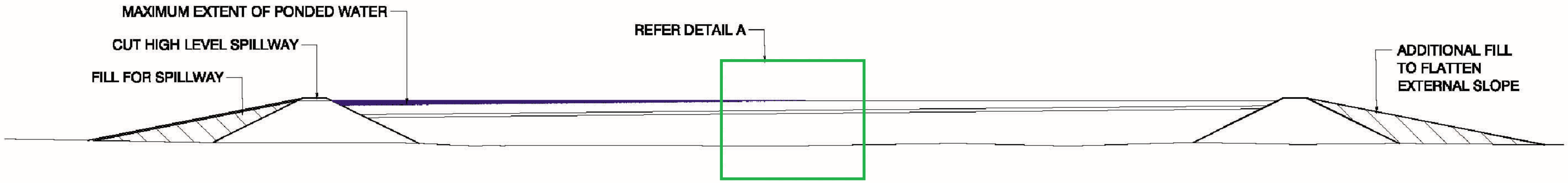
No specific management measures in relation to the potential formation of acid drainage from the tailing are therefore proposed during operations, other than regular monitoring of the tailing and the TSF to confirm these predictions. For TSF closure, a 'store and release' type of cover is proposed to minimise infiltration (Figure 4.12); further detail on the final TSF landform is provided in Section 9.10.

Definitive seepage rates from the TSF have not yet been calculated. However, given the proposed TSF design provisions and the preliminary water balance that indicates a minimum area decant pond, seepage from the storage is expected to be low. Using a number of simplifying assumptions (e.g., significant seepage occurs only from a 5 ha decant pond, in situ tailing has a permeability of 1×10^{-8} m/s, and the foundation clay layer has a permeability of 1×10^{-9} m/s), seepage through the TSF base for the 'mature' storage is likely to be in the order of 20 to 30 m^3/d (i.e., 0.3 L/s). Higher rates may apply during start-up. On closure, indicative seepage rates are expected to range from 0.25 L/s in the wet season to zero in the dry season.

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.

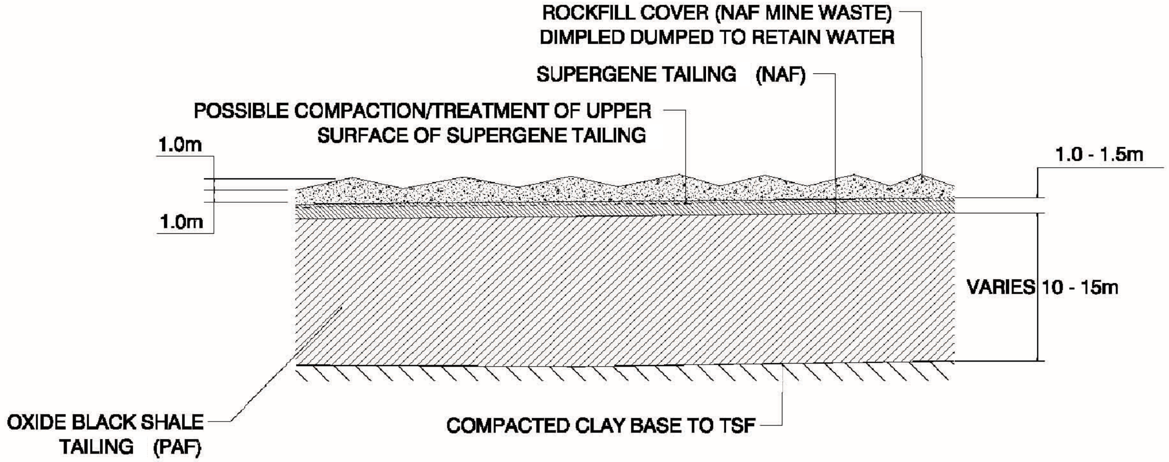
The tailing management strategy, design and operation will be based on consideration of relevant best practice measures such as:

- Detailed design based on the concepts presented herein, but taking into account the findings of detailed site investigations and revised mine schedule.
- 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.



SCHEMATIC CLOSURE PROVISIONS

SCALE 1:2000 @ A3



DETAIL A

SCALE 1:500 @ A3

Source: Appendix 8, Figure 2.	Job No: 836	Compass Resources NL	Schematic TSF closure arrangement	Figure No: 4.12
	File No: 836_08_F4.12_HB	Browns Oxide Project		

- 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.

