2.0 Proposed Project

2.1 Site Location

The proposed Yarwun refinery and the residue storage facility (RSF) sites are located within the Yarwun and Aldoga Precincts of the Gladstone State Development Area (GSDA) respectively. The GSDA is an area designated by the Queensland Government for industrial use and development. Details of the GSDA are provided in Section 10.12.

The refinery site is located on the corner of Reid and Hanson Road, Yarwun, approximately 9 km west of the centre of Gladstone (refer Figure 1.1.3). Hanson Road forms the northern boundary and Reid Road, off Hanson Road, forms the western and southern boundaries of the refinery site. The refinery site covers an area of approximately 250 ha.

The local context of the refinery site location is shown on Figure 2.1.1.

Inter-tidal wetlands cover the north-eastern corner of the refinery site. A rail connection along the eastern boundary of the refinery site is being proposed by Queensland Rail (QR) as part of the proposed Wiggins Island Coal Terminal (WICT) project. Adequate space has been provided in the refinery layout for a rail siding and dump station as part of these rail facilities should rail transport of bulk materials to the refinery site be required (refer to Section 5).

The RSF site is located at Aldoga, approximately 12 km south-west of the refinery (refer Figure 1.1.3), adjacent to the Comalco Alumina Refinery's (CAR) existing residue management area.

2.2 Project Components

Project components of relevance to the Environmental Impact Statement (EIS) are:

- Refinery at Yarwun.
- RSF at Aldoga.
- Slurry and seawater pipelines between the Coorumburra beneficiation plant (at the Marlborough Mine) and the refinery.
- Residue and return liquor pipelines between the refinery and the RSF.
- Material handling facilities at the proposed Wiggins Island Wharfs (WIW) and Fisherman's Landing port facilities.

2.2.1 Refinery

The footprint of the refinery for Stages 1 and 2 will occupy approximately 125 ha of the western half of the site. The current layout concept of the refinery is provided in Figure 2.2.1. However, the design will continue to evolve over the design period such that the current concept layout is likely to be refined with subsequent investigations.

Bulk material storage areas for imported ore and sulphur will be located at the north-eastern end of the refinery where the conveyor to/from the proposed WIW leaves/enters the site (refer Figure 2.2.2. The refinery processing areas will be located to the south of the ore and sulphur stockpiles and will be oriented in a general east-west direction. Utilities such as power and sulphuric acid plants (SAPs) will be located within the centre of the refinery.

All light vehicle access to the site will be via an entrance from Reid Road. Car parks for refinery employees and visitors will be located adjacent to the site entry. All truck access will be via a separate heavy vehicle access off

URS

Client
Gladstone Pacific Nickel Ltd

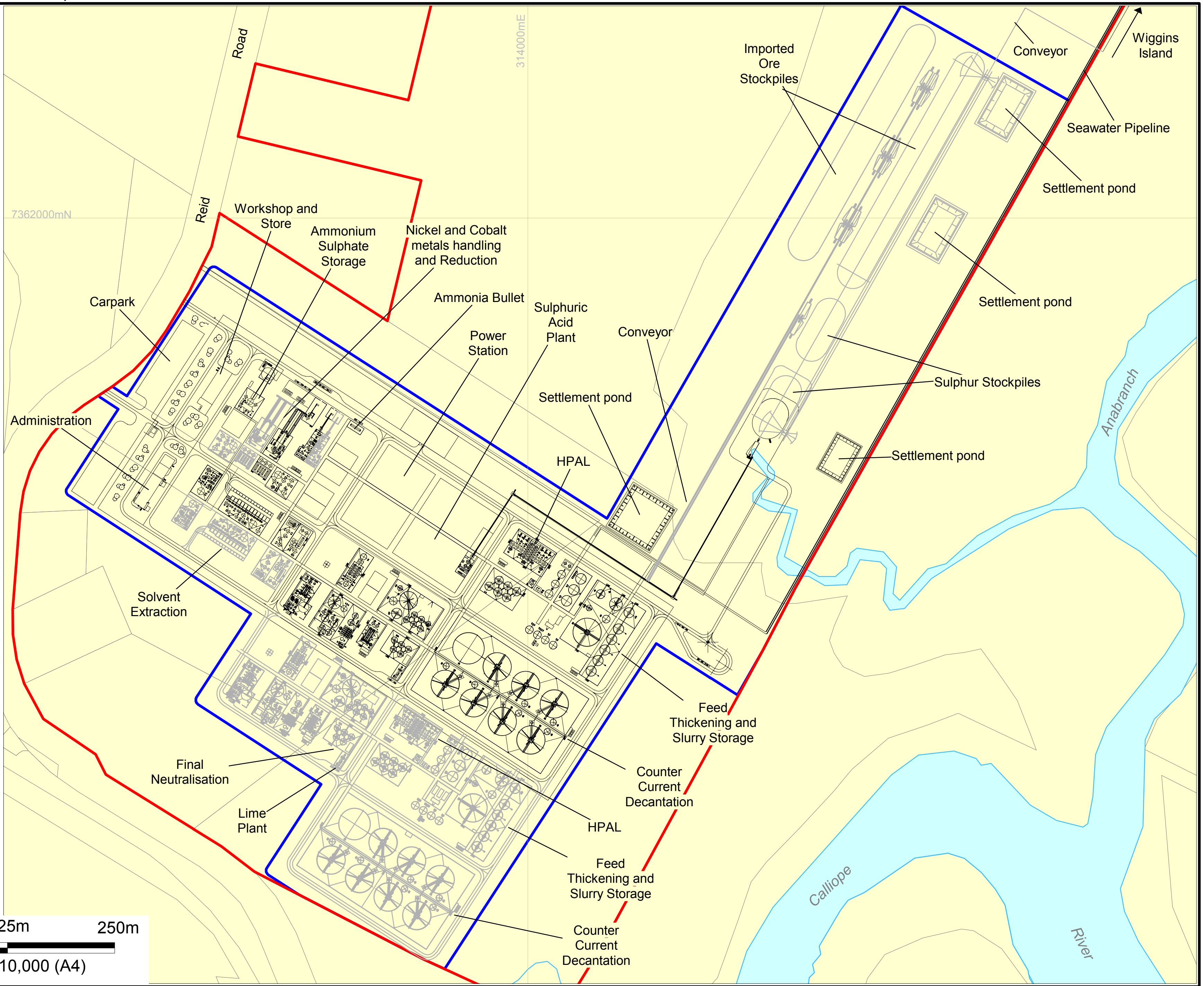
Project
GLADSTONE NICKEL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Drawn: LL
Approved: CMP
Date: 20/11/2006
Job No.: 4262 5791
File No. 42625791-g-100.cdr

Title
REFINERY SITE LOCATION
LOCAL CONTEXT

Figure: 2.1.1
Rev. A
A4

Refinery Site Boundary



Refinery layout Stage 1

Refinery layout Stage 2

Prposed Development Footprint

0 125m 250m

Scale 1:10,000 (A4)

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URS

Client: Gladstone Pacific Nickel Ltd

Project: GLADSTONE NICKEL PROJECT ENVIRONMENTAL IMPACT STATEMENT

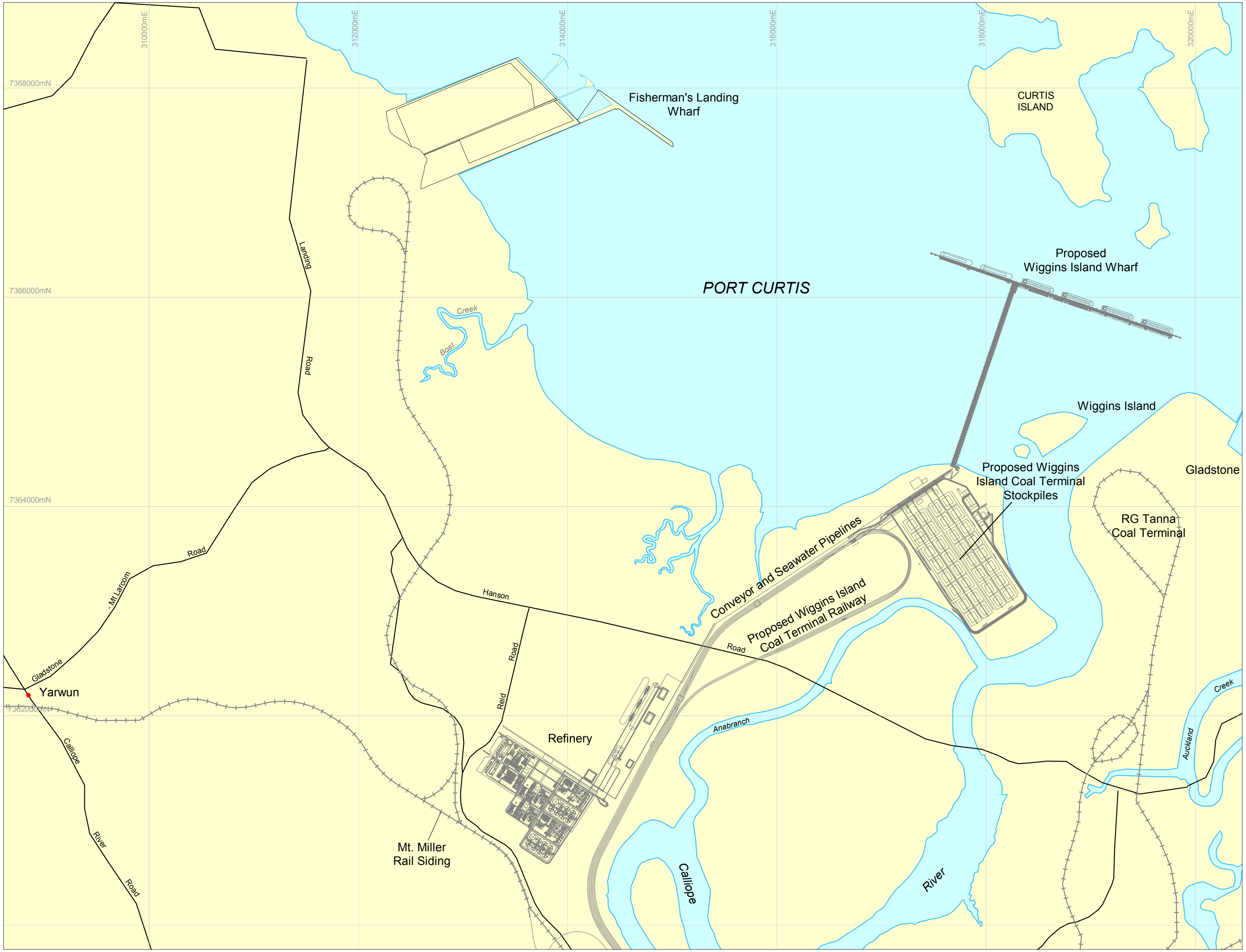
Title: YARWUN REFINERY GENERAL SITE LAYOUT

Draft

Drawn: TN | Approved: CMP | Date: 20-11-06

Job No: 4262 5791 | File No: 42625791-g-014b.wor

Figure: 2.2.1 | Rev: B | A4



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0 750 1500m

Scale 1:50,000 (A4)

MGA Z56, GDA94

Water course

Road

Railway

URS

Client: Gladstone Pacific Nickel Ltd

Project: GLADSTONE NICKEL PROJECT ENVIRONMENTAL IMPACT STATEMENT

Title: WHARF FACILITIES WIGGINS ISLAND

Drawn: TN | Approved: CMP | Date: 08-01-07

Job No: 4262 5791 | File No: 42625791-g-018c.wor

Figure: 2.2.2 | Rev: C | A4

Reid Road where the site weighbridge and administration area will be located. If required, rail access will be developed in conjunction with the WICT project to the east of the site.

Natural vegetation buffer areas will be maintained between the refinery and the roads on the northern, southern and western perimeters of the site. Landscaping and beautification works will be undertaken along the western perimeter of the refinery site to minimise the visual impact of the refinery from Reid Road.

2.2.2 Residue Storage Facility

Residue from the refinery will be pumped as a slurry to the RSF at Aldoga (refer Figure 2.2.3). The RSF will be designed to contain the residue for long-term storage.

The RSF impoundment area is located within a natural valley and is bounded on the east and west by low-lying hills with a maximum elevation of approximately 160 m Australian Height Datum (AHD). Historically, the area has been used for grazing and therefore the landscape is relatively clear with small areas of open forest with low shrub undergrowth. The natural drainage is to the south-east, leading into Farmer Creek and then to the Calliope River, which is approximately 9 km downstream and 5 km south of the RSF site.

2.2.3 Pipelines

Marlborough Nickel Pty Ltd (MNPL), a wholly owned subsidiary of Gladstone Pacific Nickel Limited (GPNL), owns 12 mining leases and a number of exploration permits over lateritic nickel/cobalt deposits approximately 175 km north-west of Gladstone in central Queensland. Ore mined from these deposits will be beneficiated at the Coorumburra beneficiation plant (at the Marlborough Mine) and supplied to the refinery by pipeline as a slurry. An existing Environmental Authority (MIM800078102) has already been obtained for project activities undertaken on the MNPL mining leases.

The ore slurry pipeline, approximately 180 km long and 500 mm in diameter will commence at the Coorumburra beneficiation plant site located on MNPL mining leases and terminate at the refinery (refer Figure 2.2.4).

Seawater will be extracted from Port Curtis and used to create slurry at the beneficiation plant at Coorumburra. This will require a pipeline (approximately 550 mm diameter) located parallel to the ore slurry pipeline to supply the seawater to the beneficiation plant.

Nickel and cobalt will be extracted from the ore at the refinery. The waste material (residue) left after the nickel and cobalt have been extracted will be transported in a residue pipeline to the RSF (refer Figure 2.2.4). Stage 1 will require a 27 km residue pipeline, approximately 700 mm in diameter. Stage 2 will require a duplication of this pipeline.