4.11 Other Waste Material

Anticipated waste production is listed in Table 4.13. This list is preliminary and will be refined once detailed engineering is completed (during which time national pollution inventory requirements will also be determined). All personnel will be instructed (and appropriately supervised) to ensure that they apply the waste management principles of reduce, reuse and recycle, and comply with the waste management plan (see Section 9.8.7)

Table 4.13 Anticipated waste production

Waste Materials	Approximate Quantities	Disposal Method
Scrap steel	10 t/a	Collection by steel recycling contractor
Wooden pallets	250 per annum	Majority returned to supplier for reuse, damaged/excess buried in onsite landfill
Diesel drums	10 per month	Collection by supplier
Domestic waste	1 skip per week	Disposal at on-site landfill
Waste oil and grease	1 load per month	Removed from site for recycling
Chemical and reagent containers	10 per month	Disposed of in accordance with relevant Australian Standard, if can't be reused.
Sewage effluent	2.9 ML/a	On-site sewage treatment

4.12 Infrastructure and Transport

4.12.1 Energy Supply

Electricity

The electricity demand for the project is estimated to be 7.5 MW, and use of an annual load factor of 0.85 shows that this equates to annual energy requirements of approximately 54,000,000 kWh. The project will generally operate on a seven days per week, 24 hours per day basis, although the crushing circuit will only operate 12 hours per day. The main power requirements are the:

- Processing plant, including grinding, concentrator and electrowinning.
- Site office.
- Laboratory.
- Water supply/dewatering pumps/tailing return water.
- Site lighting.

Connection to the Northern Territory grid is the preferred option for electricity, where the grid is supplied by Power and Water Corporation and sourced from a gas-fired power station located at Channel Island. To access the grid, a new power line of about 23 km in length will be constructed. This will comprise single poles and a 22-kV power line and will connect to the existing Darwin–Katherine 132-kV line at the Manton Dam sub-station. The proposed route passes over Aboriginal freehold land and follows the alignment of an existing track and fence line (Figure 4.13), thereby minimising requirements for clearing and potential for disturbing sites of archaeological significance. The final route will be determined in consultation with the NLC and traditional owners. Other supply options that have been considered are discussed in Chapter 5.

During the construction phase and prior to the establishment of grid power, on-site electricity requirements will be minor and will be met by on-site diesel generators. It is estimated that the peak requirement will be 500 MV/a.

Fuel

Most of the mining equipment and project vehicles will use diesel. Fuel requirements during construction and operations are:

- Construction—25 t per week (including requirements for electricity generators).
- Operations—50 t per week (including light vehicle useage).

Additional project-related weekly fuel useage will comprise:

- Product transport to Darwin:
  - 150 t/week: 3.5 x 60-t road trains.
- Transport of stores and reagents to the site:
  - Acid (400 t): 7 x 60-t semitrailers.
  - Reagents: 10 x 50-t truck.
  - Fuel: 1 x 50-t tanker.
  - Stores: 3 x 20-t truck.
  - Potable Water: 3 x 20-t truck (from Batchelor).
  - Explosives: 1 x 20-t truck.
- Employee transport:
  - 35-person bus: 14 trips (two per day).
  - Private cars: 210 trips to/from Darwin.
  - General: 70 trips to/from Batchelor.

Source: Capricorn COM035

Job No: 836	Compass Resources NL	Proposed power line route
File No: 836_08_F4.13_HB	Browns Oxide Project	Figure No: 4.13

- Other:
  - Light truck: 10 trips to/from Darwin.
  - Light vehicle: 35 trips to/from Darwin.

Diesel fuel will be transported to site by tanker and stored in a bunded fuel storage tank located in the mine contractor area (see Figure 4.1). The maximum holding volume for this fuel storage will be 65,000 L.

4.12.2 Water Supply

Water requirements for the mining and processing operations will be met from the following sources (see Section 4.14):

- Externally supplied drinking water.
- Fresh water from groundwater bores (see Figure 4.1).
- Recycled water from the TSF, site catchment and pit water.

4.12.3 Sewage Treatment Plant

Sewage from the site office, process plant building and mine contractor building will be piped to a package treatment plant, which will be designed and constructed to approved Northern Territory standards (see Section 4.14.6). The treatment plant will be located in the process plant area and treated effluent will be returned to the process water dam.

4.12.4 Road Access and Transport

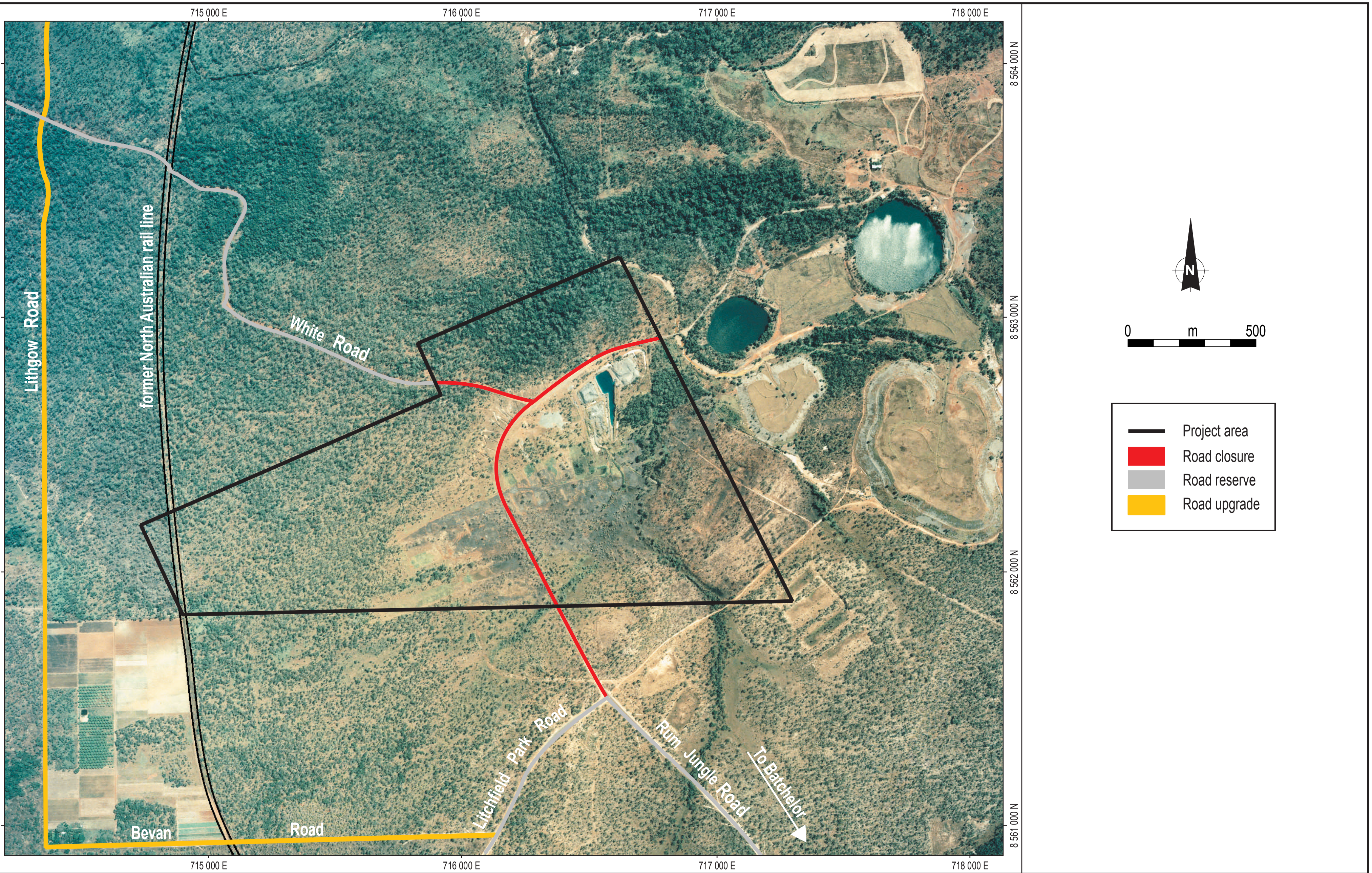
Changes to Existing Road Infrastructure

The existing Rum Jungle Road runs from Batchelor to the historic Rum Jungle site and is bituminised to the locked gate into that area. White Road is a graded, unsurfaced road that intersects the Rum Jungle Road near the proposed pit.

As part of the proposed project, the Rum Jungle Road will be used as the main site access road. Public access along this road will be restricted past the Litchfield Park turn-off. The White Road–Rum Jungle Road route to Batchelor will be severed, with alternative public access provided via Bevan and Lithgow roads. Both Bevan and Lithgow roads are gazetted as roads, although Lithgow Road has to date not been formed up. It is anticipated that these roads will be upgraded under the supervision of the local council to provide alternate access for residents. Compass is currently liaising with the Coomalie Community Government Council pursuant to the *Local Government (Road Opening and Closing) Regulations* in relation to the proposed road alterations (as shown in Figure 4.14).

Site Access

Vehicular access to the site will be via the Rum Jungle Road. The main transport route for all heavy goods and services required at the minesite will be from Darwin via the Stuart Highway and Batchelor Road to Batchelor and then via the Rum Jungle Road. Product transport will be via the same route, only in the opposite direction.



enesar peopleandplace	Job No: 836	Compass Resources NL	Changes to existing road infrastructure
	File No: 836_08_F4.14_HB	Browns Oxide Project	Figure No: 4.14

The project is a continuous operation and so freight and product dispatch will not be restricted to daylight hours. Shift changes will occur at 6:00 am/6:00 pm for the plant workers and 7:00 am/5:30 pm for mine/office employees. Most personnel are expected to access the site via private vehicles (and car pooling will be encouraged). Consideration will be given to bussing employees from Darwin/Batchelor if demand is sufficient.

Expected transport volumes for both the construction and operation phases are shown in Table 4.14. Loads will be properly secured and there will be compliance with appropriate road vehicle axis limits [C].

Table 4.14 Estimated transport volumes to and from site

Description	Vehicle Type	Trips Per Month
Construction phase		
Construction materials	Single trailer	30 (for 5 month period)
Construction workforce	Bus Light vehicles	60 (for 5 month period) 850 (for 5 month period)
Operation phase		
Consumables and materials	Single trailer	Four
Bulk liquid reagents	Tanker (3 x 22-kL load)	33
Employee transit	Light vehicles	1,300
Copper, cobalt and nickel product	Road train (60-t load)	100

Haul and Site Roads

Proposed haul and site roads (see Figure 4.1) will be constructed and subsequently graded and watered as required to allow efficient mining operations. The site access road and car park will be bitumenised.