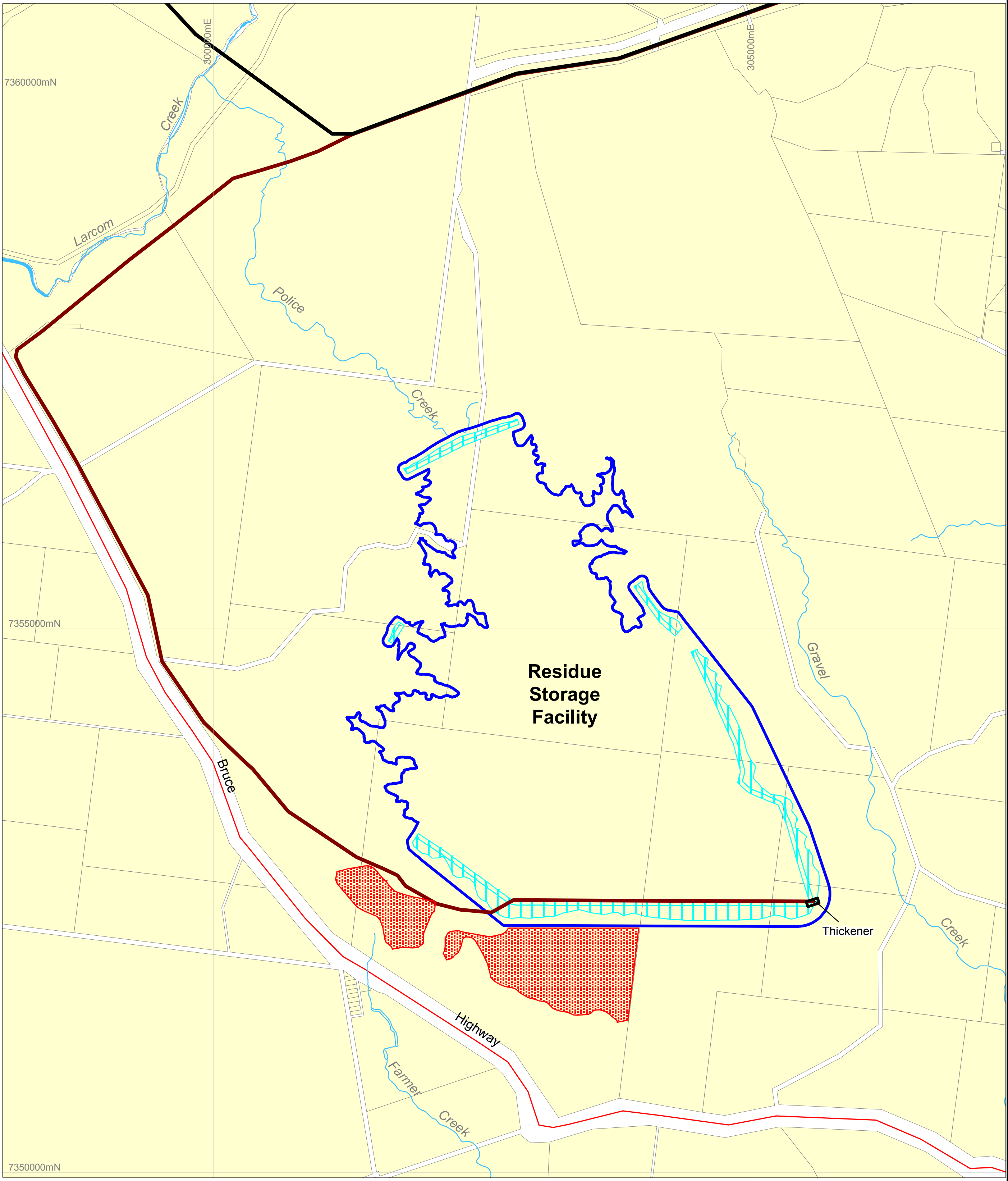
Liquor that is separated from the residue at the RSF will be returned to the refinery in a return liquor pipeline (refer Figure 2.2.4). Stage 1 will require a 27 km pipeline, approximately 500-660 mm in diameter. Stage 2 will require a duplication of this pipeline. Return liquor will either be re-used within the refinery process or combined with cooling water and discharged to Port Curtis.

Other off-site pipelines for reagents and utilities will support the refinery and are discussed in Sections 2.5.3 and 3.

2.2.4 Wharf Facilities

2.2.4.1 Wiggins Island

Nickel ore from the Marlborough Mine will be supplemented by nickel laterite ores sourced from the south-west Pacific Region. These nickel laterite ores will be unloaded (imported) via WIW which will be located approximately 3 km north-east of the refinery site (refer Figure 2.2.2). Sulphur will also be imported through WIW.



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Scale 1:50,000 (A4)

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Proposed Development Footprint

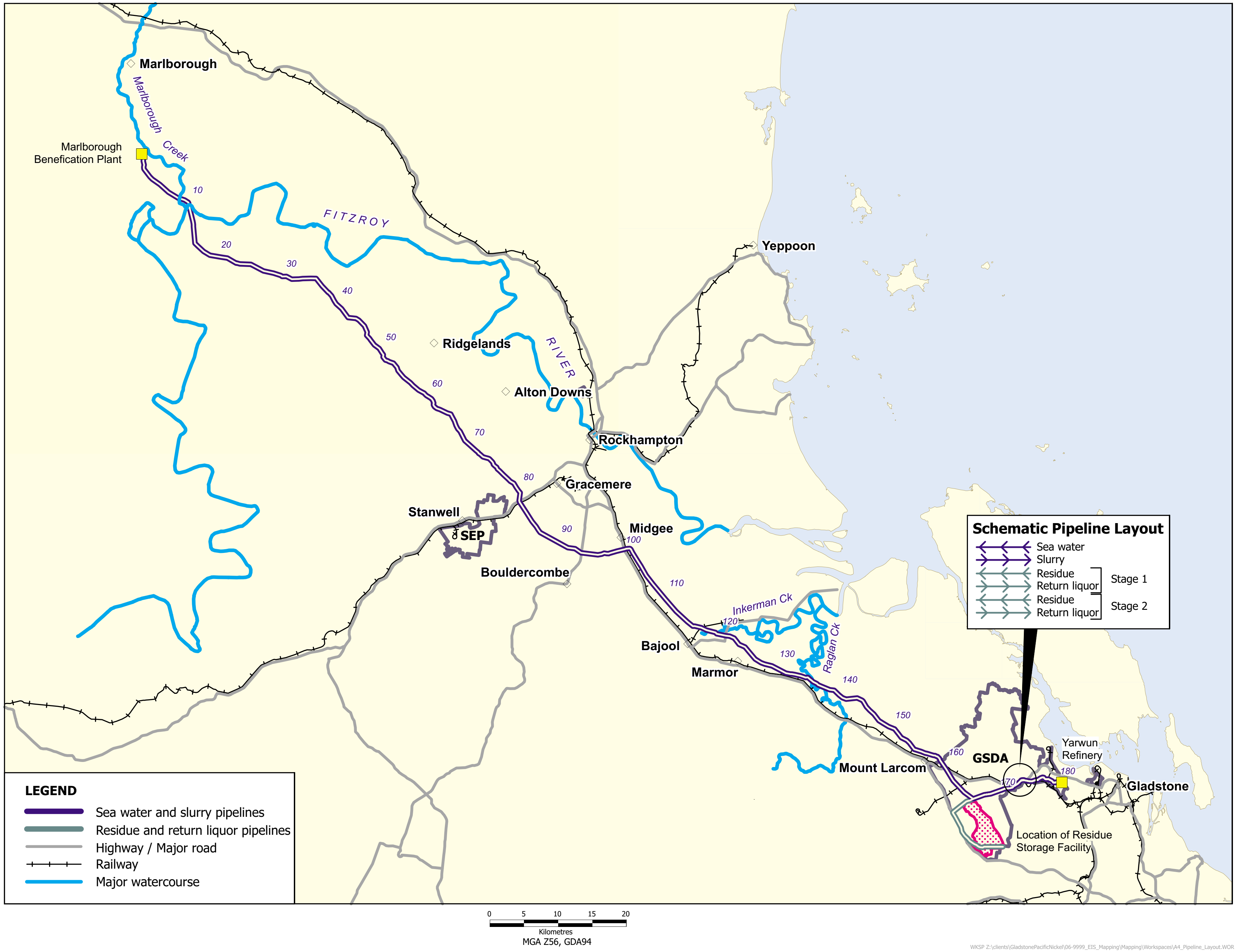
Embankment

Topsoil stockpile

Slurry pipeline route

Residue and return liquor pipeline route

Client: Gladstone Pacific Nickel Ltd	Project: GLADSTONE NICKEL PROJECT ENVIRONMENTAL IMPACT STATEMENT	Title: RESIDUE STORAGE FACILITY LAYOUT
URS	Drawn: TN · Approved: CMP · Date: 20-11-06	Figure: 2.2.3 · Rev:B
	Job No: 4262 5791 · File No: 42625791-g-015b.wor	A4



Source:

Client: Gladstone Pacific Nickel Ltd

URS RLMS

Project: GLADSTONE NICKEL PROJECT ENVIRONMENTAL IMPACT STATEMENT

Drawn: DBJ | Approved: KD | Date: 31-08-06

Job No: 4262 5791 | File No: A4_Pipeline_Layout.WOR

Title: SCHEMATIC OF PIPELINES

Figure: 2.2.4

Rev: A

A4

The port to be developed at Wiggins Island has been designed to contain six berths. It is proposed that it will be a multi-user facility that will support additional uses other than coal. The four downstream berths (WICT) are to be fully utilised for coal and the two upstream berths (WIW) are available for other trades, currently expected to include those associated with the Gladstone Nickel Project (GNP). Initial discussions with Central Queensland Ports Authority (CQPA) indicate that, should the WICT project proceed, the GNP is likely to be allocated berth No. 5 for Stages 1 and 2.

Details of imported ore and sulphur are provided in Section 2.6.1 and 2.6.2.

2.2.4.2 Fisherman's Landing

Ammonium sulphate (amsul) is generated as a by-product of the refining process. Amsul will be trucked to the existing Fisherman's Landing wharf to be stockpiled in a storage shed and loaded onto export ships via a common use load/unload facility at the planned berth No. 3 (refer Figure 2.2.5). Details of amsul transport, storage and loading are provided in Section 2.7.2.

2.3 Construction Phase

2.3.1 Refinery Construction Workforce

The construction phase for Stage 1 of the refinery and RSF will last for approximately 3 years and will extend from the beginning of 2008 through to mid 2010. The peak construction workforce during Stage 1 is likely to be 2,600 (refinery, RSF and GSDA pipelines) and will occur in mid 2009. The average peak construction workforce is approximately 1,250 (refer Figure 2.3.1).

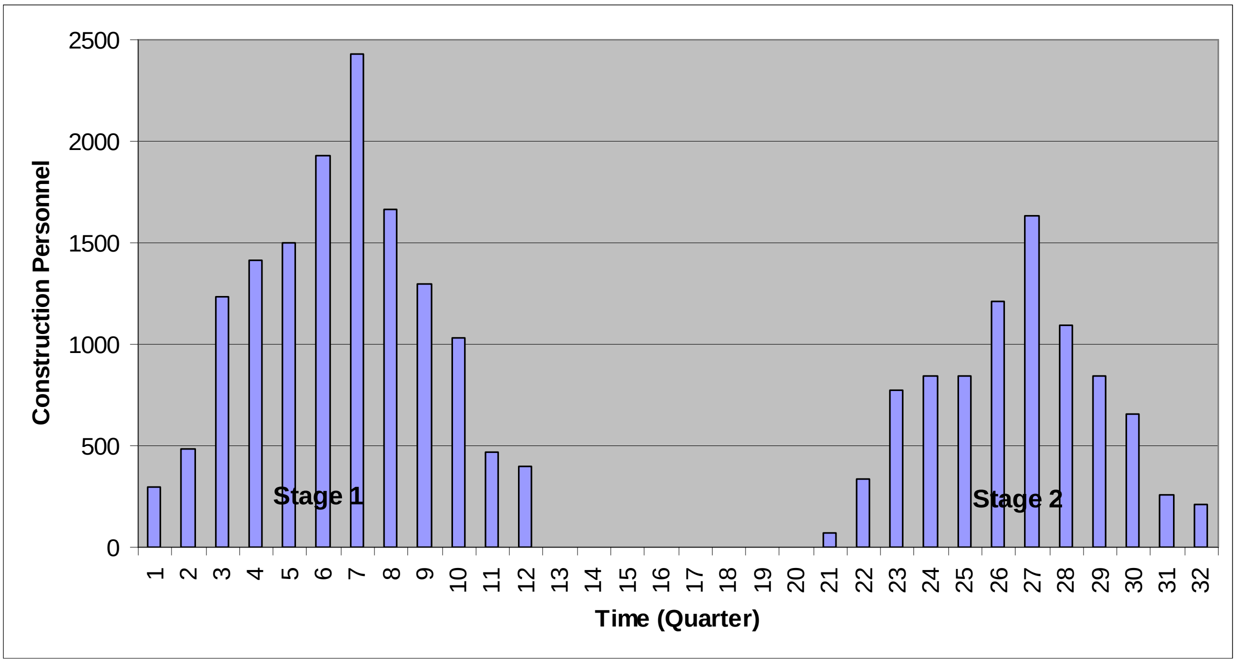
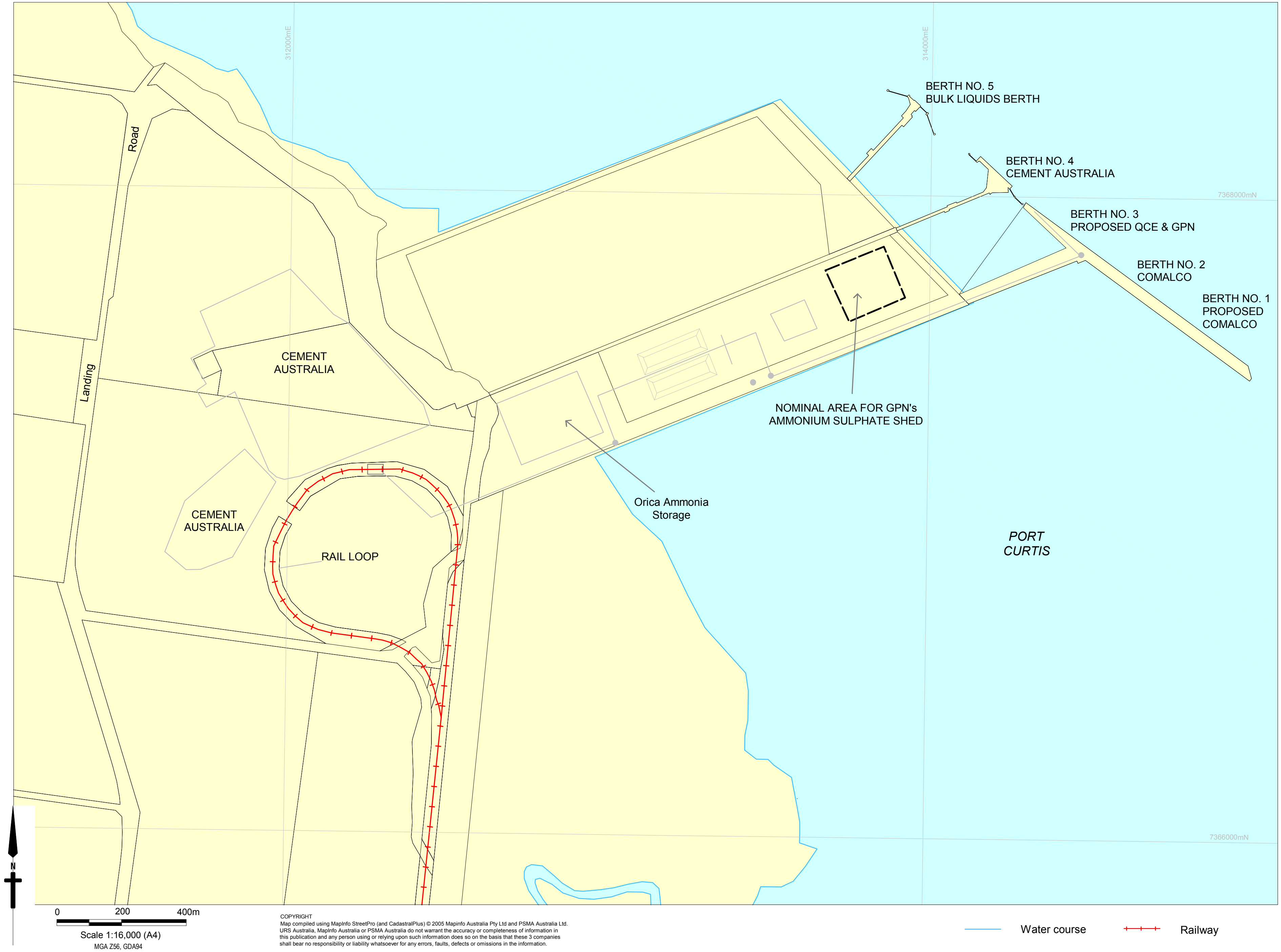


Figure 2.3.1 Construction Workforce

The construction phase for Stage 2 could begin in early 2013. However, the timing of the construction of Stage 2 will ultimately depend on market conditions. The construction requirements for Stage 2 will be similar to Stage 1 although, as some of the necessary site infrastructure will already be in place, the Stage 2 workforce will be less. The peak construction workforce during Stage 2 will consist of approximately 1,750 personnel. The average peak construction workforce is approximately 800 (refer Figure 2.3.1).



URS

Client: Gladstone Pacific Nickel Ltd

Project: GLADSTONE NICKEL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Title: FISHERMAN'S LANDING WHARF FACILITIES

Drawn: VH/TN | Approved: CMP | Date: 08-01-07

Job No: 4262 5791 | File No: 42625791-g-037c.wor

Figure: 2.2.5 | Rev: C | A4

Construction will generally be undertaken on a 12 hour-a-day basis.