4.12.5 Ancillary Infrastructure

The office for the operations workforce is located to the west of the processing plant next to the main car park. A separate office and workshop area adjacent to the run of mine (ROM) pad is provided for the mining contractor. A security gate office will be located at the main entrance.

The process plant building contains a laboratory, stores room, concentrator office and emergency services/first aid room. Core storage will continue to be off site at Compass' core shed in Batchelor.

4.12.6 Communications

Telephone

Multi-line telephone systems will be installed to service the site office, processing plant and mine contractor area. The phone will be linked to the national phone network and will also provide service for fax communications.

Intranet and Internet

Intranet and internet ports will be provided for the site office, processing plant area and mine contractor office. Internet access will be broadband.

Site Radio

Local minesite communication between vehicles, contractors and management and similar will be via VHF band radio systems.

4.13 Plant and Machinery Requirements

Plant and machinery (Table 4.15) will be sourced locally where possible. It is expected that much of the earthmoving equipment acquired for the construction phase will also be utilised for mine operations.

A single 60-t excavator and three 50-t off-highway dump trucks will form the main mining fleet. These will be supported by a bulldozer, grader, water cart, blast hole drill, grade control drill and small ancillary items such as pit pumps and light vehicles.

Table 4.15 Plant and machinery requirements

Equipment	Quantity	Primary Functions
Construction		
Excavator (backhoe)	1	Site preparation.
30-t off-highway dump trucks	2	Site preparation.
Scrapers	2	Topsoil removal. Preparation of plant and TSF area.
Bulldozer	1	Clearing of stockpile areas and construction of sedimentation traps.
Compactor/roller	1	Site preparation.
Motor grader	1	Preparation of drains and bunds, servicing of access roads.
Water cart	1	Spraying water to control dust.
500 kVA genset	1	Power for construction activities.
Light vehicles	5	Access during construction.
Operation		
60-t hydraulic excavator	1	Mining and loading material onto dump trucks.
50-t off-highway dump trucks	3	Transporting mined materials to the ROM pad, ore stockpile and TSF (waste rock).
Bulldozer	1	Clearing and levelling of project areas.
Grader	1	Clearing and levelling of project areas.
Compactor/roller	1	TSF embankment compaction.
Water cart	1	Spraying water to control dust.
Blast hole drill	1	Drilling holes in ore for explosives.
Pit pumps	3	Pit dewatering.
Light vehicles	8	Access to pit and project facilities.

4.14 Water Management

The region has a tropical climate with pronounced wet and dry seasons (see Section 3.1) and longer-term weather trends ranging from extreme cyclonic rainfall to drought. The water management system must accommodate both the normally variable rainfall and the occasionally more severe shortages and surpluses of water that may occur over the life of the operation. The following principles apply to the design and operation of the water management 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 land disturbance.

The water use hierarchy adopted to meet process water requirements involves recycling process water and input from the following sources (listed in order of preference):

1. TSF decant.
2. Sewage effluent.
3. Sedimentation trap water (comprising mine water and site runoff).
4. Groundwater (e.g., from interception bores).

The various key components of the project's water balance (Figure 4.15) are discussed below.

4.14.1 Mine Water

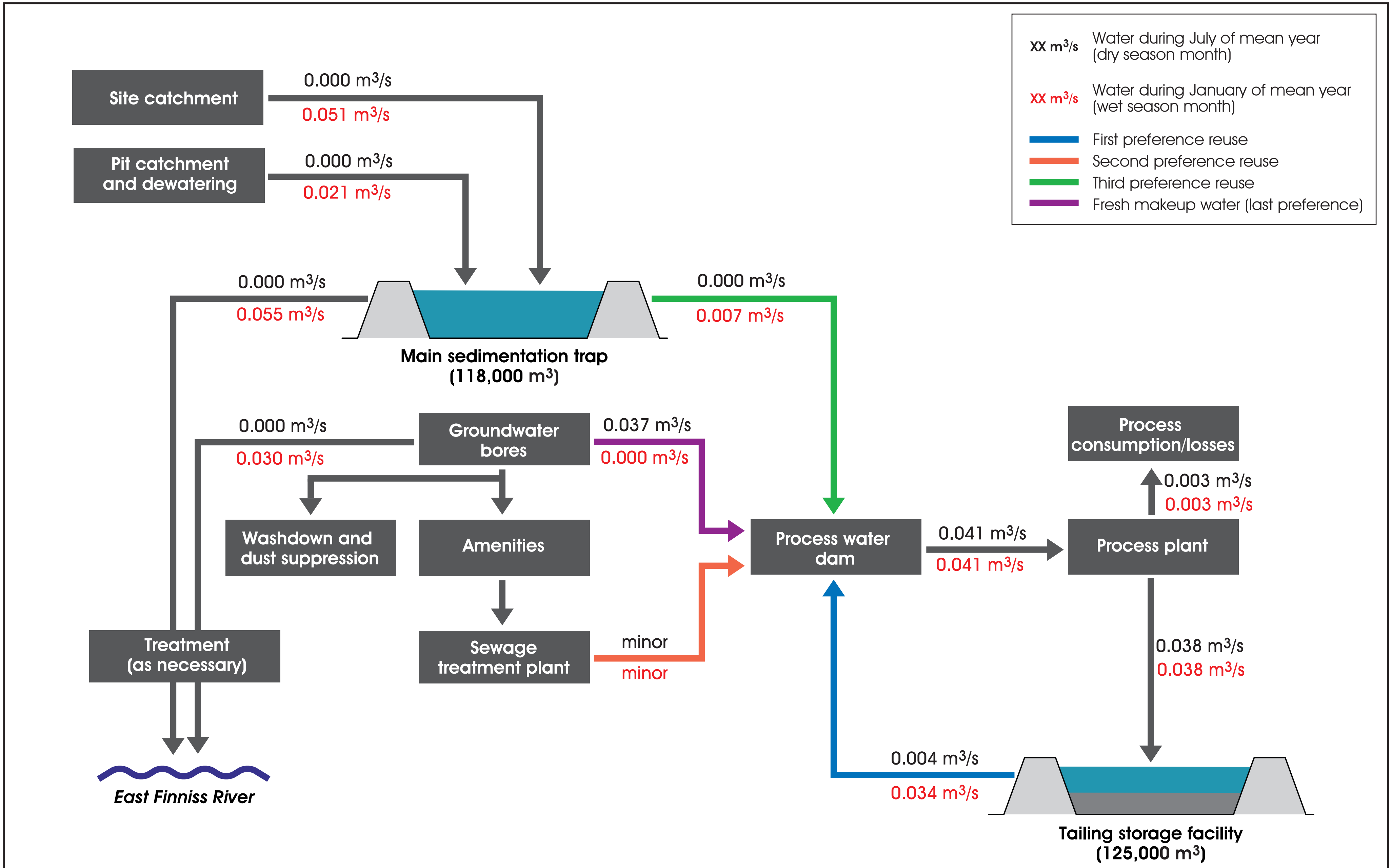
Mine water will comprise incident rainfall over the pit area and groundwater inflows that are not intercepted by advance dewatering (via the interception bores). The mine water will be pumped from the pit to the main sedimentation trap.

4.14.2 Site Runoff

Runoff from disturbed areas will be captured in collection drains and directed to one of three sedimentation traps, located in the northeast corner, the northwest corner and, for the main sedimentation trap (Table 4.16), in the centre of the lease area. The main sedimentation trap drains most of the site and, as indicated above, will also contain mine water pumped from the pit.

Table 4.16 Main sedimentation trap design parameters

Parameter	Description
Maximum storage	118,000 m^3
Maximum water depth	3.5 m
Disturbed area (if full)	10.3 ha
Overflow	At southern end
Crest width	5 m
Slopes	1 vertical: 2 horizontal



Note: Water balance takes into account evaporation, rainfall and seepage.

enesar	Job No: 836	Compass Resources NL	Conceptual water balance	Figure No: 4.15
	File No: 836_08_F4.15_HB	Browns Oxide Project		

Water from the main sedimentation trap will be recycled to the process water dam, while the other two sedimentation traps will be pumped out as required to the main sedimentation trap (see Figure 4.1). During the peak of the wet season, the sedimentation trap may contain more water than necessary for processing requirements. If the capacity of the sedimentation trap is exceeded, water will be discharged to the East Finniss River. Water quality within the sedimentation trap will be monitored regularly and any discharge to the East Finniss River will be treated as necessary to ensure conformance with the water discharge licence (see Section 4.14.6).

Treatment system specifications will be developed during detailed design. The most probable treatment technology for solids removal would involve addition of a suitable flocculant via a mixing box prior to passage to an engineered settlement pond. Should further treatment be required to reduce metal concentrations, water would be pumped to a treatment plant located at the process plant. Treatment would involve lime addition to increase pH and precipitate metals, either using the neutralisation facilities required for metallurgical processing or a parallel circuit constructed specifically for discharge water.

Runoff from undisturbed areas will be prevented from running on to areas of disturbance by the collection drain bund and allowed to drain naturally.

4.14.3 Interception Bores

Three interception bores will intercept groundwater before it seeps into the pit, thereby providing raw water for the process plant. The bores will also supply fresh water for amenities (including, kitchen areas, toilets and safety showers), vehicle wash down and dust suppression. The interception bores will be located in the dolomite beyond the pit perimeter (see Figure 4.1), as this is where the transmissivity is expected to be the greatest. Additional interception bores will be added around the pit perimeter if required. Extracted groundwater in excess of plant requirements will be discharged to the East Finniss River. Should groundwater be contaminated due to legacies from the Rum Jungle Mine (see Section 7.8.4), management strategies may involve treatment prior to discharge using the liming facilities located at the process plant (see Section 4.14.2), or other options as described in Section 7.8.4.