Further details on the spread of workforce numbers and skills during the project are provided in Section 10.5. Details of housing options during construction are provided in Section 10.7.

2.3.2 Site Access

Access roads will be required prior to the construction of the refinery, RSF and pipelines. Construction access to the refinery will be via Reid Road.

The provision of construction access to the RSF and the pipelines will require upgrades and re-alignments to some existing access roads and will involve the establishment of sufficient road formation to enable maintenance where required.

Construction traffic planning will be undertaken in conjunction with the Department of Main Roads prior to any construction activities occurring. The impact associated with construction traffic is assessed in Section 6.2.

2.3.3 Construction Equipment

During the construction phase, both light and heavy vehicles will access the refinery, RSF and pipeline areas. Numerous items of mobile equipment will be required at each of the sites. Power for mobile equipment used during the construction phase will be provided by on-site generators set up by the construction contractors. The refinery site will have a temporary electricity supply from the local grid.

A large quantity of prefabricated steelwork will be delivered to the refinery site for erection of buildings and infrastructure. This material will be delivered by semi trailer truck and in the case of larger assemblies, low loaders. Cranes of various sizes up to 1,200 t capacity will be used for erecting steelwork and placing equipment. Delivery of vendor-supplied equipment for erection on the refinery site will include numerous items that require significant site craneage. Yarwun craneage will consist of a 1,200 t crane for major lifts, complimented by two 600 t cranes. Various smaller cranes ranging from 150 to 250 t will also be used.

2.3.4 Refinery Construction

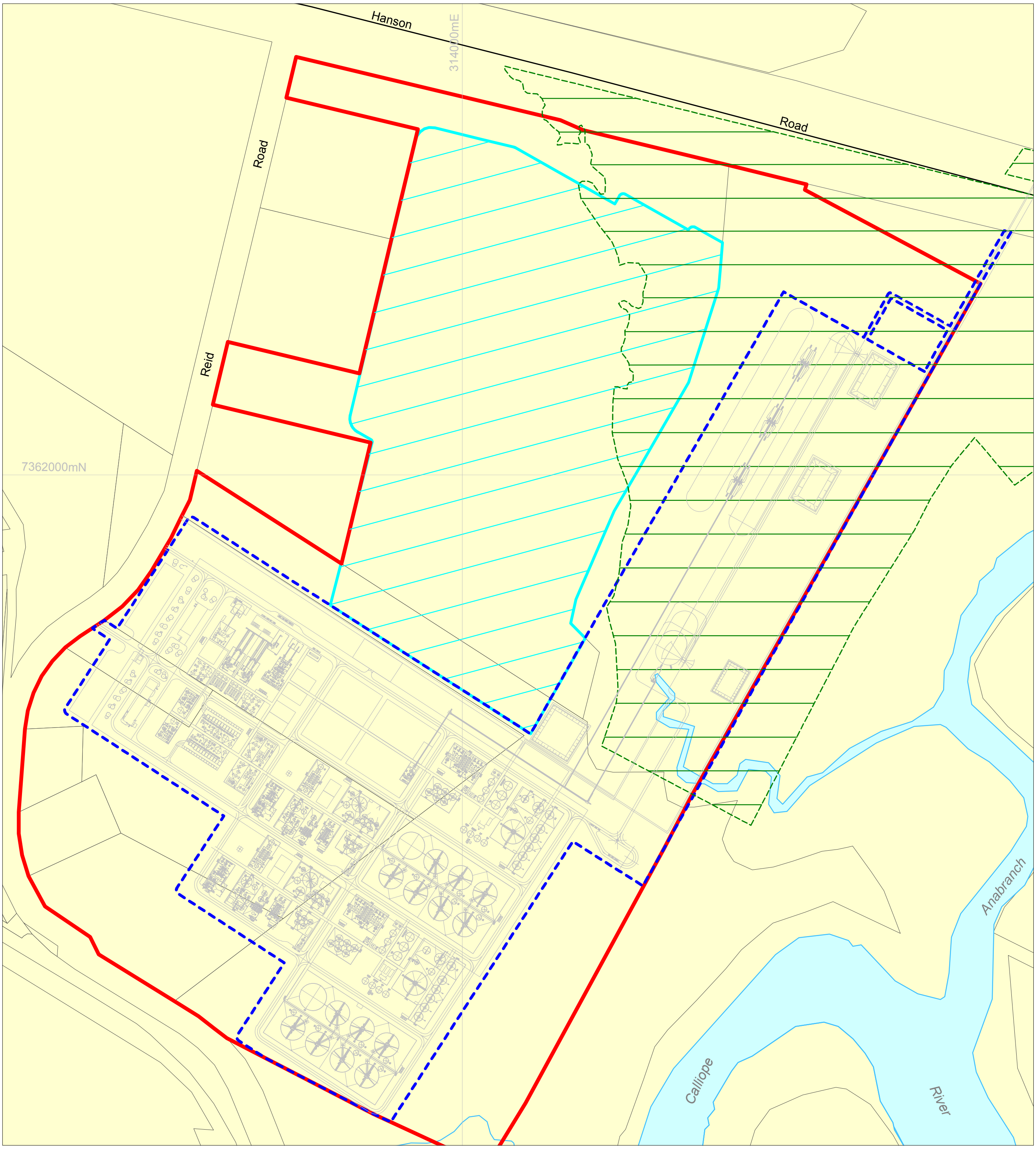
Construction of the refinery will begin with the site infrastructure contractor undertaking earthworks, preparing the site and providing temporary facilities for the construction contractors, including the erection of the warehouse (which will be used as a construction store). The infrastructure contractor will prepare site construction site access at the south-western corner of the site. Once access is provided, drainage, perimeter fencing, internal roads and underground services will be supplied.

Foundations will be dug, trimmed and poured across the site and steelworks and pipe-racks erected. Mechanical erection of infrastructure will generally begin with the installation of heavy items (such as vessels, heat exchangers, tanks) as available and proceed to lighter or higher mounted equipment such as cyclones, spirals and hoppers. Electrical and instrumentation work will be undertaken once the major infrastructure is installed.

Details of the staging of construction and the services required during construction are provided in the sections below.

2.3.4.1 Construction Staging

As part of Stage 1, the hill at the southern end of the refinery site will be excavated. Excess excavated material will be utilised by CQPA as fill for rail infrastructure and for bunds for dredge spoil disposal, both of which are required as part of the WICT project. The likely extent of the area to be filled by CQPA is presented in Figure 2.3.2. The environmental impacts of this filling are assessed in the EIS for the WICT project.



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MGA Z56, GDA94

- Refinery Site Boundary
- Proposed Development Footprint
- Potential construction pad area (Stage 3)
- Proposed CQPA reclamation area
- Refinery layout (Stages 1 and 2)

Client	Project	Title
Gladstone Pacific Nickel Ltd	GLADSTONE NICKEL PROJECT ENVIRONMENTAL IMPACT STATEMENT	**REFINERY CONSTRUCTION STAGING**
URS	Drawn: TN / Approved: CMP / Date: 20-11-06	Figure: **2.3.2** / Rev: B
	Job No: **4262 5791** / File No: 42625791-g-017b.wor	A4

The stockpiles and conveyors associated with Stage 1 of the project will be constructed on the filled area. The environmental implications of the use of this area for stockpiles and conveyors have been assessed in this EIS.

Initial design calculations as part of the GNP and the WICT project have indicated that the WICT project will utilise all available material from the excavation of the refinery site hill that is in excess to GNP requirements. The GNP and the WICT project will work together to achieve a cut / fill balance, but in the event of there being a surplus of fill that cannot be utilised for the WICT project or the timing of the two projects does not coincide sufficiently to enable joint optimisation of earthworks, it is proposed that a construction pad be developed within the footprint for Stage 3 of the refinery project (refer Figure 2.3.2). Details of the construction, rehabilitation and management of the Stage 3 construction pad, should it be required, are provided in Section 8.1.

2.3.4.2 Water

Water for refinery construction activities will be provided by connection into existing Gladstone Area Water Board (GAWB) water reticulation system piping which is located in the vicinity of the refinery site. Both untreated and potable water will be delivered to the site from the GAWB.

The location of construction workforce accommodation facilities is likely to be in an area serviced by the GAWB water supply.

Anticipated average water needs during the construction are provided in Table 2.3.1

Table 2.3.1 Construction Phase Average Water Demand

Item	Refinery	RSF
Accommodation Facilities	250 m^3/day	-
Compacted Fill Moisture Addition	460,000 m^3 total	970,000 m^3 total
Concrete Batching (180 L/m^3)	16,000 m^3 total	1,400 m^3 total

2.3.4.3 Sewage

Sewage and waste water will be generated during the construction phase at both the construction site and at the construction workforce accommodation facilities. Sewage from the refinery will be collected and piped to the existing sewage treatment plant at Yarwun.

In discussions with Calliope Shire Council, the following assumptions have been made regarding sewage generation rates during construction of the refinery:

- Average 1,000 person day shift and 2,500 person peak over a 3 month period.
- Maximum 40,000 L per day sewage from construction site.

Calliope Shire Council has recently completed an upgrade of its sewage treatment plant located adjacent to the refinery site (refer Figure 2.1.1). Based on the likely sewage loads generated by the refinery’s construction, it is not anticipated that there will be any need for a further upgrade of the sewerage treatment plant to cater for the project’s requirements.

2.3.4.4 Electricity

A temporary electricity supply to the refinery site will be provided by temporary connections to the local grid. The construction contractors may also provide their own temporary construction power using diesel power generating sets operated and maintained by the contractors.

2.3.4.5 Telecommunications

A temporary Private Automatic Branch Exchange (PABX) system will be hired and installed for use during construction. This system will provide individual access and billing for construction contractors and an interface with mobile telephone and radio communications. A mobile telephone and radio network will be established to provide voice and data links to all mobile and fixed stations on the refinery site. The telecommunications system will be extended to workforce accommodation facilities to provide voice and data outlets for the accommodation services and senior personnel and adequate public phones for other personnel.

2.3.4.6 Transportation

During the construction of both Stages 1 and 2, light and heavy vehicles will access the site from Reid Road.

The average workforce during the three years of the Stage 1 construction is 1,250 and 800 during Stage 2. The construction workforce is assumed to arrive/depart in the following mode split:

- One-third of personnel arriving by car with each car having an occupancy of 2 persons; and
- Two-thirds of personnel arriving by bus with each bus having an occupancy of 20 persons.

Based on the above assumptions, the estimated number of light vehicle and bus trips during construction is provided in Table 2.3.2. The numbers in Table 2.3.2 represent the number of trips in and out of the refinery during construction.

Table 2.3.2 Estimated Number of Light Vehicle and Bus Trips

	No. of Personnel	No. of Light Vehicle Trips	No. of Bus Trips
Stage 1 – Average Construction	1,250	210	42
Stage 1 – Peak Construction	2,600	420	85
Stage 2 – Average Construction	800	135	27
Stage 2 – Peak Construction	1,750	295	60

In addition to light vehicles, construction activities will also generate heavy vehicles at an average rate of approximately 10 heavy vehicles per day entering the site to deliver the following:

- Construction equipment – earthmoving equipment, cranes and trucks.
- Commodity materials – concrete, reinforcing steel and building materials.
- Refinery equipment.

Details of refinery equipment required during construction of Stage 1 are provided in Table 2.3.3. Similar equipment will also be required for the construction of Stage 2.

Table 2.3.3 Refinery Equipment

Item	Approx Quantity	Comment
Mills	7	Various types and sizes
Process Thickeners	20	Various diameters
Filters	40	Various types and sizes

Table 2.3.3 Refinery Equipment

Item	Approx Quantity	Comment
Sintering Furnaces	3	Various lengths
Autoclaves	11	Various sizes
Pressure vessels	60	Various sizes
Conveyors	20	Various sizes
Tanks	220	Various sizes
Sulphuric Acid Plant	1	Turnkey package
Hydrogen Plant	1	Turnkey package
Hydrogen Sulphide Plant	2	Turnkey package
Ammonium Sulphate Plant	1	Turnkey package
Air Separation Unit	1	Turnkey package
Power Station	1	Turnkey package
Water Treatment Plant	1	Demineralised water, turnkey package
Lime Plant	1	Turnkey package
Pumps	320	Various types and sizes
Balance of Items	180	Various types and sizes of process equipment

A breakdown of the heavy vehicle movements during construction of Stage 1 and Stage 2 is provided in Table 2.3.4.

Table 2.3.4 Heavy Vehicle Movements During Construction of Stage 1 and Stage 2 – Refinery (Semi-Trailers).

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Deliveries per day	10	10	10	10	0	10	10	10	10
Annual Deliveries	260	3,120	3,120	2,340	0	260	3,120	3,120	2,340

Note: Stage 1 Construction – December 2007 to September 2010
Stage 2 Construction – December 2012 to September 2015

2.3.4.7 Construction Facilities

GPNL's permanent administration office will be constructed early in the construction phase in its final location for occupation by the construction management staff. This office will be extended with temporary office capacity to suit the peak construction management workforce. Small offices will be established adjacent to isolated facilities for the construction of off-plot facilities. These offices will be re-locatable and of modular construction, and will be erected and demobilised in accordance with the requirements of the project schedule.

2.3.5 RSF Construction

2.3.5.1 Access

Construction of the RSF will begin with the preparation of site infrastructure and provision of temporary facilities for the construction contractors. A road to access the area will be constructed from the Bruce Highway and vehicle access-ways within the construction area extended and re-graded as required. Compounds for construction personnel, equipment laydown areas, temporary utilities, site drainage, fencing and underground services will be established.

2.3.5.2 Construction Activities

The residue impoundment will be formed by constructing cross-valley and saddle containment dams. The containment dams will be constructed from a combination of processed native clayey soils and rockfill from within the impoundment basin. The containment dams are designed to provide stable containment of the residue under the anticipated static and earthquake loads. Containment dams include chimney and blanket drainage layers to control pore pressures and enhance stability. The clay core of the embankment includes an upstream key to intercept potential seepage flows. The development and construction of the containment dams is likely to be phased.

The impoundment design includes an operational spillway to allow controlled discharge of excess water from the impoundment under extreme climatic conditions. No discharge from the impoundment is anticipated under normal operating conditions. The spillway will consist of an excavated, unlined spillway crest and chute cut into slightly weathered to moderately weathered bedrock, and an unlined channel section that terminates within a natural drainage system. The spillway will be excavated in the bedrock. Where the rock is hard and durable, no concrete protection will be required. Where it is less durable, this softer rock will be over-excavated to a minimum of 450 mm and backfilled with dental concrete.

The RSF has been assessed as being a significant hazard dam according to the Department of Minerals and Energy (DME) guidelines (1995) because of the potential for “significant” economic loss and environmental impact from a failure of the dam embankment.

A foundation seepage collection system will be constructed downstream of the containment dams. The seepage collection system will consist of a series of wells and/or collection drains that will be used to intercept seepage and pump it back into the impoundment for reclamation.

Where feasible, all fill material for RSF embankment construction will be excavated from within the area to be filled with residue. Following clearing of the RSF site, the construction contractor will construct the embankment, spillway and seepage collection system. Controls for erosion and sediment control will be provided. Mechanical erection of the residue thickener, pumps and pipe-work will then commence. Electrical and instrumentation work will be undertaken once all major plant is installed.

Further details on the design of the RSF are provided in Section 9.

2.3.5.3 Utilities

Water for site construction activities will be provided by the construction of a borefield at an early stage in the project. A permit will be sought for the construction of this borefield. Potable water will be provided by road tanker.

Sewage and waste water from site construction activities will be collected by pipelines, treated by a package treatment plant and disposed of by reticulating over adjacent grazing land. The treatment plant will incorporate an enclosed bio-filter and would be completely sealed, thus ensuring odourless and virtually noise free operations.

A temporary electricity supply to the site will be provided by diesel generators operated and maintained by contractors on site.

A mobile telephone and radio network will be established to provide voice and data links to all mobile and stations on the project site.

2.3.5.4 Transportation

During construction of the RSF, vehicles will access the site from the Bruce Highway. Construction of the RSF is expected to take approximately 2 years to complete. A workforce of 50 is expected to be required to construct the RSF. These workers are expected to travel to the site in private vehicles and it has been assumed that there will be one person per vehicle. During the mobilisation and demobilisation, there will be a number of flat loads carrying earthmoving equipment that will enter and exit the site. These heavy vehicles will consist of semi-trailers and B-Doubles depending on the size of the load.

It is anticipated that an existing access road will be cleared and widened to accommodate these movements. The likely number of heavy vehicle movements during mobilisation and demobilisation are provided in Table 2.3.5.

Table 2.3.5 Vehicle Movements During Mobilisation and Demobilisation – RSF

Description	Vehicle Type	Total Number of Trips (entry and exit)
Site Sheds/containers and other site infrastructure	Semi Trailer	24
Mechanical equipment and generator for temporary power	Crane	2
Flat loads (up to 30 t)	Semi Trailer	80
Flat loads (up to 60 t)	B-Double	40
Flat loads (up to 70 t)	B-Double	24
Flat loads (up to 80 t)	B-Double	6
Flat loads (up to 90 t)	B-Double	4

During the construction period a number of light vehicles containing staff will enter and exit the site. In addition there will be the occasional heavy vehicle that will enter and exit the site to deliver fuel, rocks and other materials that may be required. The likely numbers of vehicle movements during construction are provided in Table 2.3.6.

Table 2.3.6 Vehicle Movements During Construction – RSF

Description	Vehicle Type	Number of Trips Per Day (entry and exit)
Staff and Workers	Light Vehicle	65
Fuel Deliveries	B-Double	2
Sand Deliveries	25 t truck	6
Rock Deliveries	25 t truck	6
General Deliveries	Semi Trailer	1

These numbers are seen as conservative. Where possible, fill will be won on site thus potentially limiting the number of deliveries to the RSF site.

2.3.6 Pipelines Construction

2.3.6.1 Construction Procedures

Construction of the slurry, seawater, residue and return liquor pipelines will require the following procedures to be undertaken consecutively (refer Figure 2.3.3):

- Survey of the pipeline route;

- Provision of access tracks and temporary facilities – Existing roads will be utilised as far as practicable to minimise disturbance to the surrounding areas. Access track routes will be completed in consultation with landholders.
- Clear and grade of the right-of-way (ROW) – The pipeline route will be marked, vegetation and other obstacles removed from the ROW, topsoil removed and stockpiled and the ROW levelled to provide a safe working surface.
- Trenching – A pipeline trench will be excavated.
- Pipe stringing and bending – The pipe will be laid out in preparation for welding and pipe bends installed as required by terrain.
- Pipe welding – The pipe will be welded into long lengths, typically 700 m, called pipe strings.
- Lining installation – High density polyethylene (HDPE) lining strings will be welded and inserted into the steel pipeline.
- Pipe placement in the trench (lowering in and laying) – The trench spoil, where suitable, will be used as bedding and backfill for the pipes. The pipe will then be lowered into the trench using side boom tractors and the trench backfilled and compacted.
- Hydro-testing – The pipeline will be cleaned and gauged prior to being hydrostatically tested for strength and potential leaks.
- Rehabilitation – Will involve removal of construction material, surface re-contouring and compaction relief, fence repair/replacement, respreading of topsoil and vegetation and seeding/revegetation.

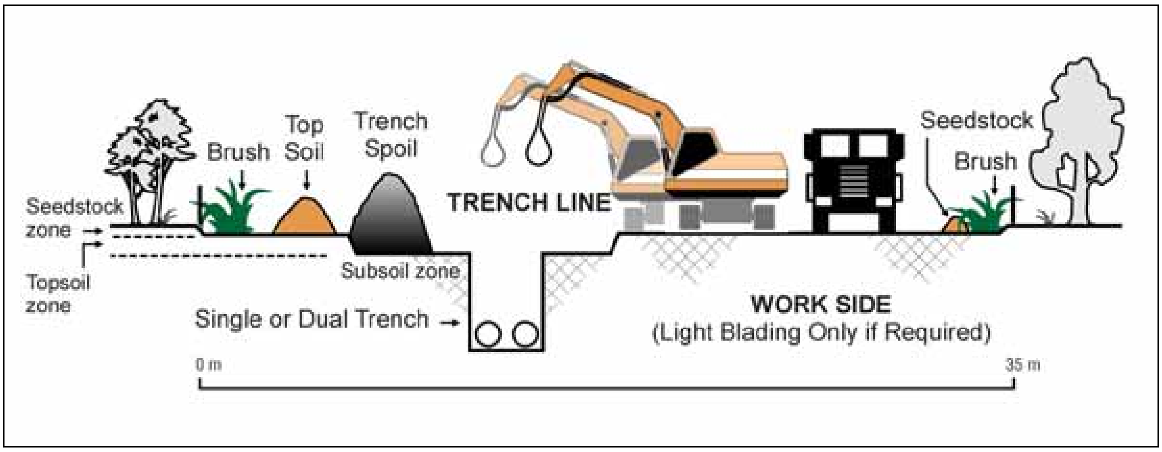


Figure 2.3.3 Pipeline Construction

The key characteristics of the construction program are provided in Table 2.3.7.

Table 2.3.7 Characteristics of the Construction Program

Construction Element	Slurry + Seawater Pipelines Only	All Four (Stage 1) / Six (Stage 2) Pipelines
Width of vegetation clearing, m (approx)	35	50
Number of trenches	One or two	One to four
Maximum length of open trench, km	25	5

Table 2.3.7 Characteristics of the Construction Program

Construction Element	Slurry + Seawater Pipelines Only	All Four (Stage 1) / Six (Stage 2) Pipelines
Combined rate of movement of construction crews	900 – 1,500 m/day	100 – 130 m/day
Potential Construction duration (entire pipeline length), days	210	150
Standard construction working hours	10 h/day, 28 days on, 7 days off	

2.3.6.2 Materials and Equipment

The construction will most likely be executed by a main construction crew with two separate smaller crews completing the more difficult sections. Typical equipment used in pipeline construction for the main crew is outlined in Table 2.3.8, while equipment used by the “poor boy” crews will be significantly less and will depend on the construction activity.

Table 2.3.8 Construction Equipment

Equipment	Approx Number	Equipment	Approx Number
Bull dozers	3	Benders	2
Graders	2	Rocksaws	2
Trucks	35	Loaders	3
Excavators	23	Sideboom tractors	25
Rocksaw	2	Bedding machines	2
Gensets	6	Wheel ditching machines	1
Carrier	1		

Typical materials for construction include:

- Line pipe.
- Consumables (i.e. welding rods, grinding discs, etc).
- Field joint coating materials.
- Skids.
- Sand bags.
- Explosives (possibly).
- Slag/garnet for sand blasting.
- Marker posts.
- Fuels and lubricants.
- HDPE liner pipes.

Materials will be stored as required at the construction depots, with the temporary facilities that follow the crews or at approved stockpile locations. Slag will be contained either in canisters or bulk bags, any explosives required will be in dedicated magazines, consumables will be in site huts, diesel fuel will be in steel tanks and the remaining materials will be stored in compounds or stockpiles as required.

2.3.6.3 Construction Depots and Temporary Facilities

The location of construction depots will be selected by the contractor prior to the commencement of construction activities. The sites may be co-located with construction workers' villages and may be relocated as the pipeline construction progresses. The construction contractor will select the number and location of depots. However, it is likely that up to three will be required.

The construction depot will be primarily used for equipment storage, vehicle laydown, site office & administration facilities and meeting points for crews prior to commencing work on the ROW. Equipment stored at a construction depot may include:

- Construction equipment.
- Maintenance equipment.
- Pipe.

Typically most construction vehicles and equipment will be secured at the depot overnight and during construction breaks.

The location of the construction depots and temporary facilities will be based on logistical requirements, constraints for the pipeline route and outcomes of consultation with the relevant landholders and local authorities. Considerations will include ensuring that facilities are located at a suitable distance from watercourses and are not endangered by threat of flood, and that locations do not require clearing of sensitive vegetation and can be managed in such a way as to ensure no long term land contamination issues.

Where required, appropriate approvals and permits will be obtained as part of the pre-construction planning activities (refer Section 10.12).

2.3.6.4 Infrastructure

The location of the various types of infrastructure (e.g. roads, powerlines, railways, other pipelines) to be intersected by the construction of the slurry pipeline are summarised in Table 2.3.9. All key highways are bitumen sealed. A series of secondary, minor and local roads and farm access tracks will also be crossed by the pipeline route or used by vehicles associated with pipeline construction activities.

Table 2.3.9 Existing Infrastructure

Approximate KP	Name / Number	Owner/Custodian
Major Sealed Roads		
81	Capricorn Highway	Department of Main Roads
94	Burnett Highway	Department of Main Roads
100	Bruce Highway	Department of Main Roads
121	Bajool - Port Alma Road	Department of Main Roads
161	Gladstone - Mount Larcom Road	Department of Main Roads
175	Targinie Road	Department of Main Roads
Minor Unsealed Roads and Tracks		
0-180	21	Fitzroy Shire
0-180	10	Calliope Shire
Railways		
82	Central line	Queensland Rail
101, KP 161, KP 173,181	North coast line	Queensland Rail
118	Central Qld Salt Line	Queensland Rail

Table 2.3.9 Existing Infrastructure

Approximate KP	Name / Number	Owner/Custodian
135	Decommissioned Rail Line	Christiansen, Ian Alexander
164	East End mine branch railway	Queensland Rail
179	Fisherman's Landing branch railway	Queensland Rail
Powerlines		
43, 80, 91	Bouldercombe-Nebo	Powerlink
81, 91	Bouldercombe-Broadsound	Powerlink
91	Bouldercombe-Stanwell	Powerlink
92	Bouldercombe-Egans Hill / Bouldercombe-Rockhampton	Powerlink
92	Bouldercombe-Rockhampton	Powerlink
152	Gladstone-Bouldercombe No. 1	Powerlink
23 (Residue/Decant Liquor Pipeline)	Calvale-Wurdong and Gladstone Bouldercombe No. 2	Powerlink
Pipelines		
76	Stanwell Water Pipeline	SunWater
99	Gladstone to Rockhampton Gas P/L	Alinta
168, 173, 175	Wallumbilla to Gladstone Gas P/L	Alinta
177	Widebay Gas Pipeline	Envestra
173, 175	300 mm East End Water Pipeline	GAWB
180	300 mm Water Pipeline	GAWB
181	900 mm Water Pipeline	GAWB

Easements, which presently do not contain any infrastructure, intersected by the pipelines routes are also presented in Table 2.3.10.

Table 2.3.10 Easements not Presently Containing Infrastructure

Approximate KP	Name / Number	Owner/Custodian
76	Easement	Stanwell
165	Transmission Line Easement	Powerlink
167	Transmission Line Easement	Powerlink
173	Pipeline Easement	Alinta
173	Pipeline Easement	East End Mine/GAWB
174.5	Transmission Line Easement	Powerlink
176	Transmission Line Easement	Powerlink
177	Yarwun Industrial Estate	Minister for Industrial Development
180	Yarwun Industrial Estate	Minister for Industrial Development

GPNL will enter into discussions with the owners/custodians listed above to make arrangements for the construction of the pipeline and the management of the existing infrastructure facilities.

2.3.6.5 Construction Workforce Accommodation

Due to the mainly rural nature of the region and the limited townships along the proposed pipeline route, accommodation is not readily available and dedicated workers' villages will be required.

It is anticipated that the three main workers' villages will be located south of the Fitzroy River, in the Gracemere area and in the Mt Larcom area. In addition, the smaller crews may operate from "fly villages" located at either end of the project.

The exact location of workers' villages will be determined during the early construction phase and will be subject to separate approvals (e.g. development applications and any relevant approvals and permits). The proponent will work closely with local authorities in regard to this issue. Key components of the workers' villages will include:

- Air conditioned demountable style accommodation units.
- Ablution units.
- Diners and cook houses.
- Offices.
- Cold room.
- Fuel storage area.
- Vehicle / equipment wash down facility.
- Level earthwork pads.
- Fencing and access roads.

2.3.6.6 Power Requirements

Supply of power for construction of pipelines, workers' villages and temporary facilities will be from mobile diesel-fuelled power generation units. The anticipated power requirements are between approximately 650 to 800 kVA. The exact location and scale of the units will be determined during the detailed design phase of the project, including any additional approvals or permits required for the operation of these units.

2.3.6.7 Telecommunications

During construction, telecommunications will be by mobile phone and/or satellite technology. Existing telecommunications infrastructure will be used where available for workers' villages. Otherwise, satellite communications will be employed for voice and data transmission.

2.3.6.8 Water Supply and Management

During construction, the main raw water requirement will be associated with hydrotesting of the pipelines. It is estimated that approximately 70,000 kL will be required. As far as practicable, hydrotesting water will be reused to test multiple pipeline sections prior to discharge.

The workers' villages, construction depots and offices will require potable and non-potable water for domestic use during construction. It is estimated that the combined usage of domestic water during construction will be approximately 400 L/person/day.

If potable water services are not available at the workers' village locations, it will either be trucked into the workers' villages or raw water will be sourced locally and treated on site. Non-potable and raw water will be sourced from local surface water sources and bores under permit. The pipeline construction contractor will be responsible for obtaining all necessary permits.

It is anticipated that package sewage treatment facilities will be installed at the workers' villages and the relevant approvals will be obtained by the construction contractor in conjunction with the workers' village approvals.

2.3.6.9 Transportation

The major transport issue associated with the construction of the pipelines is the transport of pipe to the construction ROW.

The source of the pipe has not been finalised, although it will be sourced from Australian suppliers and/or offshore mills (depending on design aspects and mill capacity). It is presently anticipated that pipes will be transported to Gladstone by either rail from manufacturing centres at Kembla Grange or by sea. The final transport option will be determined in the detailed design phase of the project and will be dependent on the location of the pipeline supplier. The HDPE liners for the pipelines will be shipped from overseas to Gladstone.

State-Controlled Roads

State-controlled roads will be used for the delivery of pipe from Gladstone to the construction sites. Trucks used for pipeline delivery will most likely be extendable semi-trailers and the pipes are likely to be transported in lengths of 12 m to 18 m.

Where the pipes are delivered by rail, it is proposed that the pipes will be delivered at a rate to match the construction rate and will be transported direct to the ROW for stringing. Where the pipes are delivered by sea, it is proposed that the pipes will be transported via road to stockpiles located adjacent to the proposed workers' villages and then trucked from the stockpiles to the ROW.

Other heavy vehicle movement associated with the pipelines construction will include the transport of the construction equipment to the ROW and mobilisation and demobilisation of the workers' villages. Additional traffic on state-controlled roads will be associated with daily travel of the construction workforce to the construction location. The workforce will most likely travel in a combination of four-wheel drives and minibuses.

Local Government-Controlled Roads and Private Tracks

Construction traffic will access the ROW by existing local roads and private tracks where ever possible. Prior to construction, an inspection of the access roads will be made in consultation with the relevant local authority representatives to determine the state of the road, whether any upgrade is required, and to record the pre-construction condition of the road (e.g. written record, photographs). GPNL will work with the relevant local authorities to make any necessary road upgrades and to agree the reinstatement condition necessary for each road. GPNL will also work with landholders to develop agreements on any upgrades or reinstatement to private access tracks.

Truck movements on the ROW and private tracks will take place in daylight hours as far as practical. Transport to and from the ROW will utilise local roads as far as possible, to minimise access via private tracks or extensive travel along the ROW.