4.14.4 Process Water and TSF Decant

Within the process plant, as much water as possible is recovered and, together with TSF decant, returned to the process circuit via the process water dam (which will have a compacted clayey soil base). Rainwater in the process plant area and any other water (e.g., washdown water) is collected and returned to the process water dam. The TSF is designed to retain sufficient volume (up to 125,000 m^3) for retention of runoff from major rainfall events (see Section 4.10.2). In extreme rainfall events, where the TSF capacity is exceeded, excess water will be released via the emergency high-level spillway and will drain to the main sedimentation trap (see Section 4.14.2). Under these conditions, the sedimentation trap may also be at capacity, hence excess water will discharge to the East Finniss River.

Seepage will either be collected in a toe drain and recycled, intercepted by bores and recycled, or captured by the groundwater drawdown around the pit (see Section 4.10.3).

4.14.5 Wastewater

Wastewater will be generated principally from ablutions and will be collected and treated in a package sewage treatment plant. After treatment, the water quality will be in accordance with the levels shown in Table 4.17. Treated effluent will be recycled to the process water dam.

Table 4.17 Sewage treatment plant water quality

Parameter	Concentrations
Biochemical oxygen demand (BOD)	15 mg/L
Non-filterable residue (NFR)	20 mg/L
Total nitrogen	15 mg/L
Total phosphorous	3 mg/L
Oil and grease	10 mg/L
Ammonia – N	5 mg/L
Thermotolerant coliforms	200 colony forming units/100 mL
pH	6.5 to 8.5 (range)