2.4 Project Staging

The GNP will be developed in two stages –1 and 2 (refer Table 2.4.1). Production stages are summarised as follows:

- Stage 1 will produce 60,000 t/y of nickel and 4,800 t/y of cobalt by processing approximately 5 million dry tonnes per year of ore from the Marlborough mine and ore imported through WIW.
- Stage 2 will produce 126,000 t/y of nickel and 10,400 t/y of cobalt by processing approximately 10 million dry tonnes per year of ore from the Marlborough mine and ore imported through WIW.

Table 2.4.1 Production Stages

Component	Stage 1	Stage 2
High Pressure Acid Leach Feed		
Marlborough mine ore (Mdt/y)	1 – 2.6	1 – 2.6
Imported ore (Mdt/y)	3 – 4	8 – 10
No. HPAL Autoclaves	2	4
Metal Products (max)		
Nickel (t/y)	60,000	126,000
Cobalt (t/y)	4,800	10,400

The timing associated with each planned stage of the project is outlined in Table 2.4.2. Beyond Stage 2, the timing of a future expansion to Stage 3 will depend on market conditions. Stage 3 will involve doubling the Stage 2 plant capacity by duplicating the high pressure acid leach (HPAL) processing plant and metals plant. Stage 3, which will also require additional residue disposal areas, will be subject to separate environmental approvals and has not been considered in this EIS.

Table 2.4.2 Timing of Project Stages

Stage	Construction Start	Commissioning Start	Full Production
Stage 1	Early 2008	Mid 2010	Late 2012
Stage 2	Early 2013	Mid 2016	Mid 2017
Stage 3	Post 2017	Post 2017	Post 2017

All project stages will require the development of the WIW.

The estimated schedule for the construction of the pipelines from the mine to the refinery is outlined in Table 2.4.3. It is expected that construction of the pipelines will commence in 2008 as part of the Stage 1 construction.

Table 2.4.3 Construction Schedule for Pipelines

Activity	Duration (months)
Mobilisation	2.5
Construct pipelines	7 to 8
Hydro testing & pre-commissioning	1
Demobilisation	1

2.5 Project Design

The refinery will utilise the HPAL process which processes nickel laterite deposits by contacting these with sulphuric acid at high temperatures and pressures, and leaching nickel and cobalt into solution. This process is successful in extracting high levels of nickel and cobalt whilst minimising the extraction of iron and aluminium. The nickel cobalt liquor is recovered and processed to produce separate nickel and cobalt products.

The refinery will consist of two separate, interconnected plants as follows:

- Leach plant; and
- Metals plant.

Both the leach plant and the metals plant are discussed further in Sections 2.5.1 and 2.5.2. Reagent and process gas plants and the power plant that support the refinery process and will be located at the refinery site. An overview of the entire refinery process is shown in Figure 2.5.1.

2.5.1 Leach Plant

The leach plant will process nickel ore to generate a mixed nickel/cobalt sulphide product (mixed sulphide). The leach plant will be based on high pressure acid leaching of low magnesium saprolite (LMS) slurry from the Coorumburra beneficiation plant at the Marlborough mine and imported ore. The HPAL process utilises sulphuric acid at high temperatures and pressures to leach nickeliferous minerals within the ore and slurry.

High magnesium saprolite (HMS) slurry from the beneficiation plant will be contacted with HPAL discharge slurry to partially neutralise it and assist in leaching metals (known as ‘enhanced saprolite neutralisation’). Discharge from enhanced saprolite neutralisation (ESN) will be sent to a counter-current decantation (CCD) wash circuit where metals that have been leached into solution will be separated from residual solids in a series of neutralisation tanks prior to precipitation of the mixed sulphide. Solid and liquid effluents will be neutralised and the residue slurry pumped to the RSF. Return liquor from the RSF that is not reused in the process will be disposed of in Port Curtis. The leach plant process is shown diagrammatically in Figure 2.5.2.

2.5.1.1 Ore Preparation Plant

Imported ore and slurry from the Coorumburra beneficiation plant will be processed in the ore preparation plant (OPP) at the refinery. The OPP will consist of storage for the slurry, slurry thickening, receival and grinding facilities for imported ore.

2.5.1.2 Marlborough Slurry Receival and Thickening

A single slurry pipeline will be used to deliver batches of LMS and HMS slurry from the beneficiation plant to the slurry storage and thickening sections at the refinery. Thickened LMS slurry will be advanced to the HPAL circuit while thickened HMS slurry will be contacted with HPAL discharge in the ESN circuit (refer Figure 2.5.2). Recovered water from the LMS and HMS thickeners will be reused in the refinery as process water.

2.5.1.3 Imported Ore

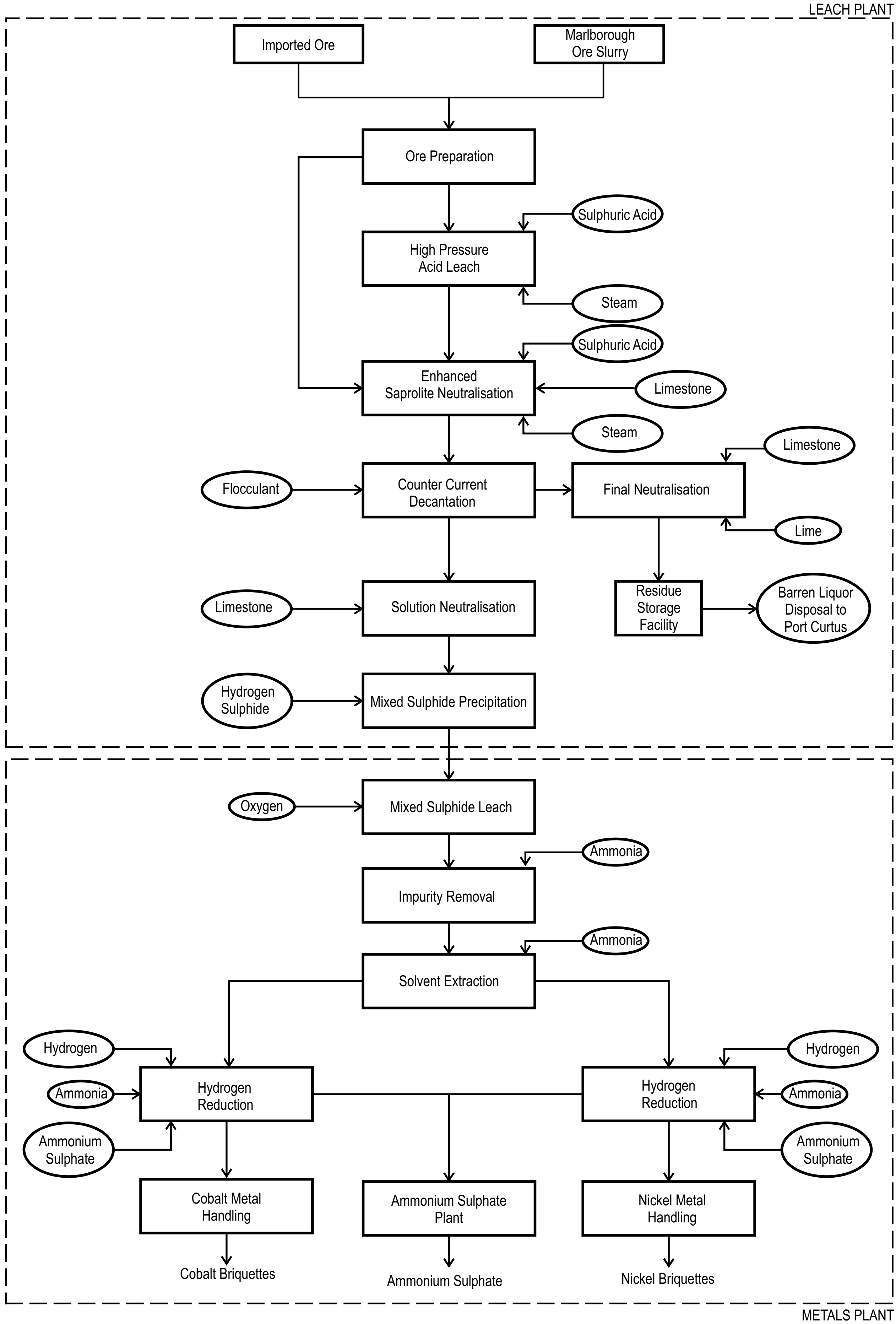
Imported ore will be reclaimed from the refinery ore stockpile (refer Figure 2.2.1) by front-end loader and slurried with water. This ore slurry will be advanced to the HPAL circuit.

2.5.1.4 High Pressure Acid Leach

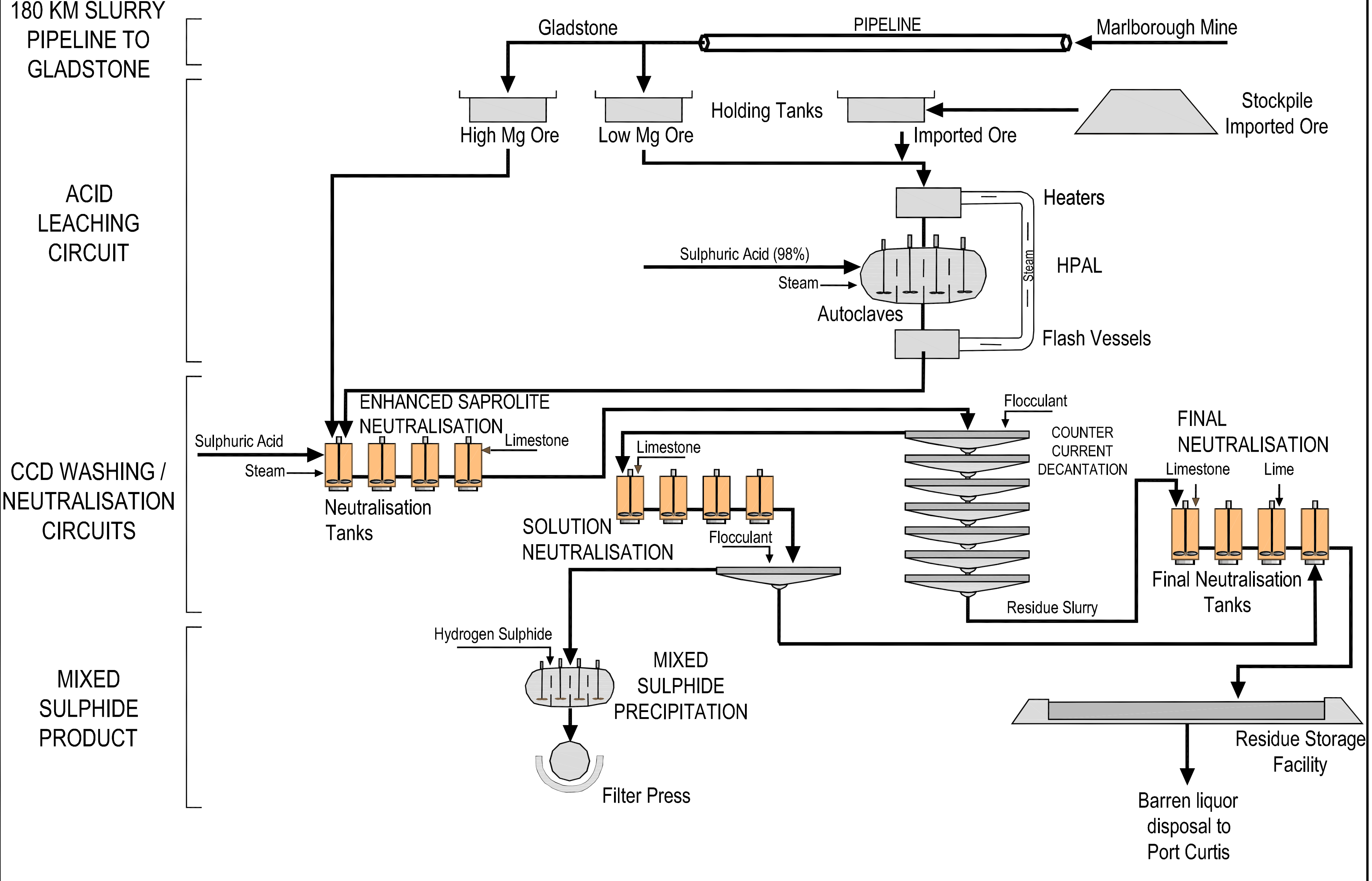
Slurry received from the OPP will be heated with flash steam and steam from the SAP. The heated slurry will be then injected into the HPAL autoclaves with concentrated sulphuric acid (98%) to achieve the desired conditions under which almost all of the nickel and cobalt will be leached from the ore.

Nickel, cobalt, copper, zinc, manganese, magnesium and a portion of the aluminium will be dissolved as a result of the reaction in the HPAL autoclaves. Most of the aluminium, iron, chromium and titanium in the ore will remain in the solid residue as stable oxides and hydroxides.

The hot pressurised leach slurry will be discharged from each autoclave and depressurised sequentially through three stages of flash vessels. Steam recovered from the flash vessels will be used in the ore slurry heaters and other plant areas to optimise energy utilisation.



Client	Project	Title	
Gladstone Pacific Nickel Ltd	GLADSTONE NICKEL PROJECT ENVIRONMENTAL IMPACT STATEMENT	**PROCESS FLOW DIAGRAM**	
URS	Drawn: TN; Approved: CMP; Date: 02-08-05	Figure: **2.5.1**	Rev. B
	Job No.: **4262 5791**; File No. 42625791-g-020b.cdr		A4



Client: Gladstone Pacific Nickel Ltd

URS

Project: GLADSTONE NICKEL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Title: **LEACH PLANT PROCESS FLOW**

Drawn: TN	Approved: CMP	Date: 28/08/2006	Figure: 2.5.2	Rev. B
Job No.: 4262 5791	File No.: 42625791-g-021b.dwg			A4

The HPAL circuit for Stage 1 of the refinery will consist of two autoclaves and associated equipment. Stage 2 of the refinery will consist of four autoclaves and associated equipment.

2.5.1.5 Enhanced Saprolite Neutralisation

The ESN circuit will consume most of the residual sulphuric acid from the HPAL circuit while simultaneously extracting nickel and cobalt contained in the HMS ore. The depressurised HPAL discharge slurry will be fed to ESN, where it will be blended with HMS slurry which neutralises most of the residual sulphuric acid. By neutralising residual sulphuric acid, limestone consumption in the final neutralisation part of the process, will be reduced (refer Figure 2.5.2).

In addition to consuming much of the free acid, approximately more than half of the nickel and cobalt in the HMS slurry is expected to be extracted in ESN. If required, sulphuric acid may be added in ESN to improve nickel and cobalt extraction from the HMS slurry. The discharge slurry from the ESN tanks will be pumped to the CCD circuit.

2.5.1.6 Counter Current Decantation

In the CCD circuit, the metals that have been leached into solution in HPAL and ESN will be separated from residual solids by washing in a series of thickeners. Washing will be by a weak acid solution that flows counter current to the slurry. Flocculant will be mixed with the feed to improve slurry settling characteristics. Washed slurry (residue underflow slurry) will be pumped to the final neutralisation tanks (refer Figure 2.5.2).

2.5.1.7 Solution Neutralisation

The purpose of the solution neutralisation (SN) circuit is to neutralise the residual sulphuric acid contained within the liquid overflow from the CCD circuit and precipitate minor quantities of iron and other impurities using a limestone slurry (refer Figure 2.5.2). The reaction of the residual sulphuric acid with the limestone will result in gypsum being precipitated.

The resulting gypsum slurry will be settled and thickened and a portion recycled to the SN tanks to act as seed to improve gypsum settling characteristics. Flocculant will be mixed with the feed to improve the slurry settling characteristics. The remaining gypsum solids will be filtered, re-slurried and pumped to the final neutralisation tanks for eventual disposal to the RSF (refer Figure 2.5.2).

2.5.1.8 Mixed Sulphide Precipitation

The mixed sulphide precipitation (MSP) circuit will recover nickel and cobalt as mixed sulphide solids. Overflow from the SN clarifier will be preheated in indirect and direct contact heat exchangers, blended with recycled seed solids and contacted with vent gas from the MSP autoclaves and flash vessel. The seeded slurry will be pumped to the MSP autoclaves where it will be contacted with hydrogen sulphide gas. Nickel, cobalt and other metals will be precipitated as sulphides.

The mixed sulphide slurry will be discharged to the MSP flash vessel where most of the residual hydrogen sulphide gas will be disengaged from solution. Slurry from the flash vessel will be cycloned and the cyclone overflow thickened and recycled as seed material. Mixed sulphide will be washed to remove barren liquor in the MSP CCD circuit and washed mixed sulphide slurry is then filtered and ground. Barren liquor will be directed to final neutralisation and to the CCD circuit as wash solution.

Tanks and equipment containing hydrogen sulphide rich solutions are sealed and continuously purged with nitrogen to maintain a non-flammable atmosphere. These tanks are vented to a scrubber and vent gas incinerator.

2.5.1.9 Final Neutralisation

The purpose of final neutralisation will be to neutralise residual acid in the final CCD underflow and excess barren liquor, precipitating most of the heavy metals from solution. Limestone slurry will be added as a reactant to the first stage, raising the pH of the slurry to 5.5.

Milk of lime slurry will be added as reactant to the second stage, raising the pH of the final slurry to at least 7. Re-pulped gypsum slurry from the SN circuit and waste streams from the metals plant and water treatment plant will be directed into the last tanks. The neutralised slurry will be pumped to the thickener at the RSF.

2.5.1.10 Residue Storage Facility

Neutralised residue slurry will be pumped via a pipeline to a thickener located at the RSF site. The thickened slurry will then be hydraulically deposited in the RSF and consolidated using mud-farming to maximise density.

Residue thickener overflow and RSF decant liquor will be collected in the return liquor tanks and pumped back to the refinery for re-use. The surplus return liquor will be combined with the cooling water return and pumped through a diffuser system to Port Curtis. The diffuser system will reduce the temperature of discharged liquid by dilution with seawater.

Details of the operation, construction and management of the RSF are provided in Section 9.

2.5.2 Metals Plant

The metals plant will process the mixed nickel/cobalt sulphide solids to produce nickel and cobalt briquettes. The metals plant will involve the pressure leaching of slurried mixed sulphide using oxygen. Iron impurities will be subsequently removed by precipitation. Solvent extraction separates the zinc, nickel and cobalt sulphate streams from the process. The nickel and cobalt sulphate solutions will then be reduced using gaseous hydrogen which leads to the recovery of nickel and cobalt metal powder. These resultant metal powders will be compacted and sintered into nickel and cobalt briquettes. The metals plant is shown diagrammatically in Figure 2.5.3.

2.5.2.1 Mixed Sulphide Leach

The sulphide leach circuit will re-dissolve the mixed sulphide solids to produce an impure nickel/cobalt sulphate solution with low acidity and impurity content. This will be achieved by reacting the mixed sulphide slurry with oxygen in an agitated autoclave at elevated pressure and temperature.

2.5.2.2 Impurity Removal

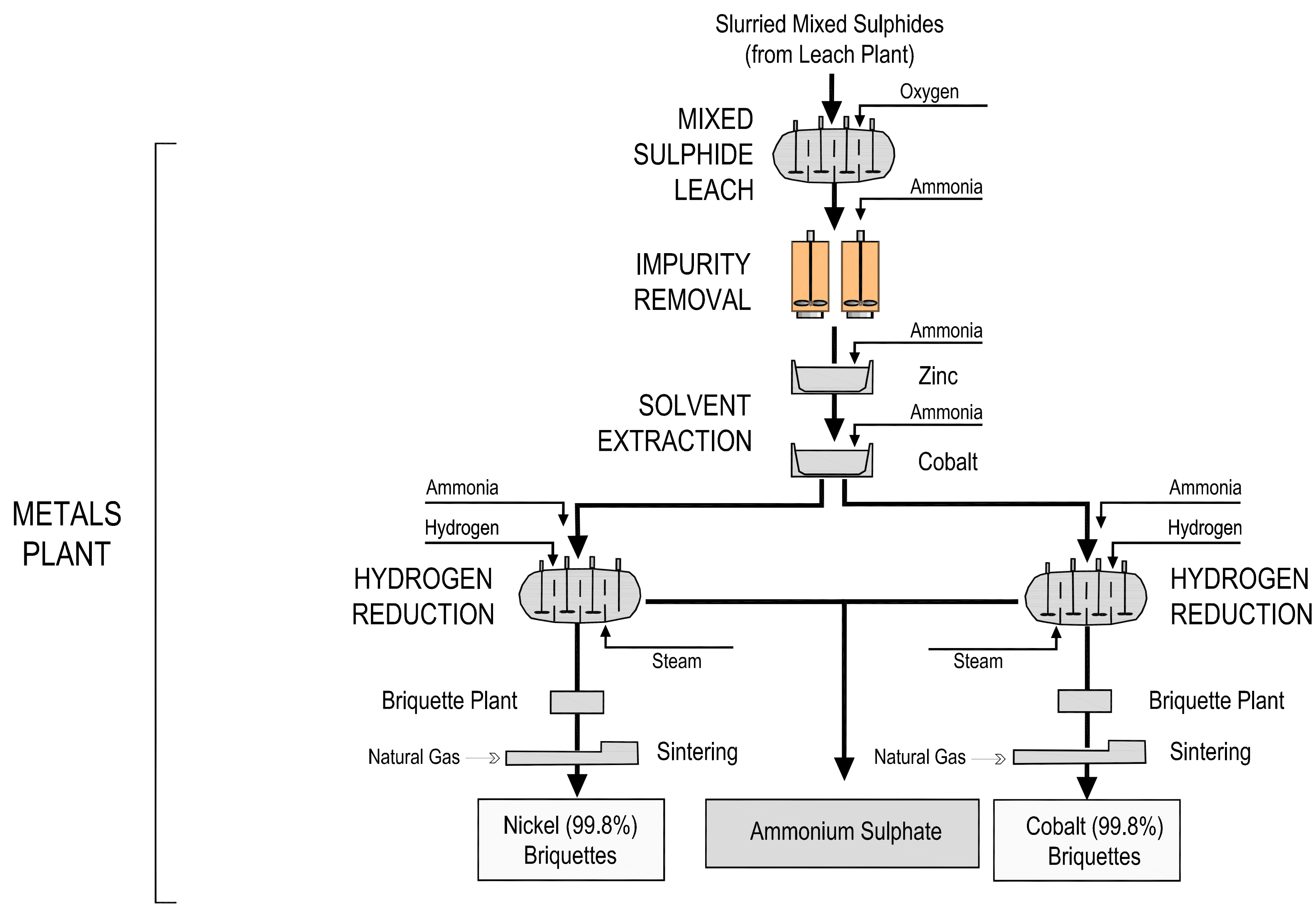
The iron removal circuit will precipitate iron and aluminium from the sulphide leach solution by neutralising the acid in the solution using aqua ammonia. It will also allow the precipitation of copper by contact with recycled zinc sulphide slurry. These reactions will be conducted in a series of agitated tanks, followed by filtration to remove the precipitated metals. The iron free liquor will advance to the solvent extraction area. The solids collected in the filters will be re-pulped and returned to the HPAL circuit or directed to final neutralisation.

2.5.2.3 Solvent Extraction

The solvent extraction circuit will separate the zinc from the nickel and cobalt and separates the cobalt from the nickel. This will be accomplished by sequentially exchanging the zinc and cobalt into an organic solution utilising Cyanex 272 as the active agent. Each element will then be removed from the two metal-loaded organic streams with sulphuric acid strip solution.

2.5.2.4 Hydrogen Reduction

Separate hydrogen reduction circuits will be used to precipitate nickel and cobalt as metal powders from the respective purified solutions. Each reduction plant will have a feed preparation section where the incoming solution composition will be adjusted by addition of ammonium sulphate and ammonia. The solutions will then be heated and transferred on a batch basis to the respective reduction autoclaves, where high pressure (HP) hydrogen will be introduced and the nickel or cobalt will be reduced from solution as metal powders.



Client: Gladstone Pacific Nickel Ltd	Project: GLADSTONE NICKEL PROJECT ENVIRONMENTAL IMPACT STATEMENT	Title: **METALS PLANT PROCESS FLOW**
URS	Drawn: TN · Approved: CMP · Date: 28/09/2006 Job No.: 4262 5791 · File No.: 42625791-g-022b.dwg	Figure: 2.5.3 · Rev. B · A4

The metals remaining in solution following hydrogen reduction will be removed in the solution strip circuit using hydrogen sulphide to precipitate remaining metals and sulphuric acid / ammonia for neutralisation.

2.5.2.5 Cobalt and Nickel Metal Handling

After reduction, the slurry will be discharged from the autoclaves, and the metal powder will be filtered, washed, dried, cooled and briquetted. Briquettes will be sintered using a furnace and packaged for transport by truck to the Mt Miller rail siding at the end of Reid Road (refer Figure 2.2.2).

2.5.2.6 Ammonium Sulphate Plant

The metals-free solution from the nickel and cobalt reduction areas will be evaporated in a crystallisation plant to produce ammonium sulphate for recycling into the reduction areas. Excess product ammonium sulphate will be dried, screened and transported by B-Double vehicles to a storage shed at Fisherman's Landing for storage prior to loading onto ships for export (refer Section 2.7.2).

2.5.3 Reagents

2.5.3.1 Sulphuric Acid Plant

The SAP will manufacture sulphuric acid for use in the processing plant and molten sulphur for the hydrogen sulphide plant. The process will consist of burning sulphur in air to form sulphur dioxide, combining the sulphur dioxide with oxygen in air to form sulphur trioxide in the presence of vanadium pentoxide catalyst, and combining the sulphur trioxide with filtered water to form 98% sulphuric acid.

The oxidation and absorption steps in the manufacture of sulphuric acid from sulphur are all highly exothermic (heat producing). The excess heat generated at each step of the process will be recovered in waste heat boilers, superheaters and economisers. The heat will be recovered in the form of HP superheated steam and low pressure (LP) saturated steam which will be used to meet process requirements. Excess HP superheated steam will be used for power generation. The process will be designed to give a conversion of sulphur dioxide to sulphuric acid of more than 99.5%.

The SAP area also includes sulphur receival, storage, reclaim and melting facilities, sulphuric acid storage and sulphuric acid receival and shipment facilities.

2.5.3.2 Limestone Supply and Lime Plant

Limestone will be received as limestone slurry via a pipeline from a limestone supplier with crushing and slurrying undertaken at the limestone mine. This limestone slurry will be stored in agitated tanks as slurry before distribution. An on-site lime plant will provide an alkaline neutralisation medium to the process in the form of milk of lime slurry. Both limestone and milk of lime slurry will be supplied on demand throughout the refinery via a ring main.

2.5.4 Process Gases

2.5.4.1 Hydrogen Plant

The hydrogen plant will manufacture hydrogen gas for use in the refinery. Hydrogen will be produced through the steam reforming of natural gas. LP hydrogen will be used as a feedstock for the hydrogen sulphide plant, and as a de-sulphurising agent in the briquette sintering furnaces. HP hydrogen will be used as a reductant for nickel and cobalt metal precipitation. Medium pressure (MP) steam, recovered from the hydrogen plant, will be used in the nickel and cobalt hydrogen reduction areas.

2.5.4.2 Hydrogen Sulphide Plant

Hydrogen sulphide will be produced by reacting hydrogen gas from the hydrogen plant with molten sulphur at elevated temperatures. Hydrogen sulphide will be consumed in MSP, impurity removal, and solution strip areas.

2.5.4.3 Air Separation Plant

High purity gaseous oxygen and nitrogen will be produced in the air separation unit (ASU). The ASU will consist of air separation equipment with a front end purification process. The process scheme will be based on the principle of internal compression cycle for oxygen allowing the oxygen to be produced directly at the required pressure without the need for oxygen compressors.

The ASU main compressor will also supply process and instrument air for the process plant. Stand-alone air compressors for process and instrument air supply will also be included in the ASU as backup when the main compressor is not operating. Oxygen will be used for leaching nickel and cobalt from the mixed sulphides slurry in the sulphide leach autoclave, and for plate leaching in the nickel and cobalt reduction autoclaves.

LP nitrogen will be used as an inert purge gas (principally in the MSP area), a sintering furnace atmosphere gas, and to strip hydrogen sulphide from the sulphide strip thickener (in the solution strip area) overflow solution. HP nitrogen will be used for rinsing and purging reduction autoclaves and to provide an overpressure in the nickel reduction feed vessel. HP nitrogen will also be used to purge the sulphuric acid supply lines in the HPAL circuit.

Process air will also be used for air blowing process filters, dust collector operation, nickel and cobalt powder pan filters, and for utility stations. Instrument air will be used for driving actuated and control valves and for other control functions.

2.5.5 Power Station

Power for the refinery will be supplied by a combination of on-site power generation and the local electricity grid.

The on-site power station will comprise a HP, MP and LP steam reticulation system, boiler feed water recovery and reticulation system, power generation and package boiler facilities.

The major source of HP steam will be from the SAP, as a result of the exothermic reaction in the production of sulphuric acid. HP steam (at approx 6,000 kPa) will be an integral part of the SAP and will be fed into a HP steam header at the power station.

The secondary source of HP steam will be from gas-fired package boilers, which will produce supplementary steam into the same HP header. The package boilers will operate on hot standby when not required. From the HP header a quantity of the HP steam will be de-superheated and directed to the HPAL circuit. The balance of the HP steam will be directed to steam turbine generators at the power station.

MP steam will be generated by the hydrogen plant and additional MP steam will be produced by de-superheating HP steam from the HP steam header. LP steam will be produced in the SAP. Make-up LP steam will be produced by de-superheating HP steam from the HP steam header.

A de-aerator will be located in the power station, supporting both the power station and SAP. HP, MP and LP boiler feed water will be distributed and make-up demineralised water will be supplied from the water treatment plant.

Details of electricity requirements during the project are discussed in Section 3.2.

2.5.6 Pipelines

Ore slurry from the Coorumburra beneficiation plant will be supplied to the refinery as slurry by pipeline. Seawater extracted from Port Curtis will be pumped from the refinery to the Coorumburra beneficiation plant for beneficiating the ore and for slurry transport. Residue slurry from the refining process will be transported by pipeline from the refinery to the RSF. Liquor will be returned from the RSF to the refinery in a pipeline.

For each of these pipelines, there will be a single pumping station. Consequently, to maintain high velocities and overcome friction and other losses in the pipeline, operating pressure will be very high. Gas pipelines operate at similar pressures and provide appropriate design codes for long-distance pipelines. Therefore, the pipelines will be designed and constructed in accordance with AS2885 Pipelines - Gas and Liquid Petroleum (Standards Australia 1997). Pipelines transporting slurry will also be designed in accordance with ASME B31.11 Slurry Transportation Piping Systems.

The design specification for the pipeline is summarised in Table 2.5.1.