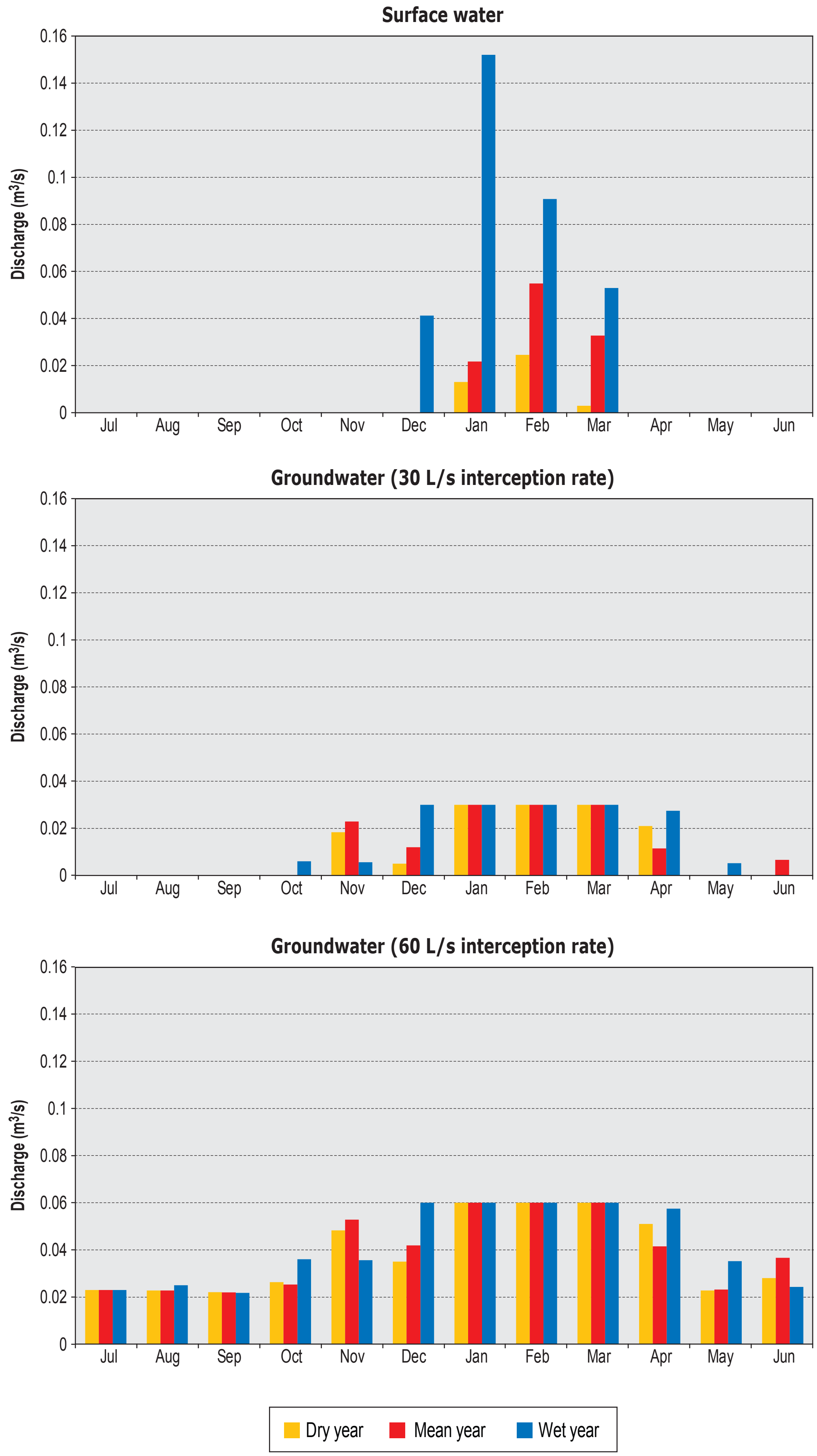
4.14.6 Water Discharges

The overall objective for water management on site is for the operation to be self-sustaining in terms of water use requirements, i.e., process and mining requirements will be met through recycling both process and mine water, with make-up water being obtained from the main sedimentation trap and interception bores. A preliminary water balance has been calculated based on the climatic conditions described in Appendix 8 for the driest, mean and wettest years on record and assessment of the various streams described above. As described in Section 7.8.4, there is some uncertainty regarding the amount of groundwater likely to be produced from interception bores during mine dewatering. The water balance has therefore been prepared considering a range of groundwater yields, namely 30 L/s and 60 L/s.

Water will be discharged via pipeline(s) to the East Finniss River where the Rum Jungle Road crosses the river (see Section 7.8.1), upstream of existing hydrological station GS8150200.

Preliminary Water Balance

Calculation of the preliminary water balance (which, for modelling purposes, ignores groundwater that will report to the pit) has been undertaken for interception bore pumping rates of 30 and 60 L/s, where these reflect the expected range of groundwater inflows (Appendix 3). These calculations show that project-related discharges from the main sedimentation trap (i.e., excluding groundwater that is intercepted via the interception bores) will occur only during the wet season months of December, January, February and March (Figure 4.16). For the 30 L/s scenario, excess groundwater from the interception bores would require discharge to the East Finniss River between the months of November and April (extending to October and June for wet and mean years,



Job No: 836	Compass Resources NL	**Water discharges to the East Finniss River**	Figure No: **4.16**
File No: 836_08_F4.16_HB	Browns Oxide Project		

respectively). The maximum rate of discharge would be 30 L/s (0.030 m^3/s). For the scenario where advance dewatering yields 60 L/s, a minimum of 22 L/s (0.022 m^3/s) is predicted to require discharge during the dry season, increasing to 60 L/s (0.060 m^3/s) in wet months (see Figure 4.16). This is discussed in more detail in Section 7.8.4.

4.15 Hazardous Materials Management

Hazardous materials such as chemicals and hydrocarbons will be fenced and bunded in accordance with the relevant Australian standards (as described in Section 9.8.7).

Explosives will be purchased on a shot-by-shot basis delivered as a 'down-the-hole' service. The explosives manufacturing, storage and transportation requirements will be the responsibility of the supplier. A small explosive and detonator magazine will be located in the southern part of the site (see Figure 4.1).

4.16 Construction and Operating Standards

The project will be constructed and operated in accordance with appropriate legislation, codes and standards as detailed in Chapter 2. Where relevant, consideration will also be given to addressing likely future changes in approaches to such projects, e.g., by incorporating features that reflect the carcinogenic, mutagenic and reprotoxic nature of cobalt and nickel.

4.16.1 Management Structure

The day-to-day operation of the site will be the responsibility of the General Manager Operations (GMO) (Figure 4.17). Reporting directly to the GMO will be a team of key personnel comprising the mine geologist, mine engineer, process plant manager, metallurgist, safety officer, administration manager and the environmental manager. The majority of the workforce will report to the mine engineer as part of the mining contractor team or will be the responsibility of the process plant manager.

4.16.2 Site Inductions

All personnel and visitors will be required to undergo appropriate inductions (see Section 9.5.3 for details). Inductions will cover health, safety and environment (including cultural heritage and archaeological matters) aspects of the project.