Table 2.5.1 Pipeline Design Specifications

Pipeline Component	Pipeline Design Specification			
	Slurry Pipeline	Seawater Pipeline	Residue Pipeline x 2	Return Liquor Pipeline x 2
Length (approx), km	180	180	27	27
Outside Diameter (OD) (approx), mm	500	550	700	660 (18.5 km) 500 (8.5 km)
Wall thickness, mm	Varies 6.4 - 12.7	6.4	7.9	Varies 6.4 -7.9
Materials of construction	API-5L Gr X70 carbon steel with HDPE internal lining	API-5L Gr B (98 km), API-5L Gr X52 (82 km) with HDPE lining	API-5L Gr B carbon steel with HDPE lining	
External Coating	3LPE			
Depth cover, mm	In accordance with AS 2885, typically: General 750 Cultivated Areas 1,200 Rock Areas 450 (minimum) Water courses 1,200 – 2,000 Road crossings 1,200 (minimum)			
Nominal Capacity (approx), m^3/h	1,325	990	1,860	1,370
Maximum Operating Pressure (approx), kPa	16,400	4,300	1,900	1,400
Construction ROW	35m (2 parallel pipelines)		50m (four parallel pipelines)	
External Corrosion Protection	External corrosion coating and cathodic protection			
Internal Corrosion Protection	Internal HDPE liner			
Non Destructive Testing (NDT)	In accordance with AS2885			
Supervisory Control and Data Acquisition (SCADA)	At pump station at start of pipeline and at terminal at end of pipeline			
Operation	Continuous			
Monitoring system[1]	Inlet and outlet pressure, inlet and outlet flowrate Remote monitoring as part of plant control system			
Location of 'pipeline operations centre'	Yarwun refinery			

[1] Each pipeline will have a flow meter and pressure transmitter located at each end. The control system will monitor the flow into and out of each pipeline on a continuous basis. An alarm will occur if a mismatch in flow is detected which would indicate that a leak is occurring in the pipeline. Pressure transmitters are installed primarily to indicate an over-pressure condition.

2.5.6.1 Above-Ground Facilities

Above-ground facilities that may be required for the pipelines include:

- Marker signs.
- Mainline valves.
- Scour valves.
- Air valves.
- Cathodic protection systems.

No meter stations will be installed along the pipeline routes.

Marker Signs

Marker signs will be installed and located in accordance with AS2885 (Standards Australia 1997) to reduce the risk of inadvertent damage of buried pipelines by third parties. Generally signs will be placed on either side of major crossings, at facility sites, and at pipeline bends. Signs will generally be placed such that each is visible from the next. Where two pipelines are installed in a single trench then a single sign will generally be installed between the two pipelines.

Mainline Valves

It is not anticipated that any mainline isolation valves will be required on any of the pipelines. This will be confirmed during the detailed design phase of the project.

Scour Valves

It is not anticipated that any scour valves (installed at topographical low points to facilitate draining) will be required on any of the pipelines. This will be confirmed during the detailed design phase of the project.

Air Valves

Air valves will be installed on the last approximately 15 km of the seawater pipeline. Air valves will be installed to allow accumulated air to be vented from the pipeline at topographical high points in order to prevent any adverse effects on flow rate. An air valve consists of a vertical small diameter pipe rising from the upper surface of the pipeline to above ground. An air release valve and an isolation valve will be installed on the upper end of the pipe. Each air valve will be located in an approximately 2 metre-square fenced area.

2.5.6.2 Cathodic Protection Facilities

A cathodic protection system will supplement the protective coating on the pipeline to prevent external corrosion. The main feature of the system will be a series of anode beds buried at intervals along the pipeline and connected to it by electrical cables.

Cathodic protection test points will be installed on the pipelines at intervals of between 2 km and 5 km in broad rural areas, between 1 km and 2 km in semi-rural areas and closer in areas where the pipeline may be subject to an alternating current induction e.g. in vicinity of electrified rail system or high voltage overhead powerlines.

2.6 Project Inputs

The major inputs required for refinery operations are as follows:

- Nickel cobalt laterite ore.
- Sulphur.
- Anhydrous ammonia.
- Limestone.
- Lime.
- Reagants, including flocculants, filter aid, hydrogen peroxide, polyacrylic acid and sodium hydroxide.
- Infrastructure, including electricity, water supply, telecommunications and natural gas.

Further details of the chemicals to be consumed within the refinery as part of Stage 2 of the project are provided in Table 2.6.1. Infrastructure requirements are provided in Section 3.

2.6.1 Nickel Cobalt Laterite Ore

Nickel cobalt laterite ore is essential for the production of nickel and cobalt briquettes. Nickel cobalt laterite ore will be supplied to the refinery by two means – as slurry from the Coorumburra beneficiation plant and imported from the south-west Pacific region through the WIW.

2.6.1.1 Nickel Cobalt Ore Slurry

Lateritic nickel/cobalt deposits at Marlborough, approximately 175 km north-west of Gladstone will be mined to supply the refinery. The ore will be beneficiated at the Coorumburra beneficiation plant and pumped through a pipeline as a slurry. The slurry pipeline, approximately 180 km long and 500 mm in diameter, will commence at the beneficiation plant and terminate at the refinery (refer Figure 2.2.4).

2.6.1.2 Imported Nickel Cobalt Ore

Nickel laterite ores sourced from the south-west Pacific region will be unloaded through berth No. 5 of the WIW (refer Figure 2.2.2). During Stage 2, it is proposed that 10 Mt/y of ore will be imported through WIW.

All vessels entering Australian waters are required to comply with the requirements of the Australian Quarantine and Inspection Service (AQIS) and international health regulations to ensure that all quarantine risks posed by the vessels are adequately managed (DAFF, 2006). This will be achieved through AQIS and GPNL working together to:

- Assess the quarantine risk of each vessel entering Australian waters.
- Taking all action necessary to ensure that the vessel does not introduce any exotic pests and diseases as determined by the risk assessment.

Prior to arrival in Australia from overseas, all vessels greater than 25 m in length or that have been in contact with overseas vessels or sea installations, are required to comply with specific AQIS requirements. These requirements include:

- Completion and submission of quarantine pre-arrival reports, 12-48 hours prior to arrival in Australia.
- Quarantine clearance procedures.
- Quarantine inspections.
- Procedures for clearance after inspection.

Imported ore will be unloaded from ships on to a conveyor which will transport the ore to the refinery site where it will be discharged from a stacker to stockpiles. During Stage 2, two stockpiles of approximately 500,000 wet tonnes each (approximately 700 m long x 70 m wide x 20 m high) will be required to store imported ore on site. The location of these stockpiles is shown in Figure 2.2.1. Stockpiled ore will be reclaimed by front-end loader as required and transported by conveyor to the OPP.

2.6.2 Sulphur

Sulphur will be used in the SAP to generate sulphuric acid and in the hydrogen sulphide plant to generate hydrogen sulphide. Sulphur will be unloaded from ships through berth No. 5 of the WIW. During Stage 2, approximately 1.2 Mt/y of sulphur will be imported. Sulphur imports will be regulated by AQIS as described in Section 2.6.1.

The same conveyor system used to transport imported ore to the refinery will be used for sulphur. Sulphur will also be stockpiled on site. During Stage 2, two stockpiles of approximately 120,000 t each (approximately 200 m long x 20 m wide x 15 m high) will be required. The location of these stockpiles is shown in Figure 2.2.1.

Imported sulphur will consist of pastille and/or prill sulphur product that is robust and of minimal dust content. Dust suppressant will be sprayed onto the sulphur at ship discharge as required to control dust during transfer to the sulphur stockpile by conveyor. Dust suppressant sprays will be installed at each conveyor transfer point with variable rate control.

Stockpiled sulphur will be reclaimed by front-end loader as required and transported by conveyor to the SAP. Details of materials handling and the potential marine impacts associated with sulphur loading/unloading are provided in Section 8.3.

2.6.3 Ammonia

Anhydrous and aqua-ammonia will be used for pH adjustment and to establish the optimum ammonia to metal ratio in solution for the hydrogen reduction process. All ammonia will ultimately be converted to a fertiliser-grade ammonium sulphate product.

The Orica Yarwun Facility at Reid Road (opposite the refinery site – Figure 2.1.1) currently uses about 250,000 t/y of ammonia to manufacture ammonium nitrate and sodium cyanide. The ammonia is predominately sourced from the Incitec Pivot plant in Brisbane and transported by road. It is supplemented by ammonia imported via Fisherman’s Landing.

During Stage 2, the refinery will require approximately 95,000 t/y of ammonia.

It is anticipated that Orica will supply ammonia to the refinery via pipeline from the ammonia bullets at the Orica plant to a storage facility at the refinery site. Alternatively, other local suppliers may be able to provide ammonia. Anhydrous ammonia will be reticulated around the refinery as required. Aqua-ammonia will be produced on-site from anhydrous ammonia.

The use of a pipeline supply will greatly reduce the need for GPNL to receive ammonia by truck and the associated risks with this method of delivery.

2.6.4 Limestone

Ground limestone will be used as a neutralising agent in several parts of the process (refer Figure 2.5.1). There are at least four substantial high grade limestone resources within 80 km of the refinery site. These include:

- East End – Bracewell, an existing limestone mine approximately 25 km north-west of the refinery site, which currently supplies Cement Australia Limited’s cement clinker plant at Fisherman’s Landing.

- Taragoola, an existing limestone mine approximately 34 km south east of the refinery site owned and operated by Unimin Australia Limited, with an annual output around 1 million tonnes. This mine currently supplies Queensland Alumina and the Cement Australia lime plant at Fisherman's Landing.
- Fairview, a high grade limestone resource approximately 15 km west of Gladstone. The area has been taken up under an Exploration Permit for Minerals (EPM) by Metallica Minerals Limited.
- Boyne, a limestone resource, located approximately 45 km south of Gladstone. This deposit is also held under an EPM by Metallica Minerals Limited.

It is anticipated that limestone will be supplied from one of the existing limestone mine sites (East End or Taragoola). Limestone will be ground and slurried at the mine site and pumped to the refinery by pipeline.

2.6.5 Lime

Lime is likely to be sourced from either Cement Australia Limited located at Fisherman's Landing, or Unimin Australia. Lime would be supplied by B-Double pneumatic tankers and delivered to a bulk storage tank located on site. During Stage 2 approximately 103,000 t/y of lime will be required. Up to 250 t of storage capacity will be provided on site.

2.6.6 Other Reagants

A number of other reagants will be consumed in the process for a variety of ancillary uses within the refinery. The nature, quantity and storage and transport requirements of these are detailed in Table 2.6.1. Descriptions of the major reagants are provided below.

2.6.6.1 Flocculants

Bulk flocculant powder will be received in tankers and added to bulk hoppers. Flocculant is used to assist solid – liquid separation by including in:

- Ore receival slurry thickeners.
- SN clarifier.
- Mixed sulphide thickeners.
- CCD thickeners.
- RSF thickener.

Systems for the preparation, storage and distribution of flocculants will be provided on-site.

2.6.6.2 Filter Aid

Filter aid will be delivered in palletised bags to separate storage areas serving the various polishing filters around the refinery. Facilities to prepare filter aid slurry will be provided at each location.

2.6.6.3 Hydrogen Peroxide

Hydrogen peroxide (H_2O_2) will be used in the MSP area to neutralise the residual hydrogen sulphide in barren liquor. Hydrogen peroxide will be delivered as a 70% H_2O_2 solution by road tanker to the hydrogen peroxide unloading and storage facility. A small amount of hydrogen peroxide will also be used in the metals plant. Because of the small consumption rate, an intermediate bulk container facility will be located in this area.

2.6.6.4 Polyacrylic Acid

Polyacrylic acid will be used in nickel and cobalt briquetting to lubricate the powder particles during compaction and to assist the release of the formed briquettes from the briquetting rolls. It will also be used as an additive in hydrogen reduction where it will activate the surface of the seed nickel and cobalt powder particles, promoting uniform particle growth and accelerating the reduction reaction.

Ammoniated polyacrylic acid will be delivered into the polyacrylic acid storage tank from bulk tankers. It will be transferred on demand to make-up tanks located in the briquetting and hydrogen reduction areas.

2.6.6.5 Caustic Soda

Caustic soda will be used in the water treatment facilities. It will be delivered to site in bulk tankers and distributed as required.

2.6.6.6 Other Miscellaneous Chemicals

In addition a number of minor reagents will be consumed within the refinery. The Stage 2 requirements are detailed in Table 2.6.1

Table 2.6.1 Summary of Raw Materials (Stage 2)

Materials	Synonyms	UN No.	Usage Quantity (per annum)		Site Storage			Australian Dangerous Goods Code Classification			Source
			Design Capacity	Units	Type	Location	Quantity / Capacity	Class	Subsidiary Risk	Packaging Group	
MAJOR RAW MATERIALS											
Imported Ore			10	Mdt/y	Stockpile	Refinery	Two 500,000 wet tonne	Not listed in code (non-hazardous for air, sea and road transport)			Overseas – South West Pacific
Ore Slurry			4	Mdt/y	Tank	Refinery	To be determined	Not listed in code (non-hazardous for air, sea and road transport)			Coorumburra Beneficiation Plant
Sulphuric Acid	H_2SO_4	1830[a]	3000[b]	t (100% H_2SO_4)	Tank	Refinery		8	None Stated	III	Internal – Acid Plant
Ammonia	Anhydrous ammonia	1005	95,300	t	Tank	Refinery	80 t	2.3	8	III	Domestic
Limestone	Calcium Carbonate ($CaCo_3$)		1,426,000	t	Tank	Refinery	To be determined (10,000)	Not listed in code (non-hazardous for air, sea and road transport)			Domestic
Lime	Calcium Hydroxide ($Ca0H_2$)		103,000	t	Tank	Refinery	600 t	Not listed in code (non-hazardous for air, sea and road transport)			Domestic
Sulphur		1350	1,100,000	t	Stockpile	Refinery	140,000 t	4.1	None stated	III	Overseas
LPG		1075	N/A		Tank	Refinery	10,000 L	2.1	None stated	NA	
Diesel Fuel	Diesel		N/A		Tank	Refinery	40,000 L				
REAGANTS											
Flocculant	Magnafloc 333, Magnafloc E10 Magnafloc 455		7,100	t	Store	Refinery	300 t	Not listed in code			Domestic
Filter Aid			2,800	t	Store	Refinery	120 t	Not listed in code			Domestic
Hydrogen Peroxide (60%)	H_2O_2	2014[c]	118	t	Tank	Refinery	6 t	5.1	8	II	Domestic
Polyacrylic Acid	PAA		860	t	Tank	Refinery	30 t	Not listed in code			Domestic

Table 2.6.1 Summary of Raw Materials (Stage 2)

Materials	Synonyms	UN No.	Usage Quantity (per annum)		Site Storage			Australian Dangerous Goods Code Classification			Source
			Design Capacity	Units	Type	Location	Quantity / Capacity	Class	Subsidiary Risk	Packaging Group	
Caustic Soda	Sodium Hydroxide (NaOH)	1824[d]	12,600	t	Tank	Refinery	200 t	8	None Stated	II or III	Domestic
Steel Grinding Balls			3,490	t	Store	Refinery	100 t	Not listed in code			Overseas
OTHER MISCELLANEOUS CHEMICALS											
Soda Ash	Sodium Carbonate (Na_2CO_3)		123	t	Tank	Refinery	15 t	Not listed in code (non-hazardous for air, sea and road transport)			Domestic
Hydrochloric Acid (33%)	HCl	1789	515	t	Tank	Refinery	N/A	8	None Stated	II or III	Domestic
Ceramic Grinding Balls			8.4	t	Drums	Refinery	3 t	Not listed in code			Overseas
Antiscalant			982	t	Tank	Refinery	30 t	Not listed in code			Domestic
Polymer			1,030	t	Tank	Refinery	30 t	Not listed in code			Domestic
Sodium Hypochlorite	NaOCl	1791	8.1	M^3	Tank	Refinery	2000 L	8	None Stated	III	Domestic
Lime Hydrate	Calcium Hydroxide $Ca(OH)_2$		1,500	t	Tank	Refinery	40 t	Not listed in code			Domestic
Acid Cleaner			2,290	L	Tank	Refinery	2000 L	Not listed in code			Domestic
Alkaline Cleaner			2,290	L	Tank	Refinery	2000 L	Not listed in code			Domestic
Corrosion Inhibitor			14.2	t	Tank	Refinery	4000 L	Not listed in code			Domestic
Biocide			2,860	L	Tank	Refinery	2000 L	Not listed in code			Domestic
Dispersant			438	kg	Tank	Refinery	2000 L	Not listed in code			Domestic
Condensate pH control			5,720	L	Tank	Refinery	1000 L	Not listed in code			Domestic

Table 2.6.1 Summary of Raw Materials (Stage 2)

Materials	Synonyms	UN No.	Usage Quantity (per annum)		Site Storage			Australian Dangerous Goods Code Classification			Source
			Design Capacity	Units	Type	Location	Quantity / Capacity	Class	Subsidiary Risk	Packaging Group	
Catalyst	Vanadium Pentoxide		1,000	drums	Bunded area	Refinery	400 drums	Not listed in code (as per MSDS)			Overseas
Oxygen scavenger			116	t	Tank	Refinery	2000 L	Not listed in code			Domestic
Ferrous Sulphate			2,860	L	Tank	Refinery	2000 L	Not listed in code			Domestic
Ferric Sulphate (45%)			N/A emergency only					Not listed in code			Domestic
Aluminium Sulphate			58	t	Tank	Refinery	15 t	Not listed in code			Domestic
Sodium Sulphide		1849[e]	2	t	Tank	Refinery	2 t	8	None Stated	II	Domestic
Sodium Cyanide			5	t	Tank	Refinery	2 t	Not listed in code			Domestic
Animal Glue			18	t	Tank	Refinery	2 t	Not listed in code			Domestic
Shellsol 2046			100	M3	Tank	Refinery	110 m^3	Not listed in code			Domestic
Tributyl Phosphate	*n*-tributyl phosphate (TBP)		6	M3	Tank	Refinery	1200 L	Not listed in code			Overseas
Cyanex 272	Bis (2,4,4,-trimethylpentyl) phosphinic acid		4	t	Tank	Refinery	7 t	Not listed in code			Overseas
Bentonite Clay			2	t	Tank	Refinery	2 t	Not listed in code			Domestic
Butylated hydroxytoluene	BHT		7.6	t	Tank	Refinery	2 t	Not listed in code			Domestic
Activated Carbon			7.6	t	Tank	Refinery	2000 L	Not listed in code			Domestic

Table 2.6.1 Summary of Raw Materials (Stage 2)

Materials	Synonyms	UN No.	Usage Quantity (per annum)		Site Storage			Australian Dangerous Goods Code Classification			Source
			Design Capacity	Units	Type	Location	Quantity / Capacity	Class	Subsidiary Risk	Packaging Group	
REAGANTS PRODUCED ON SITE											
Sulphuric Acid	H_2SO_4	1830	3,267,000	t (100% H_2SO_4)	Tank	Refinery	20,000 t	8	None Stated	III	Internal – Acid Plant
GASES PRODUCED ON SITE											
Hydrogen Sulphide	H_2S	1053	105,000	t	Tank	Refinery	-	2	6.1, 3		Internal – Hydrogen Sulphide Plant
Hydrogen	H_2	1049	16,100	t	Tank	Refinery	10 t	2.1			Internal – Hydrogen Plant
Oxygen	O_2	1072	179,000	t	Tank	Refinery	20 t	2.2	5.1		Internal – Air Separation Plant

Notes:
Australian Dangerous Goods Transportation Information taken from Australian Dangerous Goods Code, 6th Edition, 1998, published by Commonwealth of Australia
[a] *Sulphuric acid with more than 51% acid*
[b] *Will be required during commissioning only. Once operational, sulphuric acid will be generated on site by the Sulphuric Acid Plant*
[c] *2015: Hydrogen Peroxide, aqueous solution, stabilised with more than 60% hydrogen peroxide*
[d] *Solution*
[e] *Sodium sulphide with not less than 30% water*

2.7 Project Outputs

The major products from the refining process will be nickel and cobalt briquettes. Ammonium sulphate will also be generated as a by-product. The quantities, storage and dangerous goods classification of these outputs for Stage 2 are summarised in Table 2.7.1. Details of the liquid and solid wastes and air emissions are provided in Section 4.

2.7.1 Nickel and Cobalt Briquettes

Stage 2 of the project will produce approximately 126,000 t/y of nickel and 10,400 t/y of cobalt. Both metals will be produced in the form of briquettes. The briquettes will be packed into steel drums and loaded onto pallets at the refinery. The drums will be strapped and shrink wrapped to the pallet. The palletised drums will then be loaded into containers at the refinery and the containers will be trucked to either the Port of Gladstone or to the Mt Miller rail siding (refer Figure 2.2.2), railed to the Port of Brisbane and loaded onto ships for export to the required destination.

A laydown and storage area will be designed for the transfer of product to containers at the refinery site. This area will be designed to allow easy and safe access for transport and handling equipment and will provide separation of road transport and forklift truck movements in loading the containers.

2.7.2 Ammonium Sulphate

Approximately 343,000 t/y of fertiliser grade ammonium sulphate (amsul) will be generated as a by-product of the refining process. Details of the transport, storage and unloading of amsul are provided below.

2.7.2.1 Ammonium Sulphate Storage and Road Transport

After manufacture, the amsul will be stored at the refinery in a conditioning silo, which will allow for storage of approximately three days of production.

Amsul will be loaded from the conditioning silos, directly into B-Double trucks. During Stage 2, approximately 24 B-Double truck loads will be required each day. All B-Double trucks are expected to utilise purpose-built bottom dump trailers with automated rollover tarping systems to allow for both quick loading times and suitable dust suppression during travel time.

All trucks will travel from the refinery to Fisherman's Landing via Hanson and Landing Roads.

2.7.2.2 Ammonium Sulphate Storage Shed

Amsul will be unloaded from the B-Double trucks into a purpose-built 50,000 t amsul storage shed at Fisherman's Landing (refer Figure 2.2.5). The trucks will unload into a covered dump pit to control dust. The amsul will be conveyed to the apex of the shed. An overhead tripper conveyor will distribute the amsul to maximise the storage utilisation within the shed. The conveyors will be appropriately covered and the area under the conveyors sealed.

Amsul is corrosive to steel. Therefore, the shed will be designed to minimise potential for corrosion by utilising the following features:

- Concrete walls supporting the product and steel columns protected from the amsul.
- Use of significant sized steel members to reduce the overall surface area of the steelwork exposed to corrosion.
- All edges with a 3 mm radius to improve coating effectiveness.
- Timber purloins and girts, and non-corrosive sheeting.

Table 2.7.1 Summary of Products and By-products (Stage 2)

Materials	Synonyms	UN No	Usage Quantity (per annum)		Site Storage			Australian Dangerous Goods Code Classification			Markets
			Design Capacity	Units	Type	Location	Quantity	Class	Subsidiary Risk	Packaging Group	
Nickel Briquettes	Ni	3089	126,000	t	Pallets/ Containerisation	Refinery – Mt Miller rail siding	2,000 t	Not listed in code			Overseas
Cobalt Briquettes	Co	1325	10,400	t	Pallets/ Containerisation	Refinery – Mt Miller rail siding	200 t	Not listed in code			Overseas
Ammonium Sulphate	$NH_4 2SO_4$	Non Hazardous	343,000	t	Storage shed	Refinery – Fisherman's Landing	50,000 t	Not listed in code			Local and Overseas

Notes:

Australian Dangerous Goods Transportation Information taken from Australian Dangerous Goods Code, 6th Edition, 1998, published by Commonwealth of Australia

The amsul shed will be designed so that trucks will not enter and tracking of ammonium sulphate onto roads by truck tyres will not occur. The stockpiled amsul will be loaded by front end loader into mobile hoppers mounted over a load-out conveyor running the length of the shed. A conveyor will connect the shed load-out conveyor to the CQPA ship-loading conveyor system.

2.7.2.3 Ammonium Sulphate Unloading

Amsul will be loaded into ships via a common user ship load/unload facility at the planned Fisherman's Landing Berth No. 3 (refer Figure 2.2.5). Amsul will be loaded into Handymax vessels, which have an approximate capacity of 45,000 t capacity. This shiploader is likely to be able to load at an average rate of 25,000 tonnes per day. However, as amsul is soluble in water, loading will be limited to dry weather.

Details of materials handling and the potential marine impacts associated with amsul ship loading are provided in Section 8.3.

2.8 Operational Phase

2.8.1 Operational Workforce

Labour requirements will be based on the requirement to operate the refinery on a continuous basis for 365 days a year. Operational personnel will consist of four crews, each working a 12-hour shift. Shifts will be rotated every few days depending on the activities being undertaken within each area of the refinery. The estimated numbers of people required to operate the plant are outlined in Table 2.8.1.

Table 2.8.1 Operational Workforce Requirements

Role	Number
Production	188
Maintenance Services	124
General and Administration	73
Total	385

2.8.2 Contract Personnel

Contract personnel will be required for a number of activities such as:

- Planned major and minor plant shutdowns.
- Specialised inspection and monitoring.
- Routine and shutdown maintenance of the overland conveyors to the refinery.

Other contract personnel will supply labour, equipment, materials and consumables to:

- Maintain building air conditioning systems.
- Maintain mobile equipment.
- Hydroblast vessels, heat exchangers and piping.
- Provide cleaning services for offices and buildings.
- Maintain the site grounds.
- Maintain plumbing on-site.

- Provide insulation services.
- Provide civil/excavation services.
- Provide specialised maintenance services such as valve servicing, condition monitoring and high temperature and pressure leak sealing.

2.8.3 Refinery Operations

The refinery will be operated from one control room, with field units strategically located in selected plant areas. The control philosophy for the refinery is based on minimal operator intervention to control the plant. The process control system will be a fully integrated Distributed Control System package.

Inspection and maintenance of plant will be routinely undertaken by maintenance staff and contractors.

2.8.4 Pipeline Operations

All pipelines will be operated from the refinery. The control concepts will provide sequence control for all operations in response to system commands by the operator. Minimal operator supervision will be required once pumping commences. Pipeline systems will be designed to operate with a minimum of operator attention using Programmable Logic Control devices for system sequencing, alarm monitoring and analogue control.

Monitoring of the cathodic protection system for external corrosion will be undertaken on a regular basis. The timing of monitoring will be determined during the development of the operating procedures.

Periodic visual inspection, either aerial or land based, will be undertaken for the pipeline route. The inspection period will be determined during the development of the operating procedures. Inspections will include review of easement and access area maintenance, rehabilitation, third party activity, erosion and weed control.

Planned maintenance activities on the pipeline easement and any above ground facilities will be undertaken on a routine basis.

2.9 Decommissioning

The project evaluation has been based on a life of 25 years. However, it is recognised that the refinery will remain in operation well beyond this period.

HPAL refineries do not accumulate hazardous or toxic materials. Hence, decommissioning procedures will largely involve the removal of equipment and structures which are of no further economic value, including where necessary, testing to establish whether any decontamination work is required and performance of such work. Any ponds will be decontaminated, filled and re-contoured to match the surrounding topography. The site will be re-contoured as necessary and landscaped to stabilise against erosion.

It is likely that the refinery and its associated infrastructure easements/corridors will be valuable either as a package or as individual elements to other industrial users. Proximity to a quality harbour in an area with developed social and physical infrastructure and considerable energy and raw material resources suggest that the most probable decommissioning activity will be preparation of the site for alternative industrial uses. It is probable that work to decommission and rehabilitate the site could be at least partially funded by the sale of equipment, scrap metal and 'recycling' of other materials.

The port facilities will be decommissioned in consultation with the CQPA. Product and supply pipelines will be decommissioned or reused in consultation with regulatory authorities and other potential users. The portion of the pipeline corridor which is used by GPNL could be made available to other industrial users.

Should project-related infrastructure require decommissioning, negotiations will be had with relevant stakeholders as to the benefits of retaining some of the infrastructure for future use (e.g. roads, hardstand etc). Infrastructure will only be left after decommissioning where formal written agreements have been obtained from the relevant stakeholders for its use and maintenance/management.

Buildings and plant not agreed to remain on site will be demolished and disposed of. Building materials will be recycled where possible. Equipment will either be removed and used on other GNP sites, or auctioned. Hardstand (including concrete footings and foundations) not to be used in future projects will be removed and the area ripped, topsoiled and revegetated. The rehabilitated industrial/infrastructure areas will be regraded where necessary. Power lines and power poles will be removed off-site following closure if the continued use is not envisaged. Pads/footings will be removed from site and holes will be backfilled with natural clean material. Site roads and tracks will either remain with the agreement of the relevant stakeholders or will be removed. Where roads are to be decommissioned, road base will be removed and the surface ripped, topsoiled and revegetated. Electrical infrastructure will be removed where reuse is not anticipated. If sediment ponds are not to remain, these will be drained, filled, topsoiled and revegetated. The sediment ponds are anticipated to be present at the time of decommissioning to assist with the provision of water for rehabilitation, where necessary.

A decommissioning plan will be developed in conjunction with regulatory agencies at least five years prior to decommissioning. At this time there will be greater understanding of the relevant decommissioning standards and alternative land uses available for each of the decommissioned sites.

2.9.1 Contaminated Land

Potential exists for land to become contaminated from the project as a result of any of the following:

- Leaching or erosion of sediments including trace metals from process waste and permanent or temporary stockpiles of process input or product.
- Salinity.
- Acid drainage.
- Malfunction of sewage treatment facilities.
- Poor management of general and regulated wastes.
- Disposal and/or leakage of hydrocarbons and other chemicals.

Sites contaminated by any of the above will be identified in the site management plan (including register and survey plan) which will be maintained for the life of the project (DME, 1995). Identified contaminated areas will be included on the Environmental Protection Agency’s (EPA) Environmental Management Register and Contaminated Land Register as appropriate. On decommissioning, Phase 1 and 2 contaminated land assessments will be conducted on potentially contaminated land to standards prescribed by the *Environmental Protection Act 1994*. Contaminated areas will be assessed for the type and amount of contaminants. Areas that have elevated levels of contaminants will be remediated using suitable methods as the areas become available throughout the life of the project. The top 0.5 m of soil at all fuel storage areas will be remediated. In addition, all hazardous materials and wastes will be removed from site or remediated. Remediation measures will be discussed with the EPA prior to commencement of remediation works.

2.9.2 Refinery

Decommissioning of the refinery will involve flushing of the process equipment and associated pipe work with water from the water supply. This water will be disposed of to the RSF.

On completion of flushing and cleaning:

- The structural, pipe work and electrical bulk materials will be demolished to allow removal from the site for re-sale or recycling.

- The concrete bulk materials will be demolished to allow removal from the site for use as landfill.
- The equipment will be demolished or dismantled to allow removal from the site for recycling, permanent disposal or re-sale.
- The buildings will be demolished or dismantled to allow removal from site for re-use or permanent disposal.
- Any ground or drainage pond contamination will be removed from the site and disposed of in the RSF.

2.9.3 Residue Storage Facility

Closure of the RSF is expected to generally include the following concepts:

- Removal of the above-ground pipelines, return liquor pumping system and thickener.
- Placement of a soil cover closure of the RSF for dust mitigation and to promote vegetative growth.
- Grading of the RSF cover to manage surface water run-off and minimise concentrated flow and erosion of the cover.
- Regrading the access roads.
- Operation of the seepage collection system until key constituents meet the applicable regulatory standards.

Specific rehabilitation measures and post-closure land uses for the RSF are discussed in Section 9.7.

2.9.4 Pipelines

In the event that the pipelines are no longer required, these will be decommissioned in accordance with the legislative requirements of the day and the Australian Pipeline Industry Association (APIA) Code of Environmental Practice. The most likely options are:

- Moth-balling – this would involve depressurising the pipeline, capping and filling with an inert gas such as nitrogen and maintaining the cathodic protection system to prevent the pipe corroding.
- Abandonment – this could involve disconnecting the pipeline from all above ground structures including the cathodic protection systems, purging the pipes of process materials, placing plugs at predetermined intervals to inhibit groundwater flow and removing all above ground facilities. The pipeline would then be abandoned to corrode in-situ. The pipeline may be filled with a stable material (e.g. concrete grout) at critical locations such as where it passes under a railway line or major highway.

Removing the pipeline from the ground would not be an environmentally or commercially viable option.