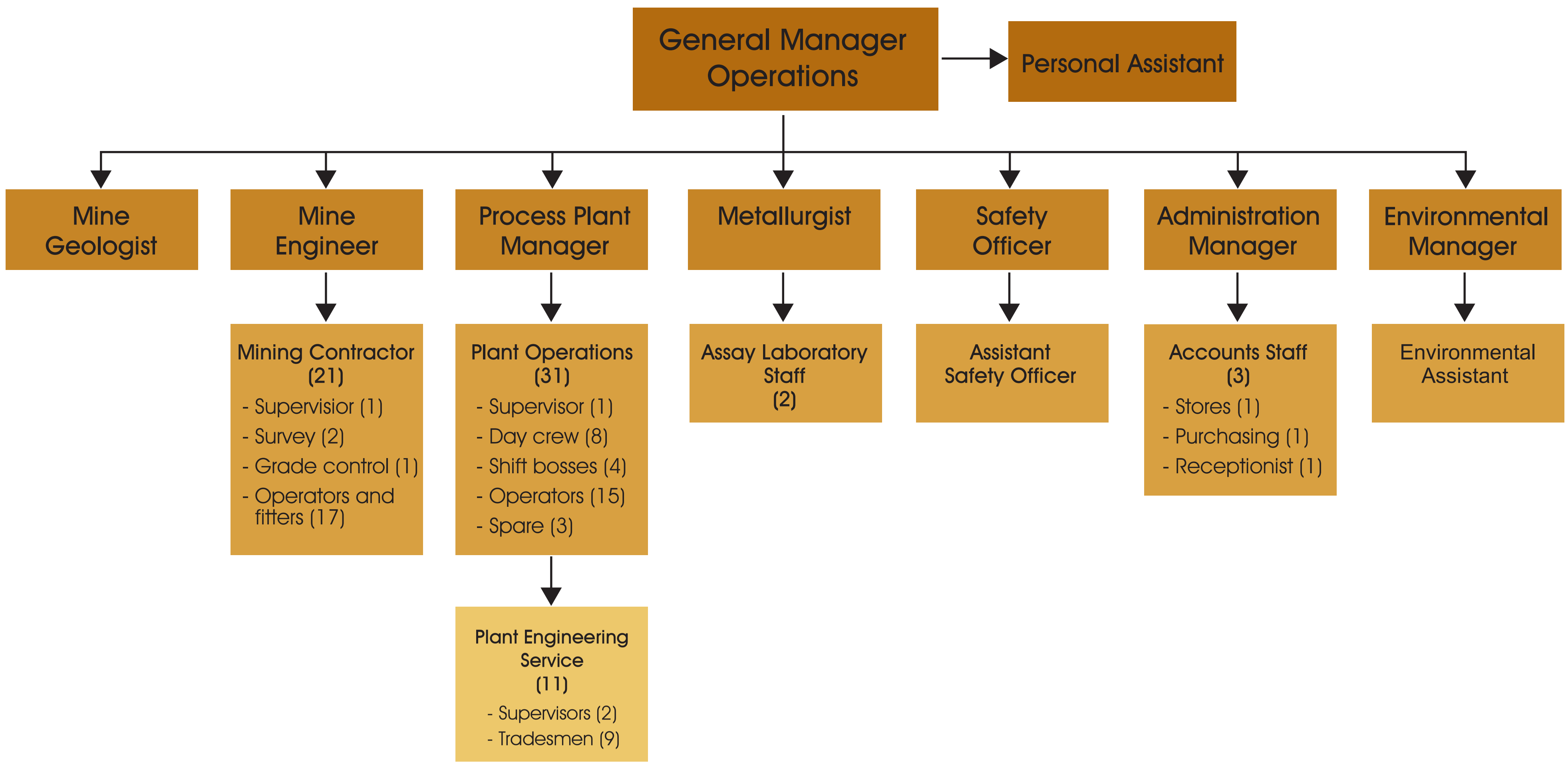
4.16.3 Occupational Health and Safety

Operations will be carried out in accordance with applicable national and Northern Territory OH&S laws and regulations. This will ensure that correct workplace practices are followed, thereby providing a satisfactory level of workplace safety. Safety measures will include:

- The employment of only suitably trained personnel.
- Ensuring workers are drug free.

Browns Organisational Chart

Total workforce: 79-site-based employees (excluding exploration)



Job No: 836	Compass Resources NL	Management structure	Figure No: 4.17
File No: 836_08_F4.17_HB	Browns Oxide Project		

- The use of safety clothing, footwear and headgear, where required.
- The use of hearing and eye protection equipment, where required.
- Development, implementation and enforcement of workplace safety and emergency response procedures.
- Provision of adequate and appropriately located first-aid equipment.
- Development and implementation of procedures which ensure that all personnel are warned and confirmed clear of blast areas prior to blasting.

4.16.4 Site Security

The project area will be fenced and access to the site will be controlled by the security gate.

4.17 Workforce and Accommodation

4.17.1 Construction Workforce

Up to 100 people will be employed during the 9-month construction phase. The construction workforce will operate 12 hours per day, six days per week on a rotational basis. The majority of the construction workforce will be employed as contractors and is likely to be sourced primarily from Darwin.

The construction workforce will be accommodated in existing facilities in the Batchelor–Adelaide River–Darwin region. Temporary accommodation facilities in Batchelor are currently limited; however, local accommodation options may be expanded by local businesses. A significant proportion of the workforce is expected to commute from the Darwin area.

4.17.2 Operations Workforce

The operations workforce is expected to comprise some 59 people including project management and processing plant staff, with another 20 people being employed by the mining contractor. Compass intends to source locally where possible, although specialist mining positions and senior management roles will require previous mining experience and may need to be sourced from a wider area. It is expected that the majority of the operations workforce will come from the Batchelor–Adelaide River–Darwin region. It is anticipated that Aboriginal people will comprise a significant portion of the workforce.

The operations workforce will provide its own accommodation in the Batchelor–Adelaide River–Darwin region.

4.18 Rehabilitation and Mine Closure

Section 9.10 contains the strategic rehabilitation and mine closure plan. This strategic plan will be refined and costed after PER approval has been obtained and the detailed design phase of the project completed. The revised plan will then be included as part of the project's MMP which is submitted to DPIFM for approval prior to commencement of construction.